ADB

Technical Assistance Consultant's Report

Project Number: 38555
December 2007

PRC: Evaluation of Environmental Policy and Investment for Water Pollution Control in the Huai River Basin and the Taihu Lake Basin

Prepared by:

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For State Environmental Protection Administration

Asian Development Bank

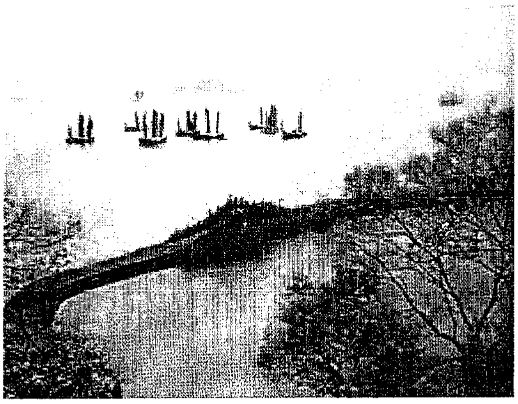
The People's Republic of China
Asian Development Bank

Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins

TA 4447 – PRC

FINAL REPORT

December 2007



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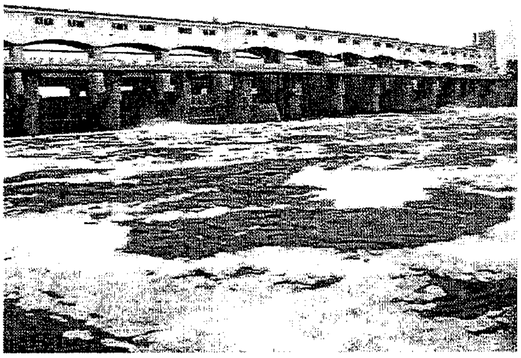

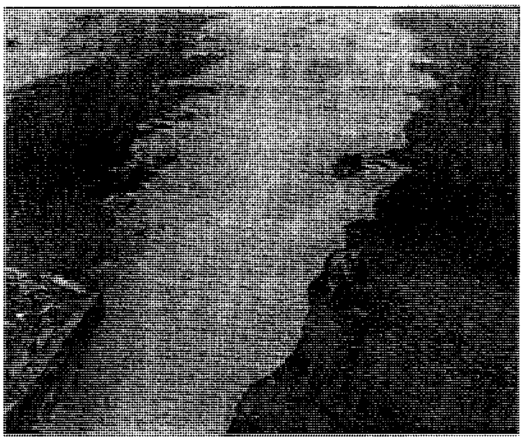

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Evaluation of Environmental Policy and Investment for the Water Pollution Control in the Huai River and Tai Lake Basins

General Catalogue of the Comprehensive Report

Executive Summary

Volume I Overview

Volume II Review and Evaluation of the Huai River Basin

Volume III Review and Evaluation of the Tai Lake Basin

Volume IV International Experiences

Volume V Summary and Reform Recommendations

Volume VI Guidelines for Watershed Evaluation

Appendices
(in Chinese)

Appendix 1 Prevention and Emergency Response of Pollution Incidents Evaluation

Appendix 2 Case Studies on Judicial Effectiveness

Appendix 3 Recommendations on Policies and Institutional Reform

Appendix 4 Questionnaires

Appendix 5 References

EXECUTIVE SUMMARY

Study Objectives and Components

The study is intended to comprehensively evaluate the efficacy of the national and local environmental policies and regulations and the actual investment of planned programs so as to provide policy recommendations on improving the Huai River Basin (HRB) and Tai Lake Basin (TLB) water pollution conditions through the review and summary of the implementation of the Water Pollution Prevention and Control Program for the HRB (including Henan, Anhui, Shandong, and Jiangsu provinces) and the TLB (including Zhejiang and Jiangsu provinces, and Shanghai municipality) during the 9th and 10th Five-Year Plans (FYPs, 1996-2005).

The Report is consisted of six volumes: Volume I Overview, where the study objective, content and methods are presented; Volume II Review and Evaluation of the Huai River Basin, where the Water Pollution Prevention and Control Program as well as the policies of the HRB are reviewed and evaluated; Volume III Review and Evaluation of the Tai Lake Basin, where the Water Pollution Prevention and Control Program as well as the policies of the TLB are reviewed and evaluated; Volume IV International Experiences, where the experiences of the United States (US), European Union (EU) and other countries in watershed water pollution control are introduced; Volume V Summary and Reform Recommendations, where recommendations on the policy and structural reform in the water pollution control are raised with reference to international experiences and according to the review and evaluation presented in the previous volumes; Volume VI Guidelines for Watershed Evaluation, which summarizes the methods applied in the evaluation.

Water Pollution and Pollution Control of the Huai River Basin

1. The HRB has been a significant growth area over the past decade, but the water pollution has been equally significant. Although the pollution to the Huai River water system exhibits signs of alleviation during the 10th FYP, such alleviation is based upon the already deteriorated water quality. The pollution issue of the Huai River water environment remains grave.

Mainly covering Henan, Anhui, Shandong and Jiangsu provinces, the HRB encompasses an area of about 27×10^4 km^2. Although of only 2.8% of the total territory of China, the HRB is home to 1.4×10^8 people, 10.7% of the total national population (2005). Its population density is 4.3 times of the national average, ranking atop among the major watersheds. Over 80% of the HRB is rural, where the proportions of traditional industries and agriculture are relatively large and its agriculture thereof is important for China. Historically, the HRB is relatively undeveloped. However, since the 1990s the economy in the HRB has boomed. Its GDP reached 21844.7×10^8 yuan in 2005, accounting for 12% of the national total.

Water pollution in the HRB has become increasingly severe since over a decade ago. The water quality of most parts of its 2 major water systems, 20-plus distributaries and 4 large-scale lakes have been lingering between Class III and V. At the aggregated level, over

half of the water bodies belong to Class V or worse. And the water quality at transprovincial monitoring sections is generally poorer. The Class II to III proportion in the Huai River water system has risen from 7.7% at the beginning of the 9th FYP to 19.8% at the end of the 10th FYP, while sections of worse than Class V decreased from nearly 75% at the beginning of the 9th FYP to 58.18% at the end of the 9th FYP and then to 32.6% at the end of the 10th FYP. As a whole, the water pollution is alleviating, but such alleviation is based on already severely deteriorated water quality.

2. Although the 9th and 10th FYPs have been important driving forces for pollution control in the HRB, the objectives of both FYPs have not been achieved. Nevertheless, considering the economic development, the pollution control has made relatively fast progress and achieved better results compared to the national average level.

China does not have comprehensive watershed-level administrative organizations. The planning and plans at the watershed level are important measures to resolve pollution control from the watershed perspective as well as the main reference for evaluating and implementing the watershed pollution control. The watershed-level plans have provided clear objectives of pollution control for each of the province and municipality and served as an important driving force for watershed pollution control.

The implementation results of the two FYPs are:

- The implementation of the water quality and pollutants discharge control of both the 9th and 10th FYPs has fallen far short of the planned objectives.
- Both the actual investment volume and the number of pollution control projects have fallen far short of the planned objectives during the 9th and 10th FYPs.

Since the implementation of the two FYPs has not achieved the water quality, the fundamental, or other objectives, it will be reasonable to conclude that the two FYPs have not been achieved.

In terms of COD reduction per unit investment in pollution control, the actual result from the 10th FYP reached only half of the planned target, which suggests a much lower capital efficiency than the plan requirement.

In summary, over the past decade, the COD discharge has been cut to half during the two FYPs; the COD discharge per unit GDP dropped from 11.38 kg/10,000 RMB (78% of the national average) to 3.90 kg/10,000 RMB (50% of national average), marking a reduction of 66%. This indicates a relatively better pollution control at the HRB compared to the national average and rapid progress given its economic development. However, given the high GDP per unit land area in the HRB (over 3 times of the national average in 2000, over 4 times of the national average in 2005, and of 96% of the US level in 2003), and the low level of pollutants discharge control compared to the developed countries (for instance, the COD discharge per unit GDP in 2005 is almost 49 times of that of the US in 2003.), the total pollutants discharge remains high.

Water Pollution and Pollution Control of the Tai Lake Basin

1. The Tai Lake Basin, an important region for the China economy, has been experiencing rapid economic growth together with severe water pollution. The pollution to the Tai Lake water system shows signs of alleviation during the 10th FYP, but the alleviation is based on the already severe pollution. The pollution issue of the Tai Lake water environment remains grave.

Encompassing Jiangsu and Zhejiang provinces and the Shanghai municipality, the TLB covers an area of 36,900 km^2 (0.4% of the total territory of China) and is home to 0.3×10^8 people (2005). Nevertheless, nearly 70% of its territories have been urbanized with a relatively developed market economy. Notably, the high-technology industries have been developed as a result of persistent development efforts. The TLB GDP in 2005 reached 7.7% of the national total. The GDP per unit area and the population density have been high.

The water quality of the Tai Lake had remained relatively good throughout the decade before the 9th FYP. However, starting 1988 it entered into a period of rapid deterioration. Throughout the 9th and 10th FYPs, both the water quality of the Tai Lake and the water bodies in the watershed have been deteriorating. In particular, the 9th FYP saw the diminishing of the Class II and III waters to disappearing, the increasing of Class IV and V water to 19%, and the surge of worse than Class V waters increasing to 81%. The 10th FYP saw the sign of recovery from the devastating situation during the 9th FYP. Nevertheless, the pollution remained grave. The proportion of Class V waters accounted for 17%, and the worse than Class V waters accounted for 50%. This is far away from the water quality conditions at the beginning of the 9th FYP, let alone the water quality before the 9th FYP.

2. Although the 9th and 10th FYPs have been important driving forces for pollution control in the TLB, the objectives of both FYPs have not been achieved. Nevertheless, considering the economic development, the pollution control has made relatively fast progress and achieved better results compared to the national average level.

China does not have comprehensive watershed-level administrative organizations. The planning and plans at the watershed level are important measures to resolve pollution control from the watershed perspective as well as the main reference for evaluating and implementing the watershed pollution control. The watershed-level planning has provided clear objectives for pollution control of each province and municipality and served as an important driving force for watershed pollution control.

The implementation results of the two FYPs are:

- The implementation of the water quality control of both the 9th and 10th FYPs has fallen far short of the planned objectives.
- The 9th FYP objectives of the pollutants discharge control have not been achieved. The 10th FYP objectives of the pollutants discharge control has been generally achieved (except for Suzhou).
- Both the actual investment volume and the number of pollution control projects

have fallen far short of the planned objectives during the 9th and 10th FYPs.

Since the implementation of the two FYPs has not achieved the water quality, the fundamental, or other objectives, it will be reasonable to conclude that the two FYPs have not been achieved.

In terms of COD and NH_3-N reduction per unit investment in pollution control, the actual level for COD reached 3.2 times of the planned level, and the figure for NH_3-N reached 4.8. This indicates a much higher capital efficiency than the requirement in the plan.

In summary, over the past decade, the COD discharge at the end of the 10th FYP has been cut to 77% of that at the beginning of the 9th FYP; the COD discharge per unit GDP dropped from 7.95 kg/10,000 RMB (55% of the national average) to 1.54 kg/10,000 RMB (20% of national average), marking a reduction of 81%. This indicates a relatively superior pollution control at the TLB compared to the national average and rapid progress given its economic development. However, given the GDP per unit land area in the TLB (nearly 16 times of the national average in 2000, nearly 20 times of the national average in 2005, 4 times of the US level and 1.5 times of the French level in 2003), and the low level of pollutants discharge control compared to the developed countries (for instance, the COD discharge per unit GDP in 2005 is almost 19 times of that of the US in 2003.), the total pollutants discharge remains high.

Causes and Issues for Severe Water Pollution and for the Shortfall in the 2 FYP Water Pollution Control Objectives

1. The severe water pollution is directly caused by the excessive pollutants discharge into the water bodies beyond their environmental capacities

The environmental capacities of HRB and TLB based on ecological safety or water functional area have not been defined due to the lack of watershed background data and the significant alternation and interference by the massive hydraulic facilities. However, the current condition of the water environment has indicated that the pollutants discharges into the water bodies have exceeded their environment capacities measured against the requirement of water functional zones, not to mention that they have far exceeded the environmental capacities measured against the requirements of water ecological safety.

2. The major direct reasons for the shortfall of the two water pollution control FYPs objectives include that: the rapid economic growth brings high GDP per unit land area, but the pollution control has failed to keep up with the pace; the expectation of the planned objectives are too high; the investment in water pollution control is far from sufficient; and the supporting mechanism to implement or mandate the implementation of the plans is still lacking.

As the COD discharges per unit GDP in the two watersheds illustrate, the pollution control in the watershed is better than the national average given the rapid economic growth, but the watershed water bodies remain heavily polluted and the two FYPs objectives are not achieved. This seeming contradiction suggests the following possibilities:

- The nationwide average water pollution is worse than in the HRB and TLB. The two watersheds are "the better among the bad".
- The high GDPs in the HRB and TLB have led to high aggregated pollutant discharge even with low discharge intensities.
- The two watersheds are susceptible to the pollutants and are of low environmental capacities.
- The current discharge monitoring data have underestimated the actual discharges, i.e., the actual pollutant discharge is much higher than the data would suggest.

Although the available data cannot prove or dismiss those possibilities mentioned above, analysis reveals that the GDPs per unit land area in the HRB and TLB in 2005 have approached to or exceeded that of the US and France (for the HRB – of 96% of the US level in 2003, and for the TLB – 4 times of the US level and 1.5 times of the French level in 2003). However, the COD discharges per unit GDP in the two watersheds have reached 19 and 49 times of the US level in 2003 respectively. This indicates that although the development level for the two watersheds have approached to the developed countries, the pollution control thereof is far behind that of the developed countries, leaving large quantity of pollutants discharge and resulting in severe pollution to the water bodies.

Inadequate background data and the underestimation of the complexity and long time span needed for pollution control efforts have led to the over expectation of the plan objectives that have gone beyond viable given the conditions then. Moreover, the GDPs in the HRB and TLB have exceeded the planned objectives by over 30%, resulting in excessive pollutants discharge load in watersheds without proper adjustment in the FYPs.

In terms of financing, the massive demand for investment in pollution control was not met due to the sluggish financing channels and the lack of accessibility to the financial markets. Especially challenging are the currently extremely low pollutants discharge tariffs and collection rates of the fees, which cannot recover the operational cost of pollution control.

As to the supporting institutions for the plan implementation, not only the supporting mechanism prescribed in the plan itself is too weak to be effective, but also institution-wise a SEPA-led implementation mechanism is absent, and the existing follow-up, monitoring, reporting, and adapting mechanism is no longer suited for the plan implementation.

Effective coordination among the State Environmental Protection Administration (SEPA), Ministry of Water Resources (MWR), Ministry of Agriculture (MOA), and the provincial or municipal governments is still lacking. Consequently the provincial/municipal plans and the watershed plans present inconsistency in time plans, contents, and responsibilities.

In terms of hydraulic and water ecological conditions, massive-scale artificial water conservancy facilities have been built for flood control and water use without considering the protection for the ecological water environment. As a result, the operation of the hydraulic facilities has degraded the ecological water environment and led to the reduction of water environmental capacity.

The coordination and quality assurance mechanism of monitoring data on the pollution sources and water quality among the SEPA, MWR, MOA and the provincial or municipal governments is still lacking, which affects the data reliability and may lead to mis-planning by the government.

3. The pollution sources are yet to be effectively controlled. Although achievements have been made in the industrial water pollution source control in the HRB and TLB, industrial water pollution has rebounded from time to time in the recent 6 years; urban water pollution sources and particularly the rural non-point sources are still to be tamed.

Certain achievements have been made in the industrial water pollution sources control, and a relatively sound administrative system has been founded. However, since 2000, the industrial non-compliant discharge of either excessive amounts or pollutant contents has resurged, and the implementation of pollutant discharge permit system is inadequate.

The average growth rate in the HRB urban population is over 10 times of the average regional population growth. The urbanization rate of the TLB has reaches approximately 70%. With the rapid urban growth, the proportion of urban domestic wastewater has surged among the point pollution sources. As for the proportion in COD discharge, the contribution from domestic wastewater in the HRB has risen from 16% to 77% during the two FYPs; and the TLB saw a rise from 42% to 63% for the same period. The urban domestic wastewater has become a major point pollution source. Although a certain number of municipal wastewater treatment plants (WWTPs) have been constructed in the two FYPs, the centralized wastewater treatment (WWT) rate remains low: during the 10th FYP, the four provinces in the HRB saw the centralized WWT rate to rise from about 20% to 43%; for the TLB, except Shanghai whose rate has risen from 62% to 70%, the centralized WWT rate of other areas has on average increased from 29% to 59%. Moreover, the wastewater connection network remains inadequate for wastewater collection, and the operation rate of WWTPs is relatively low.

Non-point source pollutions from extensive agricultural production including chemical fertilizers, pesticides, wastes from animal husbandry, livestock, aquatic production, and rural domestic discharge, have become an important contributor for the water pollution in the watersheds. During the 9th and 10th FYPs, the agricultural non-point source pollutant entering into the environment has increased steadily. The ratio of agricultural non-point to the point source pollutants into environment in the HRB has increased from 5.6 to 13.3 during the two FYPs. For the TLB, the same ratio has risen from 1.6 to 3.0 for the same period. The agricultural non-point source pollution entering into the water bodies has been threatening the watershed. However, the understanding and research for the agricultural non-point source pollution remain limited, and the actual volume of non-point source pollutants into the water bodies is unknown.

Applied research or surveys on the urban non-point source pollution in the two watersheds are generally absent. The amount of urban non-point source pollutants and their impacts on the watershed water bodies are unknown.

Policy and Institutional Issues of the Severe Water Pollution in the HRB and TLB

1. Coordination and detailed procedural requirements on water pollution control are inadequate in the *Water Act* and the *Water Pollution Prevention Act.*

The *Water Pollution Prevention Act* is considered as stipulated specifically by and for the SEPA, while the *Water Act* is considered as stipulated by and for the MWR. These two laws issue separate authorization to the two ministries without much coordination. First, the ministry-based legislation contradicts with the principles of collaborative management and the commonality of laws and should be deserted. Second, the government agencies should be the guardians rather than the owners of the legislations. The responsibility stipulated in the legislations as well as its enforcement are the commons shared by all government agencies. Third, hardly will any legislation be effective, if the legislation is celled to within the compartmented administrative territories, as frequent administrative adjustments undermine the completeness and the long-term stability of the legislation. Forth, procedural provisions should be incorporated in the legislation itself or provided separately in detailed regulations to clarify the coordination, cooperation, and division of responsibilities between the specialized government agencies, the central and local governments, and civil societies and the public. However, currently no specific provisions beyond general and abstractive descriptions such as "Ministry A shall be responsible for X, Y, Z together with Ministry B, C, D…" are present in the *Water Pollution Prevention Act* and the *Water Act*.

More specifically, the following problems remain:

- Both the *Water Pollution Prevention Act* and the *Water Act* administer water affairs, but no standardized terminology has been adopted.
- Legislations have prescribed pollution management the responsibility of the SEPA; however, neither the *Water Pollution Prevention Act* nor the *Water Act* clearly defines the contents of transjurisdictional watershed management, leaving no legal definition of transjurisdictional water pollution incidents or defined procedure for the polluted province to pursue the polluting province's liability to resolve transjurisdictional water pollution disputes through administrative means.
- Comprehensive procedural regulation is needed for the planning, management, and implementation of comprehensive watershed water resources management (of both water quality and quantity).
- The *Water Pollution Prevention Act* and the *Water Act* have artificially segregated the management of water quality and water quantity to different ministries.
- The statutory authorities in monitoring of the SEPA/environmental protection bureaus (EPBs), MWR/water resource bureaus (WRBs), and their monitoring stations partially overlap. The legal authenticity of the data from the various monitoring authorities is not defined.
- The regulation for the pollutants total mass loading limits (TMLLs) is not clear.

2. The administrative handling exercised by SEPA on environmental disputes for pollution hazards has no compulsive potency. Its legal effectiveness is equivalent to mediation. Regulations on administrative handling, mediation procedure, and their judicial relation are still lacking.

The *Environmental Protection Act* does not grant the enforcement potency to the administrative decisions on environmental disputes by the SEPA/EPBs. If either of the parties disagrees with the ruling results, the party is entitled to litigate at the people's courts. This degrades the administrative decisions (ruling) by the environmental protection authorities to mediation. However, still some 70% of the environmental disputes are resolved through mediation or administrative rulings. Nevertheless, legal vacuums still exist in procedural regulations on the mediation and administrative ruling processes as well as on the relation between the processes and the judicial process. Consequently, the environmental protection authorities are often awkwardly placed during environmental dispute resolution.

3. The existing articles on environmental protection sanction in the *Criminal Law* and the *General Principles of Civil Law* often do not adequately protect the victims.

In China, the parties of the water pollution disputes have unequal positions. The victims often are the general public. Compared to the perpetrators who are often corporative groups with financial, technology, information, and human resources, they are often the disadvantaged group. When such corporations are of significant economic importance, the dispute could even be tied to the economic performances of the local governments.

The *Criminal Law*, the *General Principles of Civil Law*, and the *Civil Procedural Law* have prescribed the civil liabilities for environmental torts and the Crimes of Undermining Protection of Environmental Resources. However, the following problems persist:

- The prescriptions tend to be too abstract to enforce.
- The light sentencing and punishment and the replacement of criminal liability with administrative liability in the court ruling are not conducive to punish the perpetrators, assist the victims, or to deter other potential polluters.
- The current litigation process for environmental tort compensation disfavors the victims. The requirement of "the advocator proves" makes it difficult for the victims to provide legal evidence, thus raising the threshold for litigation, and prevents the victims to apply for filing. Additionally, the latency and indirectness of the environmental tort activities complicate the ascertaining of the damages, tortfeasor, and causality of the torts. The difficulty in recognizing environmental tort liabilities further adds difficulty to full compensation, where the indemnity is difficult to be quantified, and the actual amount tends to be under-valuations.
- The restoration obligation of the damaged environment is not defined, which *de facto* imposes the consequences to the victims and encourages polluting activities.
- The absence of compulsive environmental insurance often leaves hole to the source of compensation during severe pollution incidents that cause huge loss.

4. The water environmental quality standard does not suit the present situation of water pollution.

As the varieties of pollutants in the water bodies increase, the water environmental quality standards cannot keep up by adding in new indicators and leaves problems in the water quality control.

Specifications on water body restoration are still lacking. Pollution control prevents further deterioration of the water qualities, but the polluted and degraded water bodies will require proper restoration before meeting certain water body functions. The Water Environment Quality Standard needs to specify the threshold criteria as when the restored water bodies can be qualified for such functions.

5. The monitoring and management of environmental protection is exercised by various specialized government agencies and the central and local governments at various levels. Unified coordination and cooperation among the agencies are needed.

According to the *Environmental Protection Act* of China, China currently adopts a multi-layered monitoring and consultation mechanism for environmental protection by the environmental authorities.

- Vertically, the **local EPBs of various levels** should **lead** the environmental monitoring and management in their jurisdictions.
- Horizontally, **resource monitoring and management** are exercised to protect resources by law by the oceanic, harbor, fishery, military affairs, land resources, minerals, forestry, agricultural and water resources authorities.
- The transjurisdictional environmental protection is resolved through consultation among the **relevant local governments** or sanctioned by the government of the higher level.

De jure, the *Environmental Protection Act* grants SEPA the monitoring and management authority of environmental protection nationwide. However, *de facto*, SEPA is authorized to issue only quality and discharge standards. Beyond the standards, SEPA does not have any other substantive authority to monitor and manage environmental protection.

Successful international experience suggests that environmental monitoring and management requires not only participation by the various local governments and specialized agencies but also coordinated, potent, and substantive management of the monitoring. The main problems in the monitoring and management of watershed water environment are:

- SEPA does not have substantive authority over local EPBs. The local EPBs are administered by the local governments in aspects of administration, personnel, and budget.
- The responsibilities overlap among the state specialized agencies, including SEPA, MWR, MOA, and Ministry of Land Resources (MLR). The agencies have not established an effective collaboration and coordination mechanism.

- The transjurisdictional environmental pollution control and dispute resolution have been curbed by the localized interests of the local governments and agencies at various levels and left without an effective resolution mechanism.
- watershed-based water environment management is absent. The watershed pollution control planning does not reflect quantitative water demand, and the watershed hydraulic planning does not reflect water pollution control in the watershed. The current watershed-level management agency and mechanism do not integrate the water quantity, quality and pollution control objectives.

6. The existing environmental monitoring and management regulations are no longer suited for the present environmental monitoring and management.

The water environment monitoring has been the weak link of the watershed water environment management. Specifically, the problems are:

- The environmental protection and agricultural, water resource, and urban construction authorities do not coordinate in pollution sources monitoring.
- In terms of vertical management, except the national headquarter monitoring station, the SEPA does not have substantive authority over other monitoring stations. The monitoring stations, thus the environmental monitoring *per se*, are administered by the local governments.
- The SEPA/EPBs and MWR/WRBs have overlap responsibilities in water environment monitoring, which has led to the waste of the limited, if not insufficient, monitoring resources. The segregated institutional arrangement has led to the lack of coordinated, synchronized, and unified arrangements in the set-up of the monitoring systems, selection of the monitoring indicators, locations, time, and frequency, which, in turn, has led to the inconsistency in the data sets from the two agencies.
- The lack of watershed-wide groundwater monitoring network has limited the knowledge of the watershed-wide groundwater conditions.
- In terms of the reporting of the monitoring data, no single agency is responsible for summarizing, collating, and using the monitoring data from various sources. Actually, under such segregated environmental monitoring system, even if the data were available from those agencies, they tend to be inconsistent and prove difficult to use.

7. The pollutants discharge permitting system is not effectively implemented.

In the 3 years since the enactment of the *Environmental Impact Evaluation Act*, the SEPA has strengthened regulation over new polluting projects. But the TMLL targets are still not met. A major cause on the policy side is that the pollutants discharge permitting system is not effectively implemented.

Successful international experience indicates that the pollutants discharge permitting

system is an important tool for pollution control. In fact, if the pollutants discharge permitting system is implemented, even without environmental impact assessment (EIA), the polluter will evaluate its possibility of acquiring pollutants discharge permits, as the total number of permits is limited for a given area, and the unauthorized discharger will be shut off by the local governments.

The negative experiences from the past 5 years of the implementation of the discharge permitting system have revealed problems in not the system *per se* but the inadequacy in its support institutions. A sound supporting institutional system should incorporate management institutions, implementation procedures, technical guidelines, independent monitoring and its self-checking mechanism, enforcement and monitoring institutions, and the financial support.

8. The cost of compliance exceeds the cost of non-compliance; the fees and fines mechanism for pollutants discharge does not match the economic development level.

The average wastewater discharge tariff is considerably low compared to the average WWT cost in the market economy. For enterprises, the required inputs for compliance involve: the large investment in technological reform and treatment operations; the high expense for the day-to-day operation and management of WWT facilities; human, material and financial resources for an effective environmental management and monitoring system, and pollutant discharge fees. However, the only direct economic benefit from compliance is to free from discharge penalty for excessive, non-compliant discharge. Other indirect benefits such as an environmentally friendly reputation and the fulfillment of social responsibility of the enterprises are almost non-existent. In particular, the "excessive" environmental cost for compliance will increase the total cost of production and therefore reduce the competitiveness of the enterprises.

On the other hand, the cost of non-compliance includes only: investment in treatment facilities aiming at passing the acceptance tests; submitting small amounts of pollutant discharge fee and the non-compliant discharge penalty at a rate twice of the regular pollutant discharge tariff. Furthermore, the *Water Pollution Prevention Act* and the *Detailed Regulations for Implementation of Water Pollution Prevention Act* have placed the cap limit for this penalty at 20×10^4 yuan for regular cases or 100×10^4 yuan for severe incidents with "great economic losses." On the other hand, the enterprises receive "additional benefits" from non-compliance: (1) Savings from the huge treatment and environmental management costs, which in turn becomes savings in their total production costs and higher competitiveness of their products. (2) No debiting in the enterprises' reputation, as no social responsibilities are required. Neither will the companies be required to clean up nor restore the damaged environment, and few would pursue litigation for the polluting activities.

9. Public participation in management and monitoring of the water environment is far from adequate.

Public participation is an important component of water environment management and monitoring. Still in its infancy, public participation is experiencing underdeveloped information disclosure institutions, absence of public's environmental right to know,

end-of-the-pipe and passive participation, abstract and impractical stipulations, and low awareness and ambiguous concept of public participation.

The present legal system shows a significant shortage in stipulations on public participation. The decision-making and management systems of public participation are to be cultivated, and an incentive mechanism for board participation is still missing. The legal assistance channel for violation of the right to participate is still to be established.

Suggestions on Policy and Institutional Reform for Existing Problems in Water Pollution Control of the HRB and TLB

Based on the framework and priority levels analysis of recommendations (Table Framework and Priority of the Reform Recommendations), ten reform recommendations were derived and summarized. The design of the reform recommendations revolve around the pollutants discharge permitting system. Other perscriptions, to a certain degree, can be regarded as its supporting system. In term of reform contents, the organizational and institutional reform of SEPA and the pollutants discharge permitting system belong to the first step. Other reforms can be conducted after or simultaneously with the first step reforms.

Reform Recommendations of the First Priority

1. Organizational and Institutional Reforms for SEPA

1 This reform aims at establishing a new SEPA that is empowered with the unified authority to administer all affairs regarding China's pollution control and equipped with sufficient financial resources. The new SEPA will take in charge of and be held accountable for the water pollution control:

- SEPA be empowered with the complete authority to lead and enforce environmental legislations and equipped with the required funding.
- SEPA be authorized with the complete authority of environmental monitoring and equipped with the required funding.
- SEPA directly administer the provincial and local EPBs.
- In water environmental protection, SEPA be authorized to coordinate with other specialized agencies.

2 In order to ensure the effective direct administration of SEPA to the EPBs, the new SEPA could adopt an authorizing mechanism, where SEPA authorizes the provincial, prefecture, and county level EPBs the corresponding authorities in environmental protection under SEPA's monitoring; in the case of improper or mis-conduct by the authorized EPBs, SEPA can immediately withdraw its authorization. The authorization can be re-issued when the improper or mis-conduct have been corrected and the related EPB will be able to properly implement the policies.

3 An alternative to the institutional reform is to establish a Ministry of Environment &

Resources to integrate the environmental functional departments under the current SEPA, MLR, MWR and other ministries. Considering the negligible chance of macro-scope administrative adjustment among the Chinese government agencies, this report does not provide detailed recommendations on the founding of a comprehensive ministry of environment and resources.

2. Reform in Monitoring & Management of Water Pollution Control

1 This reform aims at establishing a comprehensive set of monitoring and management institutions of water pollution control through:

- Establishing the monitoring and management institutions and implementation guidelines for water pollution control planning/plans. SEPA should be responsible for coordinating the monitoring and management of key water pollution control plans including watershed environment plans across the agencies. Such monitoring and management also include that of the water quality in the water bodies.
- Establishing the monitoring and management institution of discharge permits and TMLLs. SEPA should set the TMLLs and manage the monitoring of all key implementation processes including the inspection, auditing, approval, issuance, and retiring of the discharge permits. This also includes the monitoring of the pollution sources. Considering the massive damage to the public and private assets caused by environmental hazards, SEPA should be endowed the authority of environmental policing so as to take immediate mandatory measures to stop polluting activities; otherwise, the public security departments must be obliged to team up with the EPBs for environmental law enforcement.

3. Management Reform of Discharge Permits and TMLLs

The reform aims at establishing a unified and sound management system and implementation guideline and a matching supporting system for the pollutants discharge permits through:

- Establishing management system for implementing the permits, including the water functional zones of watershed water bodies and water environment quality standard, the watershed TMLLs plan and its allocation scheme, and a verification, approval, issuance, or retiring mechanism and information disclosure institution for discharge permits based on the pollutants TMLLs plan authorized by SEPA.
- Establishing the implementation procedure of the permits, including the guideline for water body functional zoning, guideline for water body TMLLs verification and the TMLL planning, allocation scheme of TMLLs, pollutants reduction plan, and management regulation for issuance of pollutants discharge permits.
- Establishing a new monitoring system, including a unified evaluation system and technical specification for water quality monitoring and a unified monitoring system, technical specification, monitoring guideline, reporting system, and public participation institutions for pollution sources. .

- Establishing a monitoring and law enforcement system authorized by SEPA and executed by the local EPBs.
- Establishing a funding mechanism to ensure the administrative budget of the SEPA/EPBs, add monitoring and enforcement budget and SEPA's monitoring budget, and establish the State Fund for Pollution Control and the State Environmental Pollution Risk Insurance Fund.
- Pollutants from all industrial pollution sources, urban sewages, agricultural point sources should be included within the scope of pollutants discharge permits.
- Establishing a pollutants discharge fee mechanism consistent with the economic development level to ensure the cost of non-compliance be far higher than the cost of compliance.

4. Investment and Financing Reforms

1 The reform objective is to establish a market-based water pollution control mechanism under the governmental guidance. Its main features include:

- Raising the wastewater discharge tariff and impose high premier fee standards for non-compliant discharge (excessive in quantity or pollutants density) to economically disencourage non-compliant activities. The imposed premier fee must be as high as the total treatment cost of the non-compliant discharges. When environmental restoration is needed, the restoration costs will be imposed to reflect the "polluters clean up" policy. The fees are to internalize the pollution costs to the accounting of the polluters and to free the public from pollution hazards and the government from the cost of cleaning up.
- Raising urban wastewater tariff, tightening the wastewater fee collection, encouraging the use of the civil society funding in urban WWT, issuing regulations and promoting public private partnerships (PPP), and promoting domestic and foreign civil investment into the water pollution prevention and control.
- Establishing the government public budget system and increasing the budget allocation to watershed pollution control in central and local government expenses, especially in the investments in the municipal WWTPs.
- Establishing the State Pollution Control Fund to centralize all available funding for pollution control.
- Establishing the compulsory State Environmental Pollution Risk Insurance Fund to ensure restoration incurred by pollution incidents.

Reform Recommendations of the Second Priorities

1. Revising the *Environmental Protection Act*, the *Water Act*, and the *Water Pollution Prevention Act*

1 The reform objective is to establish a potent environmental protection and monitoring

system where the government agencies coordinate and collaborate in pollution control and the mutually supporting and coordinated environmental legislations through:

- Revising the *Environmental Protection Act* by legitimatizing SEPA's authority in leading the monitoring and coordinating from the central to the local governments and the hydraulic, agricultural, land resources, and construction authorities.
- Revising the *Water Act* the *Water Pollution Prevention Act* based on the revised *Environmental Protection Act* to reflect the new pollutants TMLLs and discharge permitting system and to resolve the issues of overlapping or undefined responsibilities and sketchy regulations.

2. Establishing a comprehensive watershed-based planning system

1 The reform aims at establishing a watershed-based planning system, which includes water pollution control, water ecology, water resources utilization, and flood prevention. First, the management of water quality and quantity cannot be segregated; the water management planning must integrate both. Second, detailed and programmatic requirements for collaboration between the SEPA/EPBs and MWR/WRBs must be defined. Third, by drawing experiences from the watershed-based comprehensive planning among the EU countries, the water management planning must be watershed based and reflect the collaboration between SEPA/EPBs and MWR/WRBs. Forth, the plans must incorporate water pollution control, water ecology, water resources utilization, and flood prevention and coordinate with the enforcement reform to establish a dynamic monitoring and inspection mechanism for the plans.

3. Recommendations on watershed managerial organizational and institutional reform

The reform aims at establishing a coordinated and unified water environment management institution:

- The SEPA, MWR and the provincial governments work toward unified watershed management through joint watershed planning. SEPA should be responsible for the monitoring and management of pollution control and water quality in watershed planning.
- SEPA should be responsible for the monitoring and management of watershed pollutant discharge, the water quality in the water bodies and groundwater quality. Upon SEPA's authorization, the monitoring organizations under SEPA, MWR, and MLR should conduct monitoring and report the monitoring results to SEPA based on the standardized monitoring requirements. SEPA will provide the funding for the monitoring.
- It will be necessary to reorganize the current watershed water resources protection bureau into an office with combined responsibility of monitoring and management for watershed water resources and water environmental protection. With SEPA's authorization, this office will monitor and manage the development and exploitation of the watershed water resources on SEPA's behalf. Specifically, its

responsibilities will include: organizing the preparation of watershed water resource protection plans and monitoring the plan implementation by the local governments; inspecting, monitoring and management of the local water resource development projects; monitoring of transjurisdictional water quality and providing guidance to transjurisdictional pollution dispute resolution; preparing the watershed ecological water use or ecological flow plans and monitoring their implementation.

4. Reform recommendations on non-point source pollution control

1 The reform aims at establishing the agricultural non-point source survey and study plan and making agricultural non-point source control plan together with the current rural development plan in China:

- As the agricultural non-point source pollution has become an increasing signficant water pollution source, SEPA in collaboration with the MOA should immediately launch the watershed-wide agricultural non-point source survey and study. Upon understanding of the agricultural non-point source conditions, SEPA and MOA should together work on the agricultural non-point source control plan.
- SEPA together with the MOC should initiate the survey and study on urban non-point source pollution.
- Further actiions includ issuing the *Regulations on Agricultural Clean Production* to form an agricultural and ecological legal system to prevent the rural non-point source pollution from its sources, revising and issuing new standards, technical guidance and operational guidelines on rural non-point source pollution prevention and control, issuing prescribed agricultural technical standards, and improving the industrial layout of plantation and husbandry.
- The reform also includes promoting environmentally friendly agricultural production techniques through subsidies and adopting agricultural production technical standards. The promoted technologies include improved fertilizing techniques, low toxicity, low residual and biological pesticides, utilization of animal excreta, and agricultural clean production.
- The reform will also issue the *TLB Rural Non-Point Source Pollution Prevention and Control Plan* and the *HRB Rural Non-Point Source Pollution Prevention and Control Plan* as part of the watershed comprehensive plan.

5. Modification or supplements to the *General Principles of Civil Law*, the *Criminal Law* and the *Civil Procedural Law*

1 The reform aims at establishing and improving the environmental pollution dispute handling mechanism, the environmental torts civil liability institution and victim assisting legal institutions through:

- Issuing the *Environmental Tort Civil Liability Act*. As a special civil law, the Act supplements the indemnity liability of environmental torts, which covers the environmental torts indemnity and damage removal liability.

- Perfecting the environmental litigation procedures to fit into the particularties of environmental torts, relaxing the filing requirements and enforcing the reversed burden of proof, and perfecting group and environmental public interest litigation.
- Enforcing the "total indemnity" principle that all damages should be compensated to achieve civil indemnity for restoration, punishment, prohibition, and prevention and defining the scope and amount of compensation. The affordability issue of the tortfeasors should be resolved through environmental torts liability insurance.
- Laying out the scope of environmental torts indemnity, which should encompass direct and indirect property damage, personal injury, and pollution control and environmental restoration.

6. Reform in public participation mechanism

1 The reform aims at establishing the mechanism for public participation in environmental monitoring, decision-making, and proactive law enforcement/plan implementation by establishing specific regulations and implementation guidelines through:

- Acknowledging the public's right to know and right to participate in environmental affairs in the legislation, standardizing the legal procedure of public participation in the practices of the permitting system, and specifying concrete and practical procedures in the related civil and administrative litigation to ensure the effective participation by the public in the environmental affairs.
- Timely publicize and update environmental law enforcement information including water bodies environmental monitoring, pollution source discharge monitoring, and discharge permit system.
- Timely publicize the implementation information of environmental legislation/plans and issue the concrete and practical procedural provisions on public participation in pollution control planning/plans.
- Establish the mechanism of public participation in environmental monitoring by allowing the public monitoring of water quality and pollution sources of the water bodies.
- Revising the *Constitute* at a proper time to spell out the citizens' environmental rights by acknowledging the public's right to know of and the right to participate in the environmental affairs and confirming a procedure that ensures the citizens to exercise their right to participate when issuing and revising the environmental legislations and other laws concerning environment and resource protection. Through legislation, an environmental information disclosure mechanism should be established to cover the various aspects and levels of environmental protection administrative authorization, specify the approaches and forms of public participation in environmental decision-making, standardize the legal procedures of public participation in environmental administrative authorization, improve the related civil and administrative litigation system and civil and administrative

indemnity mechanism concerning the citizens' environmental rights, and ensure the public participation in the environmental affairs with more concrete institutions and more practical procedures.

The above paragraphs present our ten reform recommendations of the two priority levels.

Following are the framework and priority levels of recommendations and the framework of pollutants discharge permitting system.

Table Framework and Priority of the Reform Recommendations

Priority Level	Required inputs (contents of reform)			Outputs (expected reform results)						Reform objectives	
	Laws and regulations	Govern-ment institutions	Policy and institutions	Government institutions and collaboration	Monitoring, management and enforcement	Planning and financing	Pollutant discharge control and water body restoration	Watershed pollution source and water quality and quantity monitoring	Watershed baseline databases	Phased objectives	Ultimate objectives
Level 1		Institutional reform of SEPA	Discharge permit system and TMLLs reform	Coordination among the different laws, regulations, and institutions	Unified leadership of environmental monitoring, management and law enforcement system	Comprehensive watershed-based pollution control and water resources plan that incorporates water quality and quantity and reflects the economic development features of the watershed	TMLL-based pollutants discharge target; the setting, approval, and allocation mechanism of pollutants TMLL	Unified pollution source/water quality and quality monitoring standard	Database of watershed natural/artificial environmental attributes	When the water functional objectives cannot be achieved in the short run, the phased water environment objectives can help gradually achieve the water functional area objectives or a historical relative good water quality	To protect and improve the living environment of humans and the ecological environments of other living organisms so as to ensure the sustainable development
		Water environmental protection monitoring & management reform	water pollution financing and investment reform				Discharge permitting system and its implementation mechanism	Unified requirements on pollution source/water quality and quantity monitoring and evaluating reporting	Watershed environmental/ ecological safety baseline		
Level 2	*Environmental Protection Act, Water Act, Revised Water Pollution Prevention Act*	watershed organizational and institutional reform	Watershed comprehensive planning system	Coordinated management of water environment	With proper and substantive monitoring, management, legal enforcement authorization	Pollutants discharge fee system that matches discharge permit system	Technical guidance system of discharge permits Legal requirements of water body restoration	Unified pollution source/water quality and quantity monitoring and evaluation technical guideline. Unified reporting/disclosure mechanism of pollution source/water quality and quantity monitoring data	Pollutants environmental capacity baseline based on watershed ecological safety Environmental capacity baseline of the environmental functional zone	Water functional zone objectives aiming at meeting the human water demands in production and domestic living	
	General Principles of Civil Law, Criminal Law, Civil Procedure Law Revised	public participation reform	non-point source pollution control reform	Collaboration between multi-agencies	Judicial system that protects the interests of pollution victims	Market-based financing mechanism guided by the government	Standard system of water body restoration Technical guidance mechanism on water body restoration	monitoring technologies and monitoring institutions Authorized pollution source/water quality and quantity monitoring organizations	Pollutants TMLLs based on phased objectives of watershed planning Pollutants TMLLs regional/phased objectives.	Ecological safety of the water environment for the human, fauna, and flora	

Notes: Arrow indicates support from the base level to the higher level; double-headed arrow indicates mutual support. The core and pioneering reforms are indicated with a deeper shade of color in its own area

Framework of Pollutants Discharge Permitting System

1 The study from the technical assistance project "TA3588-PRC Transjurisdictional Environmental Management Project" of the ADB has indicated that the discharge permits systems is an effective method of transjurisdictional watershed pollution control. SEPA has issued the *Management Regulation of the Key Water Pollutants Discharge Permits in the HRB and TLB (Trial)* in 2001. The negative experiences from the past 5 years of the implementation of the regulation have revealed problems in not the discharge permitting system *per se* but the inadequacy in its support systems. A sound supporting system should incorporate:

- Management institutions,
- Implementation procedures,
- Technical guidelines,
- Independent monitoring and its self-checking mechanism,
- Enforcement and monitoring institutions, and
- Financial support.

2 The following paragraphs will provide recommendations on the management reform in the supporting systems of the HRB and TLB water pollutants permits.

3 The reform objectives include establishing a comprehensive discharge permits and TMLLs management institution and the matching supporting system for the discharge permits implementation.

1. Management Institutes for Permitting System Implementation

1 The pollutant discharge permitting is a venue to achieve the TMLL targets. The institutional and legal framework as follows will sort out and clarify the implementation and monitoring mechanism of pollutants TMLLs and the discharge permits.

(1) SEPA should be responsible for coordinating with the MWR/WRBs and the related provincial governments to set the key water body functional zones and water environmental quality standards.

(2) SEPA should be responsible for coordinating with the MWR/WRBs and the related local governments to set the TMLL plans of key watersheds and of the transjurisdictional water bodies. The TMLL plans include the pollutants environmental capacity check of water body sections, identification of the major pollutants for TMLL planning, setting of the TMLLs and pollutants reduction quota and its time limits, and allocation of TMLLs within the jurisdictions.

(3) It will be important to gradually incorporate all pollutants from industrial, urban wastewater, and agricultural point sources into the scope of pollutant discharge permitting system.

(4) The reform will need to establish a new SEPA that directly administers the provincial EPBs, which, in turn, administer the local EPBs. The new SEPA will have the authorities to administer the provincial EPBs and approve or disapprove their funding. EPBs at provincial, prefecture, and county levels will report administratively to the governments at the

corresponding levels.

(5) As an intermittent solution, the new SEPA could adopt an authorization approach, where the new SEPA authorizes the provincial, prefecture, and county level EPBs the authorities to exercise environmental protection. In the case of improper or mis-conduct by the authorized EPBs, SEPA can withdraw its authorization immediately. The authorization can be re-issued when the improper or mis-conduct are corrected and the involved EPB will be able to properly implement the policies. **The following paragraphs will address the intermittent solution in greater detail.**

(6) SEPA authorizes the governments of provinces, autonomous regions, and municipalities to audit, approve, issue, or retire the discharge permits according to the pollutants TMLLs. The local EPBs are the designated agencies to implement the discharge permits.

(7) SEPA authorizes and monitors the implementation of the discharge permits. SEPA also authorizes the local EPBs to monitor. In case of non-compliance, SEPA can withdraw temporarily its authorization to the provincial-level governments for auditing, approval, issuance, or retiring the discharge permits or its authorization to the local EPBs for monitoring the permits and delegate to their higher level EPBs.

(8) The pollutants TMLLs should be disclosed to the public through fixed channels by the EPBs.

(9) The auditing, approval, issuance, or retiring of the discharge permits are open to the public. Per SEPA's authorization, the provincial-level governments are responsible for informing the public.

Inconsistency regarding Pollutants TMLLs and Permits Management in the *Environmental Protection Act*, *Water Act*, and *Water Pollution Prevention Act*

The *Environmental Protection Act* does not include contents regarding pollutants TMLLs and permits management. Article 27 reads that "Enterprises and institutions discharging pollutants must report to and register with the relevant authorities in accordance with the provisions of the competent department of environmental protection administration under the State Council." This can be understood as that so long as the registration has been successful, the discharge will be legal. This is not permits management.

Article 32 of the *Water Act* has required the MWR to verify the water environment capacity and the TMLLs. The MWR monitors the water quality. In the case of non-compliant discharge or the failure to meet the water quality requirements of the water functional areas, the MWR should report to the related authorities and notify SEPA.

Article 16 and 17 of the *Water Pollution Prevention Act* have designated the provincial governments or higher to implement the pollutants TMLLs. The State Council is responsible for issuing the detailed approaches. SEPA/EPBs together with the MWR/WRBs and the related provincial governments select the appropriate water environmental quality standards for the water bodies at provincial boarders in the key watershed. Upon the State Council's approval, the standards will be enforced.

Article 6 through 10 of the *Implementation Details of the Water Pollution Prevention Act* spelled out the TMLLs planning, and the allocation and issuance of the discharge permits. Based on those articles, SEPA together with other related agencies and the local governments issue the TMLL plans of the key watersheds for the State Council's approval. The TMLLs of transjurisdictional water bodies will be made through consultation among the involved provinces, autonomous regions, and municipalities.

2. Implementation Procedures of Permits

1 To successfully implement the permits, the current permits management institutions need to be revised and the permits implementation mechanism be perfected gradually through:

(1) Establishing a state-level specification on delineating the water body functional zones, where the details on management, organizational structure, principles, methods, and procedure of setting or revising water functional zones and water quality standards are articulated.

(2) Establishing the legislative standard procedures for calculating and verifying the water body pollutants TMLL, which is based solely on the environmental and ecological safety.

(3) Establishing the standard procedure for operationalize water body pollutants TMLL plans, which specifies the management, organizational structure, principles, methods, and procedure of water bodies pollutants TMLL plans. Considering that most water bodies have been receiving pollutants exceeding their environmental capacity based on ecological safety, the pollutants TMLL plans need incorporate the reduction plan of pollutants exceeding the TMLL.

(4) Establishing the detailed allocation scheme of the pollutant discharge TMLL and its reduction plan among the industrial, urban wastewater, agricultural point sources. The allocation will be the only basis for permits issuance.

(5) Setting detailed regulations of pollutant discharge permits including declaration, registration, and verification of pollutants discharge and the auditing, approval (or rejection), retiring, monitoring (including punishment) of the permits. The issued permits must be equal or less than the allocated pollutants discharge.

(6) Specifying the contents and formats of the permits, including the types of pollutants, discharge limits, effective time frame, rights and obligations, monitoring methods and requirements (locations of sampling, sampling methods, water flow measurement, time, frequency, analysis, and legislation), day-to-day self-monitoring of the pollution dischargers, and the requirements of government monitoring reports.

3. Monitoring System of Permits

1 The current environmental monitoring institutions needs to match the requirements for permitting system, where:

(1) SEPA is responsible for the monitoring and evaluation of the water quality in the water bodies nationwide, the reporting of the water quality, and the establishment, management, and publicizing of the water quality database.

(2) SEPA is responsible for setting and updating/publicizing regularly the national standard water quality monitoring & evaluation reporting standards and the guideline for reporting, which include the objectives, indicators, design (location of the monitoring points, sampling methods, time, frequency, analysis, and legislation), quality assurance, data evaluation, water quality evaluation legislation, and water quality evaluation results. Any monitoring

organization can conduct monitoring in the designated watershed according to the selected standards, once authorized by SEPA.

(3) SEPA is responsible for the data summary, analysis, and publicizing of the pollution sources. All other environmental monitoring organizations, including the environmental monitoring stations under SEPA, MWR, MOA, MLR, industries, and any other legal, certified monitoring stations and laboratories, can conduct independent monitoring within the scope of SEPA's authorization and receive funding accordingly from SEPA.

(4) The subordinate environmental monitoring organization of SEPA includes only the headquarter and regional central stations. Their responsibilities include making the regulations and guideline, summarizing and analyzing data, technical guidance, monitoring and auditing other monitoring stations. All other environmental monitoring organizations, including the environmental monitoring stations under SEPA, MWR, MOA, MLR, industries, and any other legal, certified monitoring stations and laboratories, can conduct independent monitoring within the scope of SEPA's authorization and receive funding accordingly from SEPA.

(5) The monitoring rights of individuals, NGOs and other entities not authorized with monitoring responsibilities should be legitimatized to monitor the water bodies and pollution sources according to the publicized monitoring standards. The results of the monitoring can serve as evidence for non-compliance. The authorized monitoring stations are responsible for verification. The rights of the individuals, NGOs, and other entities not authorized with monitoring responsibilities are inviolable. Impedance of their sampling of the water bodies or pollution sources with the approved procedure is prohibited.

4. Monitoring and Enforcement

1 Successful monitoring and enforcement would require changes in the segregated management framework between the central and local agencies and adoption of the monitoring and management authorization by SEPA, where:

(1) SEPA is responsible for the monitoring of the discharge permitting implementation; SEPA can authorize the local EPBs to monitor.

(2) Articles on civil and criminal liabilities to the *Civil Litigation Act* and the *Criminal Law* regarding pollutant discharge permitting should be added.

(3) Polluters are required to establish self-monitoring systems according to the monitoring standards and report the monitoring results, including non-compliance results, to the overseeing EPBs. SEPA or the authorized EPBs will dispatch inspectors to check the pollutants discharge. The pollutant discharge monitoring results from the self-monitoring facilities or the EPBs will be open to the public.

(4) Impose premier level discharge tariff to non-compliant discharge exceeding the permits. For severe non-compliant discharge, SEPA or the authorized EPBs will enforce immediate ceasing of the discharge (not timed correction) and impose fines. The amounts of the fines should far exceed the regular cost of pollution control. For cases where environmental

restoration is needed, the EPBs will evaluate the cost of restoration, mandate environmental restoration, and monitoring and acceptance of the restoration efforts. The polluters will bear the cost of restoration.

(5) For deliberate violation to the discharge permitting or severe damage to the environment or human health due to pollutant discharge, SEPA or the authorized EPBs will inform and immediately initiate civil or criminal procedures together with the judiciary according to the *Civil Law* or the *Criminal Law*. The EPBs will be responsible for the valuation of environmental indemnity or the cost of restoration.

(6) SEPA can withdraw partially or in entirety the authorization to the government offices designated the management of environmental monitoring in the case of incompetence, neglect, or misconduct and hand over the authorization to its superior agencies. SEPA can also withdraw partially or in entirety the authorization to the monitoring organizations and reduce its funding in the case of incompetence, neglect, or misconduct and hand over the authorization to other monitoring organizations.

(7) The *Regulations on Administrative Handling of Environmental Disputes* and the *Regulations on Health Hazards Compensation* should be issued and enacted.

5. Financing Mechanism

1 The new financing mechanism should increase the SEPA/EPBs administrative budget and add monitoring and enforcement budget of SEPA's in the state budget. In particular, it should:

(1) Impose pollutants discharge fee to the discharge within the discharge permits quota, where the pollutants discharge tariff must be set with full consideration of the accumulated pollution in the surface water, groundwater, and soil and the potential future restoration costs. Impose premier pollutants discharge fee for discharge exceeding the permits allowance, where the premier tariff must fully consider the pollution cleaning and environmental restoration costs.

(2) Establish the State Pollution Control Fund and its independent management organization. The Fund provides loans to pollution control research, design, and engineering projects. SEPA approves and monitors the fund uses.

(3) EPBs at various levels are responsible for the collection of the pollutants discharge fees. The collected pollutants discharge fee will be fused into the State Pollution Control Fund.

(4) Establish the State Environmental Pollution Risk Insurance Fund and mandate participation of the polluters according to their discharge levels. The polluters can choose to increase the amount of insurance.

(5) The administrative and monitoring and enforcement costs of SEPA should be included in the state budget. SEPA then disburses its monitoring funding through limited tendering to the authorized monitoring organizations.

(6) The administrative and enforcement expenses of the EPBs are listed in the government budget of the according level.

Reversed Economic Incentive of Pollution Control

A close look at the discharges from a chemical enterprise required for Grade II discharge standards reveals the reversed economic incentive for pollution control. The plant discharges daily 1000 m^3/day wastewater of pH 10.8, which contains on average COD 750mg/L, anionic surfactants 180 mg/L, BOD 190mg/L, and SS 330mg/L. This wastewater has exceeded the standard requirements. According to the *Collection and Management Provisions of Pollutants Discharge Fee* (State Council, 2003 Order No. 31), the discharge fee for the non-compliant discharge should be 3.01 yuan/m^3. However, should the enterprise opt to treat its wastewater prior to discharging, it will need to invest 1348×10^4 yuan in the WWTP and pay for the WWT cost (including equipment depreciation) at 5.36 yuan/m^3. On top of that, the plant will still need to pay for the wastewater pollutants discharge fee at 0.17 yuan/m^3. Thus, paying for the non-compliant discharge is much cheaper.

6. Discharge Permitting System and the Permits Trade

Upon the successful enforcement of the discharge permit system, the polluters will tend to trade the permits to maximize efficiency. The state should allow the permits trade to develop and issue regulations on permits trade.

The permits trade is closely related to the institutions, policies, and the monitoring and management system of pollutants TMLLs, pollutant discharge fees, watershed pollution control, and water resources utilization. It is a market-oriented behavior by the economic entities under the complex of policies and institutions.

In the two watersheds, the supporting policies for the discharge permits traiding system are far from adequate. The low collection rate of wastewater discharge fee, low tariff of water resources extraction fee, and the current weak inforcement of the discharge permits disencourage permits trade. Therefore, this study recommends first launching the reforms in legislation, institution, and policies then gradually launch the permits trading, depending on the needs for the trade. However, the reforms in legislation, institution, and policies need take into full consideration of the possible future permits trade.

Volume I

OVERVIEW

Table of Contents

1. Objectives and Framework 1
   1.1 Project Objectives 1
   1.2 Framework of the Evaluation Report 2
2. Methods 3
   2.1 Evaluation Methods 3
   2.2 Evaluation Process 3
      2.2.1 Key Evaluation Steps 3
      2.2.2 Evaluation Objective 4
      2.2.3 Scope of the Evaluation 4
      2.2.4 Principles of the Evaluation 4
      2.2.5 Survey, Data Collection and its Quality Control 4
      2.2.6 Data Analysis and Evaluation 5
      2.2.7 Evaluation Results and Optimization 5
      2.2.8 Evaluation Reporting and Expert Commentating and Revision 6
   2.3 Evaluation Techniques and Tools 6

1. Objectives and Framework

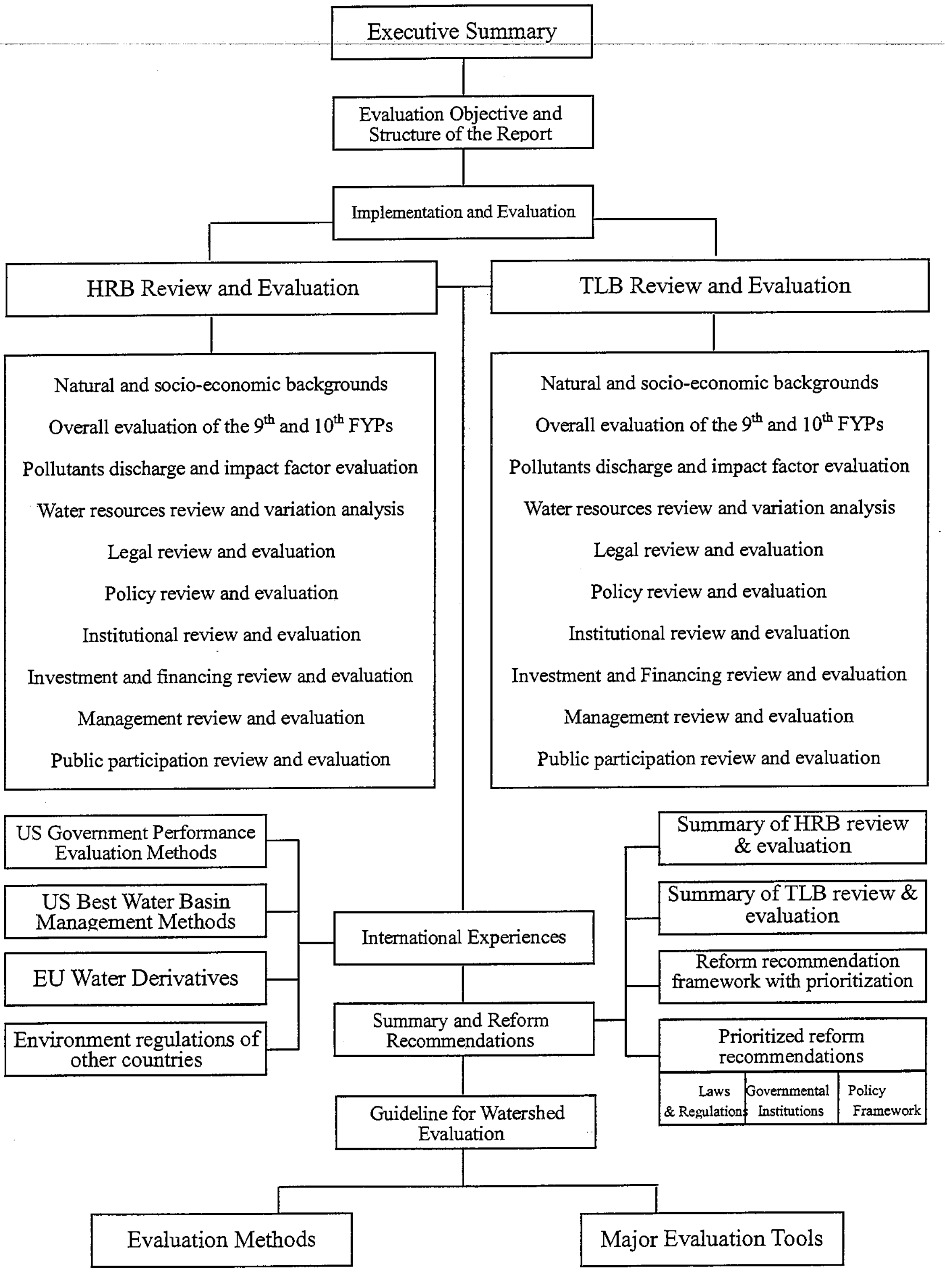
1.1 Project Objectives

1 The objective of this project is to evaluate the aggregated efficacy of the national and local environmental policies, regulations, and investment project implementation by examining the implementation of the water pollution control and prevention programs in the Huai River Basin (Henan, Anhui, Shandong, and Jiangsu provinces) and the Tai Lake Basin (Zhejiang and Jiangsu provinces and Shanghai municipality) during the 9th and 10th FYPs (1996~2005). This TA will further use the evaluation results to provide policy recommendations so as to improve water pollution situations in the HRB and TLB.

2 According to the project Terms of Reference (TOR), the project outputs will incorporate the following 3 aspects: (1) comprehensive review and analysis of all aspects of the water pollution control and prevention with emphasis on the review and evaluation of the 9th and 10th FYPs environmental targets; (2) reform recommendations on laws, policy, institutions, and investment and financing to facilitate water basin water pollution control; and (3) guideline for watershed evaluation with major methods and tools applicable to other water basins.

1.2 Framework of the Evaluation Report

Figure 1.2-1 Framework of the Evaluation Report



2. Methods

2.1 Evaluation Methods

1 The methods of this evaluation are selected based on the overall environmental policy framework and the specific plans or programs for the HRB and TLB set by the Chinese central government. The selection also takes full consideration into the lessons and experiences learned from the past ADB TA projects in China as well as the review and analysis of international and China's domestic water basin environmental management practices.

2 The environmental policy, water pollution control investment, and water pollution control planning of water basins are characterized by their specific attributes: macro and wide in scope, of lasting impacts, related to various government agencies, and with a variety of un-expectancies in the course of implementation. Accordingly the evaluation will require large quantity of comprehensive and consistent data that tend to be difficult to acquire. Moreover, compared to the evaluation of construction projects, policy and investment evaluation is far more complex and need incorporate a variety of impact factors and consider more complicated causality and rich information sources. Subsequently the evaluation methods employed should respond to those specifics. Among the available evaluation techniques and methods, no single method would be able to meet the comprehensive requirements of this evaluation task; therefore, a handful of complementary methods have been adopted.

3 This evaluation has selected the logic model to link the study objectives, methods adopted, activities taken, results generated, and the impacts exerted. Among the selected methods, the comparative and trend analysis have been adopted as the basic methods. The selection of evaluation methods is closely tied to the scope of study and the data obtained. The selection has been based on the analysis and review of similar evaluations in the United States, analysis of the 9th and 10th FYPs and plans of the HRB and TLB, and the examination of the available information and data. The selection also takes into consideration the rich contents, diverse topics, wide scope, and limited availability of data of the evaluation.

4 Specifically, in the evaluation processes, different evaluation methods will be adopted for different evaluation objects, data, and purposes. Due to the wide evaluation scope and objects, the evaluation methods will combine qualitative and quantitative analyses, relative and absolute evaluation, measurements and modeling. For details concerning the evaluation methods, please refer to *Volume VI: Guidelines for Watershed Evaluation.*

2.2 Evaluation Process

2.2.1 Key Evaluation Steps

1 The key steps of this evaluation include: (1) setting the objectives, scope and principles of the evaluation, (2) selecting the methods, (3) survey and data collection, and data quality control, (4) data analysis, conclusion and optimization, (5) report writing, and (6) the expert commentating and report revisions.

2.2.2 Evaluation Objective

1 The evaluation objective of this study, to evaluate the policy and investment effectiveness of the HRB and TLB during the 9th and 10th FYPs, as indicated in Section 1.1, is the core of the evaluation.

2.2.3 Scope of the Evaluation

1 According to the Terms of Reference (TOR) of this TA project, the scope of the evaluation will encompass the laws, statues, policies, plans, standards, institutions, and management capacity concerning the environmental performance and investment effectiveness in the HRB and TLB by the central and provincial governments during the 9th and the 10th FYPs. For the details on the evaluation contents, please refer to *Volume VI Guidelines for Watershed Evaluation.*

2.2.4 Principles of the Evaluation

1 At the HRB and TLB 9th and 10th FYPs represent a thorough summary of all policies and investments in the HRB and TLB during the decade, the evaluation should be consistent with the FYPs' indicator system, data collection (temporal and spatial), and objectives.

2 The policy and investment effectiveness should be evaluated based on their objectives and expectations. If the actual policy and investment results match the original expectations, then the conclusion should be efficacious. Therefore, this evaluation will adopt the expected objectives at the end of the 9th and 10th FYPs.

2.2.5 Survey, Data Collection and its Quality Control

1 Survey, data collection and its quality control are fundamental to any evaluation. For this study, this part includes :

- Collection of the official statistics;
- On-site survey in the key areas of in the HRB and TLB;
- Survey (by questionnaires) on the policy and investment of the HRB and TLBs water pollution control and prevention environment;
- Designated survey and pollutant discharge monitoring;
- Data quality analysis and control.

2 Official statistical data comes often from the publicized monitoring and statistical data, communiqué, and environmental report by the environmental protection, hydraulic, and agricultural government offices. In particular, the study has used extensively the environmental monitoring data reported to SEPA.

3 The on-site survey of the key regions in the HRB and TLBs refers to the two-week on-site survey by the project team during June 4-16, 2006 in 7 cities in 4 provinces (Huzhou of Zhejiang Province, *Wuxi*, *Suzhou*, and *Nanjing* of Jiangsu Province, *Hefei* and *Bengbu* of Anhui Province, and *Jinan* of Shandong Province). The survey received the support from the

Foreign Economic Cooperation Office of SEPA and some of the local EPBs. The survey activities included: interviews with the officials at the local EPBs, WRBs, and construction committees, and local environment monitoring staff; visits to the Huzhou City *Bilang* Wastewater Treatment Plant, Huzhou City Phoenix Water Quality & Treatment Plant, Wuxi New Town Water Supply Plant, Hefei *Wangxiaoying* Wastewater Treatment Co., and Anhui *Fengyuan* Biochemical Co., Inc.; collection of local water pollution control and prevention plans and policies; distribution of the pre-designed questionnaires.

4 Questionnaires on environmental economics and investment, institutions and policy, and law case, and the comprehensive questionnaire of water basin water pollution control and prevention and environment policy and investment have been distributed at the selected sites, and the collected responses have been analyzed in the later evaluation process.

5 The designated survey and monitoring is to collect the historical water quality monitoring data (surface water quality classification, COD_{Mn}, NH_3-N, TP), water basin industrial wastewater discharge and pollutants discharge data (CODcr, NH_3-N, TP), water basin domestic wastewater discharge and pollutants discharge data (CODcr, NH_3-N, TP), and related agricultural non-point source data (pesticide and fertilizer use, livestock quantity, aquaculture produce, area of sowed land) of the key water bodies in the HRB and TLB during the 9th and 10th FYPs. The data are collected mainly through secondary sources and complemented by on-site surveys. Secondary data are obtained mainly from the reported data by the monitoring system supervised by SEPA. On-site data are collected by sampling the pre-selected industrial water pollution sources and municipal WWTPs.

6 As the collected data come from a variety of sources, the statistics is likely to represent different scopes, and the data reliability and consistency are subject to check. Main data quality control methods include: (1) maximizing data consistency by using data from a single sector when conducting the same analysis across different region; and (2) maximizing the use of publicized official data; other data are used only as references and data collating.

2.2.6 Data Analysis and Evaluation

1 During the application, the logic model is adopted to formulate the processes of policy and investment as inputs, outputs, and results and impacts. Then, through the analyses of relations and the comparison between their achievements and the planned objectives, the gaps between the objectives and the results can be identified to further evaluate potential problems and issues. The details of the evaluation processes will be further discussed in the future sections.

2.2.7 Evaluation Results and Optimization

1 Due to the diverse fields concerning this policy and investment evaluation, the evaluation will lead to a broad area of results concerning different aspects of those fields, and those results will impose different levels of connections and importance. Therefore, further summary of the results will be needed to prioritize reform recommendations. The final reform recommendations will be presented with priorities according to the problems identified and the results from the evaluation.

2.2.8 Evaluation Reporting and Expert Commentating and Revision

1 The Evaluation Report will accurately describe the evaluation basis, processes, results and the lessons and experiences learned. The preparation of the Report includes the design of the evaluation structure and the report framework, and the preparation of topics of the report.

2 To ensure the quality and validity of the evaluation report, the evaluation process incorporated 3 wide-scoped expert panel discussions. The experts attended the panel discussions included high-level officials in environmental protection, hydraulics, and agriculture; experts on water basin planning; and environment policy and investment experts and scholars. The 3 expert panel discussions are designated as:

- Project Initiation Symposium, which mainly discussed the Project Initiation Report, detailed the project tasks, evaluation methods, and work plan and timetable;
- Project Mid-Term Symposium, which mainly discussed the project Mid-Term Report, the framework of evaluation methods and report, collected data, on-site survey results from key areas of the HRB and TLB, preliminary evaluation results, and the work plan for the remaining tasks;
- Draft Final Report Symposium, which mainly discussed the draft final report, methods, baseline and other data, the detailed evaluation process, results, and reform recommendations.

2.3 Evaluation Techniques and Tools

In the evaluation process, a combination of evaluation techniques and tools has been adopted:

(1) Statistical Analyses

Statistical analyses include statistical and eigenvalue calculation methods, statistics inference, statistical tests, regressions, and correlation analysis. Mathematical statistical techniques and tools are mostly used in collating, comparing, and analyzing data.

(2) Inventory or Matrix Analysis

Inventory and matrix analysis include data table and data matrix analysis and impact factors inventory and matrix analysis. Data table and data matrix analysis are mostly used for data comparison and trend analysis. Impact factors inventory and matrix analysis are mostly used for multi-factor identification and nexus analysis among the impact factors.

(3) Forecast Methods

Forecast methods include analogy forecast and logical deduction forecast. Analogy forecast is often used in referencing international and domestic experiences and trend analysis processes. Logical deduction forecast is frequently used causality deduction from either the causes to the results or from the results to the causes.

(4) Logic Models

Logic models include the logic model and objective tree analysis. The logic model is to analyze the nexus between multiple factors so as to identify the hidden problems or to illustrate reasoning.

(5) Sampling and Monitoring Techniques

Sampling and monitoring techniques include socio-economic survey sampling techniques (which is mainly used for the verification of economic data) and sampling and monitoring techniques for water quality and quantity (which is mainly used to check the reliability and usability of water quality and quantity data and on-site data verification).

(6) Survey and Questionnaire

According to the objective and the scope of the evaluation, survey questionnaires are designed for various sub-topics, which include the general laws policy survey questionnaires, special policy, institution survey questionnaires, and economic investment survey questionnaires. The survey and questionnaire methods are generally used in the public participation evaluation.

(7) On-site Survey and Interviews

According to the evaluation objective and its scope, typical survey sites are selected. During the surveys, informants will be interviewed on-site. On-site survey and interviews are mostly used for data collection and case studies.

(8) Information Dissemination Using Media Resources

Information dissemination using public media resources including broadcasting, television, newspaper, Internet about the evaluation will serve two purposes: Dissemination during evaluation processes aims at broader public participation; post-evaluation dissemination is to inform the public about the evaluation results and to take active actions.

(9) Expert Panel Discussion

Water basin, policy and investment are topics covering a broad scope of disciplines. Although the evaluation experts belong to their own particular fields, due to the complexity and inter-connections of the impact factors, experts of a particular field also need the support and assistance from experts of other fields, especially for the comprehensive issues. Panel discussions that convey experts of various fields thus become an important evaluation tool to consolidate expertise and solve the difficult issues.

Volume II

REVIEW AND EVALUATION OF THE HRB

Table of Contents

1. Natural and Socio-Economic Background 5
  1.1 Natural Conditions 5
    1.1.1 Climate 5
    1.1.2 Vegetation 6
  1.2 Socio-Economic Background 7
    1.2.1 Industries 8
    1.2.2 Agriculture 9
    1.2.3 Urbanization 9
2. HRB Overall Evaluation during the 9th and the 10th FYPs 10
  2.1 Water Quality Objectives 10
    2.1.1 Water Quality Review against 9th FYP Objectives 10
    2.1.2 Water Quality Review against 10th FYP Objectives 14
    2.1.3 Huai River Water Quality Changes – 1995 to 2005 18
  2.2 Pollution TML and Load Reduction Objectives 19
    2.2.1 Of the 9th FYP 19
    2.2.2 Of the 10th FYP 20
  2.3 Investment in Pollution Control Programs 21
    2.3.1 During the 9th FYP 21
      2.3.1.1 Planned Investment 21
      2.3.1.2 Actual Investment 22
    2.3.2 During the 10th FYP 23
      2.3.2.1 Planned Investment 23
      2.3.2.2 Actual Investment 24
3. Indicator System 28
  3.1 Of the 9th FYP 28
    3.1.1 9th FYP Indicator System 28
    3.1.2 Analysis of the 9th FYP Indicators 29
  3.2 Of the 10th FYP 30
    3.2.1 10th FYP Indicators 30
    3.2.2 Analysis of the 10th FYP Indicators 30
4. Sources of and Factors Impacting Pollutants Discharge 31
  4.1 Sources of Pollutants Discharge 31

4.1.1 Industrial Point Sources 31
4.1.1.1 During the 9th FYP 31
4.1.1.2 During the 10th FYP 31
4.1.2 Domestic Wastewater Discharge 31
4.1.2.1 During the 9th FYP 31
4.1.2.2 During the 10th FYP 32
4.1.3 Agricultural Non-Point Sources Discharge 33
4.1.3.1 Non-Point Sources and Pollution Pathways in the HRB 33
4.1.3.2 Production of Non-Point Source Pollution and Amounts Discharged into the Environment 36
Non-Point Source Contribution to the HRB Water Pollution 41
4.2 Factors Impacting Pollutants Discharge 41
4.2.1 Development Level 41
4.2.2 Economic Growth 42
4.2.2.1 Growth during the 9th FYP 42
4.2.2.2 Growth during the 10th FYP 43
4.2.3 Factors Impacting Industrial Point Source Discharge 45
4.2.3.1 Discharge Non-Compliance 45
4.2.3.2 Impact of the Economic Growth on the Industrial Wastewater Discharge 51
4.2.3.3 Impact of the Industrial Structure on its Wastewater Discharge 51
4.2.4 Factors Impacting Urban Domestic Wastewater Discharge 58
4.2.4.1 Lagged Municipal WWTP Construction 58
4.2.4.2 Rapid Urban Population Growth and Urbanization 60
4.2.4.3 Improper Operation of WWTPs 61
4.2.4.4 Capacity, Effectiveness and Efficiency of Municipal WWTPs 64
4.2.5 Factors Impacting Non-Point Source Discharge 67
5. Water Resources 70
5.1 Water Resource and its Impact on Water Environment 70
5.1.1 Change of the Water Resources 70
5.1.2 Watershed Water Usage Variations 71
5.1.3 Impact from Water Quantity Change on Water Quality 74
5.2 Impact of Hydraulic Facilities on Water Environment 76
5.2.1 Hydraulic Facilities 76
5.2.2 Features of Hydraulic Facilities 80
5.2.3 Impacts from Hydraulic Operations 81
6. Legal Review and Evaluation 85
6.1 Laws 85
6.1.1 Basic Legislative Framework of China's Transjurisdictional Water Environment Management and Disputes Resolution 85
6.1.2 On China's Legislation on Transjurisdictional Water Environment Management 90
6.2 Standard System 94
6.2.1 Overview of Standards 94

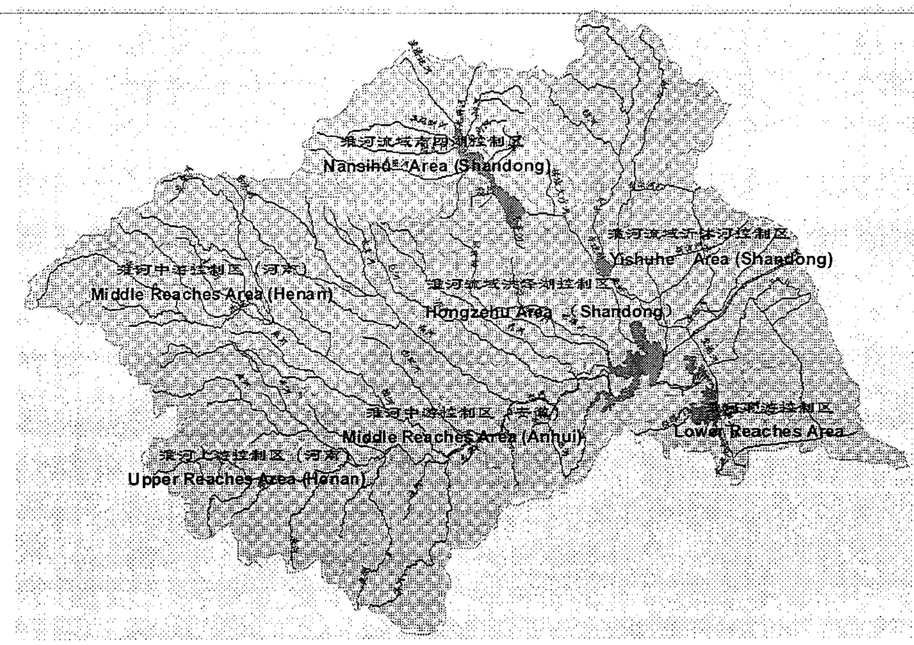
6.2.2 Environmental Quality Standards 94
6.2.3 Pollutants Discharge Standards 95
6.3 Judicial System 97
6.3.1 Judicial Institutions and Dispute Resolution Mechanism 97
6.3.1.1 Overview 97
6.3.1.2 Alternative Dispute Resolution (ADR) 98
6.3.1.3 Litigation 101
6.3.2 Causes for Transjurisdictional Disputes 103
6.3.3 Measures to Settle Transboundary Environmental Cases 106
6.3.4 Case Studies of the HRB Water Pollution Litigations 108
7. Policies 114
7.1 Environmental Policies 114
7.1.1 Major Environmental Policies 114
7.1.2 Implementation 117
7.2 Regional Development Policies 118
7.2.1 Building Ecological Provinces 118
7.2.2 SNWD East Line Pollution Control Project 119
7.3 Industrial Development Policies 120
7.4 Investment and Financing Policies 121
7.5 Technical Policy 125
8. Institutions 128
8.1 Institutional Settings and Responsibilities 128
8.2 Water Environmental Managerial and Organizational Functions 131
8.3 Watershed Management Institutions 133
8.3.1 Introduction of Watershed Management Authorities 133
8.3.2 Particularities and Issues in the Management System 136
9. Investment and Financing 137
9.1 Key Issues 137
9.2 Funding Sources 139
9.2.1 During the 9th FYP 139
9.2.2 During the 10th FYP 140
9.3 Fund Utilization 143
9.4 Investment Benefit 145
9.5 Economic Measures 148
9.5.1 Preferential Policy 148
9.5.2 Pollutants Discharge Fee 149
9.6 Sustainability Evaluation 150
10. Management 153
10.1 Management Settings 153
10.1.1 Environmental Impact Assessment and the "Three Synchronousness" 153
10.1.2 Permitting System 154
10.1.3 Other Management Institutions 157
10.2 Monitoring System 160
10.2.1 Monitoring System of Water Environment 160

10.2.2 Reporting System of the Water Environment Monitoring Data ... 165
10.2.3 Installation of the Monitoring System ... 166
10.3 Small Watershed Pollution Control Plan ... 166
11. Public Participation ... 169
11.1 Forms of Public Participation ... 169
11.2 Effects and Issues of Public Participation ... 170

1. Natural and Socio-Economic Background

1.1 Natural Conditions

Figure 1.1-1 Administrative Map of the HRB



1 The HRB, at longitude 111°55'-121.25"E and latitude 30°55'-36.36"N, lies largely between the drainages of the Yangtze River and Yellow River in east China. The entire watershed occupies a territory of 27×10^4 km^2, equivalent to 1/35 of the entire China. It boards the *Mount Tongbai* and *Mount Funiu* in the west, reaches the Yellow Sea in the east, is bounded by the Yellow River and the *Mount Tai* in the north, and extends to the *Dabie* Mountain, *Jianghuai* Hilly Region, the Yangtze River, *Tongyang* Canal, and the *Rutai* Canal in the south. Divided by the Old Yellow River Course, the HRB can be sectioned to the Haul River System and *Yi-Shu-Si* River System that are of 19×10^4 km^2 and 8×10^4 km^2 respectively.

1.1.1 Climate

2 The HRB is located across the transitional area between the typical southern and northern climate zones. To the north of Haul River lies the area of warm temperate climate, while to the south, the area falls within the subtropical climate zone with temperate weather conditions and annual temperatures of 11-16℃. By the nature of its location, temperature variation within the HRB intensifies from the north to the south and from the coastal area to the inland. The record high reaches 44.5℃ and the record low to -24.1℃. The evaporation volume in the north surpasses that in the south with the annual evaporation volume between 900 to 1,500 mm and a frost-free period of 200-240 days. On the whole, the Haul River has been a natural division between the northern and southern China.

3 The HRB's yearly rainfall days decrease from the south to the north. The number accounts to 30-100 days in the plains to the north of the Haul River, 100-120 days in the

mountainous areas to the south and west of the River, and peaks to approximately 140 in the *Dabie* Mountain area. The HRB' multi-year average precipitation is approximately 888 mm, while that of the Haul River water system accounts to 910 mm, and the *Yi-Shu-Si* water system 836 mm. The multi-year precipitation of the Shandong Peninsular averages 731 mm.

4 Precipitations in the HRB experiences significant yearly variations. The maximum yearly precipitation accounts for approximately 3-4 times that of the recorded minimum. Precipitation within a year is also distributed unevenly; the precipitation during the flood season (June to September) accounts for 50%-80% the yearly precipitation.

1 The HRB's rainstorms take place mostly from June to August along the Haul River's mainstream and its southern terrain. Such rainstorms cover a vast territory and last for long periods of time. In August the HRB will experience the typhoons mostly in the *Lixia* River area and the Yi-Shu-Si watershed. The typhoon rainstorms, on the other hand, usually impact only a relatively small area and with a short time span, although usually with high intensity.

5 According to the research results by the Haul River Water Resources Commission of the Ministry of Water Resources, the coefficient of variation of the watershed annual precipitation falls between 0.25-0.3 and increases from south to north, from the mountainous areas with a higher precipitation to the plain areas with less rainfall. The coefficients of variation of the *Huainan* and *Yimeng* mountainous regions are less then 0.25. *Hongru* River, *Shaying* River and the *Subei* Coastal Plain all have a value higher then 0.3. As to the quarterly and monthly precipitations, the coefficient of variation can be much higher. The spring (March-May) coefficient of variation usually falls between 0.4-0.6. The monthly variations can reach the magnitude of the order of hundreds. For instance, *Rizhao* City experienced zero precipitation in September 1957 and 333 mm of rainfall in the same month 3 years later. In June 1955 *Heze* region had only 1 mm of precipitation but the June of the following year the figure reached 306 mm. The wide range of the coefficient of variation of precipitation demonstrates the instability of the precipitation within the watershed.[1]

1.1.2 Vegetation

1 Constraint by the north-south transitional natural zone, the natural vegetation of the hills and mountains in the HRB exhibit not only zonal distribution but also transitional features. Both temperate and subtropical flora can be seen. In the plain area, planted vegetation dominates.

> Natural vegetation: From the north to south of the basin and from coastal to inland areas the temperature and precipitation increases, the vegetation composition and flora type also complicate. Deciduous broad-leaved forests dominate the areas of the Mount *Funiu* main ridge, typically growing in the south warm temperature zone to the north of the Haul River. To the south of the Haul River, in the north subtropical

[1] Wang Youfeng, Zhang Fengyi, Liu Luxiang. Analysis on the HRB Agricultural Climat Conditions. Anhui Agricultural Science. 2001, 29 (3)

zone, the typical zonal vegetation is mixed evergreen deciduous broad-leaved forest mingled with bamboo forests. Due to the location in the ecotone, the mixing of the deciduous broad-leaved forest, humid coniferous forest and mixed ever-green broad-leaved forest is typical.

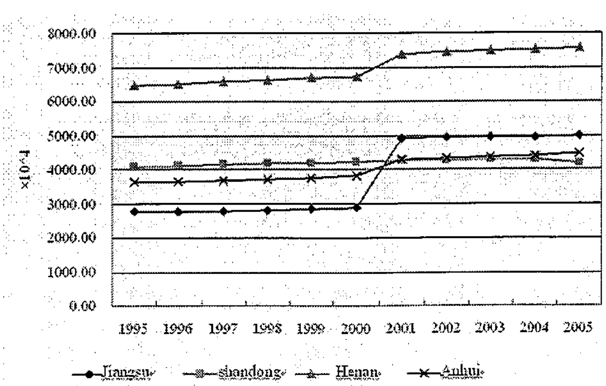
- Planted vegetation: Dry farming crop vegetation is mainly found on the *Huanghuai* Plain and *Xuhuai* Plain north of the Haul River. Rice primarily grows on the plains to the south of Haul River and on the farmlands in the mountainous region and the hilly fields. Economic forests generally grow in the hilly and mountainous areas. Orchard and vegetable gardens consisted mainly of deciduous fruit trees typical of the warm temperate zone are often found in the city outskirts.

1.2 Socio-Economic Background

1 The HRB encompasses over 30 prefectures and cities in the Henan, Anhui, Shandong, and Jiangsu provinces. The scope of pollution prevention of the HRB 10th FYP is built upon the scope of the 9th FYP with the addition of *Lianyungang*, *Yancheng* (partial), *Nantong* (partial), *Luoyang* (partial), *Changfeng* County of the Hefei City. Therefore, the scope of the 10th FYP encompasses *Zhengzhou, Kaifeng, Pingdingshan, Xuchang, Leihe, Zhumadian, Xinyang, Nanyang, Shangqiu, Zhoukou and Luoyang* in the Henan Province; *Huainan, Bengbu, Chuzhou* (partial), *Liu'an* (partial), *Fuyang, Bozhou, Huaibei, Suzhou* and *Hefei* (partial) in the Anhui Province; *Xuzhou, Huai'an, Suqian, Yangzhou* (partial), *Taizhou* (partial), *Nantong* (partial), *Yancheng* and *Lianyungang* in the Jiangsu Province; and *Dezaozhuang, Jining, Heze, Tai'an, Linyi, Zibo* and *Rizhao* in the Shandong Province. This territory houses a total population of 1.4×10^8 with an average population density of 519 persons/km^2, 4.3 times of the national average (122 persons/km^2) and the highest among all the major river basins in China. Historically the HRB has been a relatively underdeveloped region in China, but this situation has changed since the 1990s. In 2005, the HRB's GDP has reached 21844.7×10^8 yuan.

2 During the 9th and 10th FYPs, the population and GDP change in each province in the HRB are exhibited in Figure 1.2-1 and Figure 1.2-2.

Figure 1.2-1 Population Change during the 9th and 10th FYPs in the Watershed (1995-2005)



Source(s): Jiangsu Statistics Yearbook 1996-2006, Shandong Statistics Yearbook 1996-2006, Henan Statistics Yearbook 1996-2006, Anhui Statistics Yearbook 1996-2006

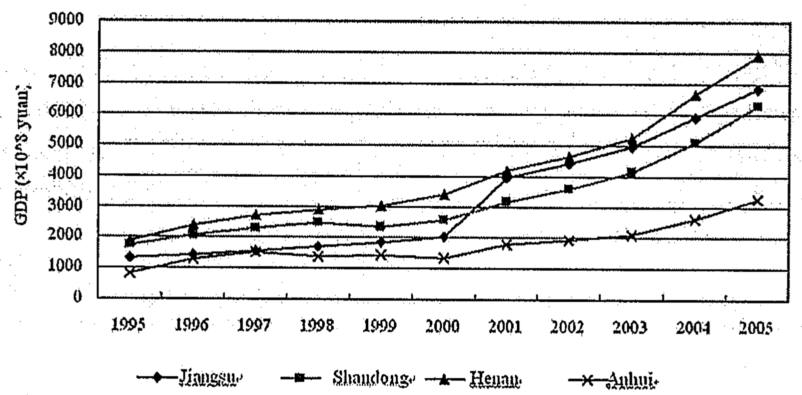
Table 1.2-1 Population of the HRB during1995-2005

Unit: $\times 10^4$ person

Province	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Jiangsu Province	2756.88	2769.24	2775.97	2791.59	2828.39	2864.10	4919.43	4931.24	4944.79	4953.63	4977.69
Shandong Province	4077.38	4103.20	4135.13	4167.29	4192.53	4223.11	4247.25	4267.87	4287.44	4308.54	4175.65
Henan Province	6460.00	6520.00	6578.00	6631.00	6685.00	6714.00	7390.00	7444.00	7486.00	7517.00	7554.07
Anhui Province	3628.75	3642.69	3682.49	3715.08	3755.14	3808.30	4284.50	4321.00	4356.21	4407.23	4455.37

Source(s): Jiangsu Statistics Yearbook 1996-2006, Shandong Statistics Yearbook 1996-2006, Henan Statistics Yearbook 1996-2006, Anhui Statistics Yearbook 1996-2006

Figure 1.2-2 GDP Change in the HRB (1995-2005)



Source(s): Jiangsu Statistics Yearbook 1996-2006, Shandong Statistics Yearbook 1996-2006, Henan Statistics Yearbook 1996-2006, Anhui Statistics Yearbook 1996-2006

Table 1.2-2 GDP of the HRB during 1995-2005

Unit: 10^8 yuan

Province	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Jiangsu Province	1328.74	1442.95	1550.73	1684.06	1830.65	2013.57	3951.67	4387.76	4949.78	5939.47	6827.12
Shandong Province	1742.19	2075.83	2293.31	2470.87	2364.38	2557.30	3160.09	3565.96	4130.31	5099.59	6275.34
Henan Province	1883.92	2383.07	2699.71	2896.80	3050.42	3381.30	4186.96	4643.29	5229.80	6645.27	7888.24
Anhui Province	817.53	1299.42	1511.09	1359.61	1432.87	1349.87	1781.13	1939.92	2124.55	2612.77	3241.99

Source(s): Jiangsu Statistics Yearbook 1996-2006, Shandong Statistics Yearbook 1996-2006, Henan Statistics Yearbook 1996-2006, Anhui Statistics Yearbook 1996-2006

3 Notably, the statistics of the 2001-2005 population and GDP include the newly added cities and regions, as the scope of the 10^{th} FYP encompasses several more cities that were not covered in the 9^{th} FYP,.

1.2.1 Industries

1 The major industries in the HRB are coal production, electricity and food and textile industries that use agricultural produce as raw materials. Currently the national large-scale coal production bases have been constructed in *Huainan, Huaibei, Pingdingshan, Xuzhou,*

Yanzhou, and *Zaozhuang*. In 1997 the HRB produced 1/8 of China's total coal production, and it is now China's largest coal production area to the south of the Yellow River. The entire water basin now has an installed capacity of thermal power generators close to 2000×10^4 kw. In the recent decade, the coal production, building materials, electricity, and machinery manufacturing industries have thrived; *Zhengzhou, Xuzhou, Lianyungang, Huainan, Bengbu*, and *Jining* have emerged as large or medium scale industrial cities.

1.2.2 Agriculture

The HRB plays a key role in China's food production. It is one of the "Three Bases" of China's food production. With 1333×10^4 km^2 of arable land, the HRB accounts for 11% of the total national arable land. Forty-five percent of the HRB's land is sowed and with a high multiple cropping index (ratio of total sown area in a year to the cropland area). It major produces include wheat, rice, corn, potatoes, soybeans, cotton, and canola.

4 The HRB, with its 13333 km^2 of water surface, is rich of rivers, canals, ponds, reservoirs, lakes, wetlands, and aqualife resources (over 100 kinds of fish) and is China's important freshwater aquacultural area.

5 A few notable features characterize the agricultural industry in the HRB: plantation accounts for 65%, an unreasonably high percentage, of the agricultural sector. This percentage is 13% higher compared to the average of the 4 provinces in the water basin and 8% higher than the national average. On the contrary, those with a higher productivity and added value – livestock raising, aquaculture and forestry – are of a notably low percentage. Especially the livestock raising, a "new incomer growth engine of the farmers", in the HRB has is 10.4% lower than the 4-province average, or 6.7 percent lower than the national average. Overall, the agricultural productivity in the HRB – as well as the income level of the local farmers – is low.

1.2.3 Urbanization

1 The urbanization rate of the HRB by the end of the 1990s on average was less than 30%. But in recent years, with the rapid development of small and medium-sized cities and small towns along the Haul River, the residential population in prefecture-level cities frequently exceeds 30×10^4; county and county-level city resident population reaches approximately 10×10^4. During the last decade, the population in the HRB has increased by over 20 million. To cite Anhui Province as an example, the urbanization rate nearly doubled from 20% of a decade ago to the current level of 35.5%. According to the urban development plan of the towns along the Haul River, by the end of 2010 the entire watershed urbanization rate will reach 40% with a net increase of over 20 million urban population.

2. HRB Overall Evaluation during the 9th and the 10th FYPs

2.1 Water Quality Objectives

2.1.1 Water Quality Review against 9th FYP Objectives

1 The *HRB Strategic Plan and the 9th FYP of Water Pollution Control and Prevention* has set the overall water quality objectives to have clear water in the Haul River water bodies by the end of 2000. The monitoring results from 2000 suggest that among the 86 control sections set up in the HRB during the 9th FYP, 19% reached the national surface water environment quality standards Class II or III, 23% belonged to Class IV or V, and the rest 58%, or 64 control sections, fell to the "sixth" category – Worse than Class V. Among the 64 "worse than Class V" control sections, 43 had a non-compliant NH_3-N level, and 26 a non-compliant COD_{Mn} level. By the end of the 9th FYP, only 35.5% monitoring sections met the objectives; the rest 64.5% failed, and among the failed ones, 58.18% were of "worse than Class V" water quality.

2 The details of the compliance with the HRB 9th FYP water quality objectives are shown in Table 2.1.1-1

Table 2.1.1-1 Water Quality Condition of the HRB by the End of the 9th FYP

No.	Province	Control unit	Control section	Water quality classification (2000)	Compliance with 9th FYP objective	Non-compliance indexes	# of non-compliance index
1	Anhui	Baita River	Tianchang Chemical Plant	Worse than V	No	BOD_5, NH_3-N, COD	3
2	Anhui	Chi River	Gonglu Bridge	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, COD	4
3	Anhui	Dongfei River	Dongfei River Wuli Gate	IV			
4	Anhui	Dongsha River	Linhuanji	V	No	COD	1
5	Anhui	Feng River	Gongnongbing Bridge	IV			
6	Anhui	Gu River	Funan	IV			
7	Anhui	Heici River	Niqiu	Worse than V	No	BOD_5, NH_3-N, COD	3
8	Anhui	Hong River Flood Bypass	Taolao	V	No	BOD_5	1
9	Anhui	Haul River	Bengbu Zhaxia	III			
10	Anhui	Haul River	Dajiangou	V	No	NH_3-N	1
11	Anhui	Haul River	Mehekou	IV	No	NH_3-N	1
12	Anhui	Haul River	Shitoufu	IV	No	NH_3-N	1
13	Anhui	Haul River	Wangjiaba	IV	No	COD_{Mn}, BOD_5, Petroleum	3
14	Anhui	Haul River	Wuo River join Haul	III			

No.	Province	Control unit	Control section	Water quality classification (2000)	Compliance with 9th FYP objective	Non-compliance indexes	# of non-compliance index
			River				
15	Anhui	Haul River	Xiashankou	V	No	NH_3-N	1
16	Anhui	Haul River	Xiaoliuxiang	IV	No	NH_3-N, Petroleum	2
17	Anhui	Haul River	Xinchengkou	V	No	NH_3-N	1
18	Anhui	Haul River	Xintie Bridge	IV	No	NH_3-N	1
19	Anhui	Hui River	Bengbu Gu County	IV			
20	Anhui	Huiji River	Liuzhaicun	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, Volatile Phenol, COD, Fluorid	6
21	Anhui	Kui River	Yangzhuang	Worse than V	No	Dissolved oxygen, COD_{Mn}, BOD_5, NH_3-N, Petroleum, COD	6
22	Anhui	Pi River	Xinan Ferry	Worse than V	No	NH_3-N	1
23	Anhui	Quan River	Downstream of Linquan	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, COD	4
24	Anhui	Quan River	Xuzhuang	Worse than V	No	BOD_5, NH_3-N	2
25	Anhui	Shi River	Hongshizui	II			
26	Anhui	Sui River	Si County Bali Bridge	Worse than V	No	COD_{Mn}, BOD_5, Petroleum, COD	4
27	Anhui	Tuo River	Xiaowang Bridge	IV	No	COD_{Mn}, BOD_5, COD	3
28	Anhui	Wuo River	Haozhou	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, Volatile Phenol, COD, Fluorid	6
29	Anhui	Wuo River	Downstream of Mengchang	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, Volatile Phenol, COD	5
30	Anhui	Xifei River	Lixin	IV	No		
31	Anhui	Xinbian River	Si County Gonglu Bridge	V	No	COD_{Mn}, BOD_5, Petroleum, COD	4
32	Anhui	Yin River	Jieshou	Worse than V	No	BOD_5, NH_3-N	2
33	Anhui	Yin River	Up and downstream of Yin	Worse than V	No	NH_3-N	1
34	Henan	Bao River	Ma Bridge	Worse than V	No	COD_{Mn}, NH_3-N, COD	3
35	Henan	Beiru River	Dachen Gate	II			
36	Henan	Dasha River	Baogong Temple	V			
37	Henan	Hong River	Bantai	V	No	Volatile Phenol	1
38	Henan	Haul River	Changtai Guanganan Bridge	III			

No.	Province	Control unit	Control section	Water quality classification (2000)	Compliance with 9th FYP objective	Non-compliance indexes	# of non-compliance index
39	Henan	Haul River	Huaibin hydrology Station	III			
40	Henan	Haul River	Xi county Dafukou	IV	No	Petroleum	1
41	Henan	Huang River	Huangchuan hydrology Station	IV			
42	Henan	Hui River	Huangkou	Worse than V	No	COD	1
43	Henan	Huiji River	Dongsunying	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, COD	4
44	Henan	Jialu River	Xihua Dawangzhuang	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, COD	4
45	Henan	Quan River	Shenqiu Lifen Gate	Worse than V	No	NH_3-N	1
46	Henan	Ru River	Shakou	IV			
47	Henan	Sha River	Liuli Ferry	III			
48	Henan	Shi River	Xinyang Pipashan Bridge	IV			
49	Henan	Shiguan River	Jiangji hydrology Station	IV			
50	Henan	Tuo River	Yongcheng Zhang Bridge	IV			
51	Henan	Wuo River	Luyifu Bridge	V	No	NH_3-N	1
52	Henan	Yin River	Huaidian Gate	Worse than V	No	BOD_5, NH_3-N	2
53	Henan	Yin River	Shenqiu Zhidian	Worse than V	No	BOD_5, NH_3-N	2
54	Jiangsu	Beichengzhi River	Yigou Bridge	Worse than V	No	NH_3-N	1
55	Jiangsu	Haul River	Xuyi Haul River Bridge	IV	No	NH_3-N, Petroleum	2
56	Jiangsu	Jinghang Canal	Baoying Lock	V	No	Petroleum, Cadmium	2
57	Jiangsu	Jinghang Canal	Malin weir	IV	No	COD	1
58	Jiangsu	Kui River	Huang Bridge	Worse than V	No	BOD_5, NH_3-N, COD	3
59	Jiangsu	Paishuiqu	Suzui	Worse than V	No	NH_3-N	1
60	Jiangsu	Picang Flood Bypass	Aishanxi Bridge	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, Petroleum, Volatile Phenol, COD	6
61	Jiangsu	Subei General Irrigation Channel	Qubei Gate	III			
62	Jiangsu	Tongyang Canal	Xiying Bridge	III			

No.	Province	Control unit	Control section	Water quality classification (2000)	Compliance with 9th FYP objective	Non-compliance indexes	# of non-compliance index
63	Jiangsu	Xinsui River	Daqu	V	No	COD	1
64	Jiangsu	Xinqi River	Zhangzhuang	III			
65	Jiangsu	Yan River	Liji Bridge	IV			
66	Jiangsu	Yan River	Zhuma Gate	IV			
67	Jiangsu	Zhong Canal (Jinghang Canal)	Huaisi River	IV	No	COD	1
68	Jiangsu	Bulao River	Linjia Dam	III			
69	Shandong	Baima River	Jiezhuang	IV			
70	Shandong	Baima River	Malou	V	No	NH_3-N, COD	2
71	Shandong	Beng River	Jiaoyi	IV			
72	Shandong	Chengguo River	Qunle Bridge	Worse than V	No	COD_{Mn}, BOD_5, NH_3-N, COD	4
73	Shandong	Dongpicang Flood Bypass	Dongpianhong	IV			
74	Shandong	Dongyu River	Xiyao	V	No	COD_{Mn}, COD	2
75	Shandong	Guangfu River	Huangzhuang	Worse than V	No	BOD_5, dissolved oxygen, COD_{Mn}, NH_3-N, COD, Volatile Phenol	6
76	Shandong	Liangji Canal	Nanmatou	IV	No	Dissolved oxygen, COD_{Mn}, BOD_5, NH_3-N, COD, Petroleum	6
77	Shandong	Hanzhuang Canal	Taierzhuang Bridge	IV			
78	Shandong	Shagou River	Shagou Bridge	IV			
79	Shandong	Shu River	Gaofengtou	IV			
80	Shandong	Si River	Yingou	Worse than V	No	COD_{Mn}, BOD_5, Volatile Phenol, COD	4
81	Shandong	Wu River	310 Road Bridge	IV			
82	Shandong	Xizhi River	Beiwaihuan Bridge	IV			
83	Shandong	Xinshu River	Linshu Bridge	IV			
84	Shandong	Xi River	Gangshang	III			
85	Shandong	Zhangtong River	Zhangtong Bridge	IV			
86	Shandong	Zhuzhanoxin River	Yulou	Worse than V	No	BOD_5, NH_3-N, Petroleum, COD	4

2.1.2 Water Quality Review against 10th FYP Objectives

1 The HRB 10th FYP required that by the end of 2005 the water quality of the Huai River mainstream further improve and the water quality of the SNWD East Line basically reach the surface water Class III of theWater Quality Standards, while ensuring the natural runoff of the Huai River mainstream and its major tributaries. More specifically, it requires 1) source water quality of urban drinking water monitored at 50 sections of SNWD water line region along the Huai River mainstream should reach Class III; 2) water quality of other 46 sections should reach Class IV, and another 3 sections to reach Class V; and 3) the rest 12 sections without natural runoff during the low water seasons and sections at major dams and gateways should have a COD lower than 70 mg/L.

2 In 2005, among the 86 control sections that have monitoring data during the HRB's low water season, 35 (40.7%) reached water quality objectives, 51(59.3%) did not comply with the objectives. The proportions of non-compliance sections and indicators are: 36 sections (41.9%), NH_3-N; 28 sections (32.6%), COD; 26 sections (30.2%), BOD_5; 19 sections (22.1%), COD_{Mn}; 11 sections (12.8%), petroleum; 7 sections (7.0%), volatile phenol.

1 During the 10th FYP, the overall deterioration of the HRB water quality has been deterred. By 2005, although the proportion of the HRB Class II water quality sections has reduced by 0.4% and Class III water quality sections by 4.8% as compared to 2000, water quality sections of Class IV increased by 29.3%, Class V water quality sections by 1.5%, and Worse than Class V water quality section reduced by 25.6%.

Table 2.1.2-1 the HRB Water Quality of by the End of the 10th FYP

No.	Province	Control unit	Ccontrol section	Water quality classification (2005)	Compliance with the 10th FYP objective	Non-compliance indices	# of non-compliance indices
1	Henan	Huai River	Huaibin hydrology station	Worse than V	No	NH_3-N	1
2	Henan	Shi River	Pipashan Bridge	Worse than V	No	NH_3-N	1
3	Henan	Heng River	Huangchuan hydrology station	V	No	NH_3-N	1
4	Henan	Shiguan River	Jiangji hydrology station	III	Yes		
5	Henan	Hong River	Xincai bantai	Worse than V	No	COD, COD_{Mn}, NH_3-N	3
6	Henan	Ru River	Runan shakou	Worse than V	No	COD, NH_3-N	2
7	Henan	Hei River	Shenqiu lifen	Worse than V	No	COD, NH_3-N	2
8	Henan	Sha River	Liuli Ferry	Worse than V	No	NH_3-N	1
9	Henan	Beiru River	Dachen Gate	II	Yes		
10	Henan	Qingyi River	Gaocun Bridge	Worse than V	No	COD, COD_{Mn}, NH_3-N	3
11	Henan	Jialu River	Xihua dawangzhuang	Worse than V	Yes		
12	Henan	Yin River	Shenqiu zhidian	Worse than V	No	COD, COD_{Mn}, NH_3-N	3
13	Henan	Wuo River	Luyifu Bridge Gate	Worse than V	No	COD, COD_{Mn}, NH_3-N	3

No.	Province	Control unit	Ccontrol section	Water quality classification (2005)	Compliance with the 10^{th} FYP objective	Non-compliance indices	# of non-compliance indices
14	Henan	Huiji River	Dongsunying Gate	Worse than V	Yes		
15	Henan	Gusong River	Shangqiu County	Worse than V	Yes		
16	Henan	Dasha River	Baogong Temple	Worse than V	Yes		
17	Henan	Bao River	Ma Bridge	Worse than V	Yes		
18	Henan	Hui River	Huangkou	Worse than V	Yes		
19	Henan	Tuo River	Yongchengzhang Bridge	III	Yes		
20	Anhui	Huaihongxin River	Wu River	Worse than V	No	COD_{Mn}, NH_3-N	2
21	Anhui	Huai River	Hudajian	Worse than V	No	NH_3-N	1
22	Anhui	Huai River	Mo River	Worse than V	No	NH_3-N	1
23	Anhui	Hui River	Guzhen	Worse than V	No	COD	1
24	Anhui	Chi River	Gonglu Bridge	Worse than V	No	COD, NH_3-N	2
25	Anhui	Baita River	Tianchang Chemical plant	Worse than V	Yes		
26	Anhui	Gu River	Funan	IV	Yes		
27	Anhui	Yin River	Down stream of Yinshangduan	Worse than V	Yes		
28	Anhui	Xifei River	Lixinduan	V	No	NH_3-N	1
29	Anhui	Wuo River	Downstream of Mengchengduan	Worse than V	Yes		
30	Anhui	Heiniquan River	Down stream of Linquan	Worse than V	Yes		
31	Anhui	Feng River	Gongnongbing Bridge	IV	Yes		
32	Anhui	Pi River	Xinan Ferry	V	No	NH_3-N	1
33	Anhui	Dongfei River	Wuli Gate	III	Yes		
34	Anhui	Tuo River	Suxian luling	Worse than V	No	COD, COD_{Mn}, NH_3-N	3
35	Anhui	Shi River	Hongshizui	II	Yes		
36	Anhui	Xinbian River	Sixian gonglu Bridge	IV	Yes		
37	Anhui	Sui River	Sixianbali Bridge	Worse than V	No	NH_3-N	1
38	Shandong	Zhuzhaoxin River	Yulou	Worse than V	No	COD, COD_{Mn}	2
39	Shandong	Dongyu River	Xuzhai	Worse than V	No	COD, COD_{Mn}	2
40	Shandong	Wanfu River	Fangmiao	Worse than V	No	COD	1
41	Shandong	Liangji Canal	Liji	Worse than V	No	COD, COD_{Mn}, Petroleum	3
42	Shandong	Si River	Yingou	Worse than V	No	COD, COD_{Mn}, Petroleum	3
43	Shandong	Baima River	Malou (Lu Bridge)	Worse than V	No	COD, COD_{Mn}	2
44	Shandong	Lao Canal	Xishifu	Worse than V	No	COD_{Mn}, NH_3-N, COD, Petroleum	4
45	Shandong	Xizhi River	Beiwaihuan Bridge (Mitan)	V	No	COD, COD_{Mn}, NH_3-N	3
46	Shandong	Guangfu River (Jining)	Dongshifu	Worse than V	No	COD_{Mn}, NH_3-N, COD, Petroleum	4
47	Shandong	Hanzhuang Canal	Taierzhuang Bridge	Worse than V	No	COD	1

No.	Province	Control unit	Ccontrol section	Water quality classification (2005)	Compliance with the 10^{th} FYP objective	Non-compliance indices	# of non-compliance indices
48	Shandong	Chengguo River	Qunle Bridge	Worse than V	No	COD, COD_{Mn}, dissolved oxygen, NH_3-N, Volatile Phenol	5
49	Shandong	Xuechengsha River	Shizi River Bridge	Worse than V	No	COD	1
50	Shandong	Xinxue River	Luofang Bridge	Worse than V	No	COD, COD_{Mn}, NH_3-N	3
51	Shandong	Yichengsha River	Jiazhuang Gate(Xiao Bridge)	Worse than V	No	COD	1
52	Shandong	Xuechengxiaosha River	Pengkou Gate	Worse than V	No	COD, COD_{Mn}, NH_3-N, TP	4
53	Shandong	Beisha River	Wangchao Bridge	V	No	COD_{Mn}	
54	Shandong	Xi River	Gangshang	V	No	COD_{Mn}	1
55	Shandong	Shu River Juxian junan	Gaofengtou	III	Yes		
56	Shandong	Xinshu River Linshu	Daxing Bridge	Worse than V	No	COD	1
57	Shandong	Baima River Tancheng	Sanjiezhuang Gate	Worse than V	No	NH_3-N	1
58	Shandong	Fang River (Pingyi Feixian)	Jiaoyi	IV	No	COD, COD_{Mn}, NH_3-N	3
59	Shandong	Picang Flood Bypass	Xipianhong	Worse than V	No	COD	1
60	Shandong	Laowanfu River	Gao River Bridge	Worse than V	No	BOD, Petroleum	2
61	Shandong	Lao Canal Weishan		Worse than V	No	Dissolved oxygen, NH_3-N, BOD_5, COD_{Mn}, Petroleum	5
62	Shandong	Quan River	Niuzhuang Gate	Worse than V	No	NH_3-N, COD_{Mn}, Petroleum	3
63	Shandong	Zhushui River	105 Road Bridge	V	No	Dissolved oxygen, NH_3-N, BOD_5, COD_{Mn}	4
64	Shandong	Wu River	310 Road Bridge	V	No	COD_{Mn}	1
65	Shandong	Shagou River	Shagou Bridge	Worse than V	No	COD_{Mn}	1
66	Jiangsu	Kui River	Huang Bridge	Worse than V	Yes		
67	Jiangsu	An River	Xiaowangdian	III	Yes		
68	Jiangsu	Shu River	Shaodian Bridge	V	No	Dissolved oxygen, COD_{Mn}	2
69	Jiangsu	Chuanchang River	Dongtailianyi Bridge-Funing Brewhouse	III	Yes		
70	Jiangsu	Sheyang River	Sheyang Gate	III	Yes		
71	Jiangsu	Irrigation Channel	Suzui-Liuduo Gate	III	Yes		
72	Jiangsu	Doulongxiang	Datuan Bridg	III	Yes		
73	Jiangsu	Guan River	Xiangshui xichengwan-Chenxiang	III	Yes		
74	Jiangsu	Xinyang Habor	Dazonghu-Xinyang Gate	III	Yes		
75	Jiangsu	Yan River Guannan	Nan Gate	III	Yes		

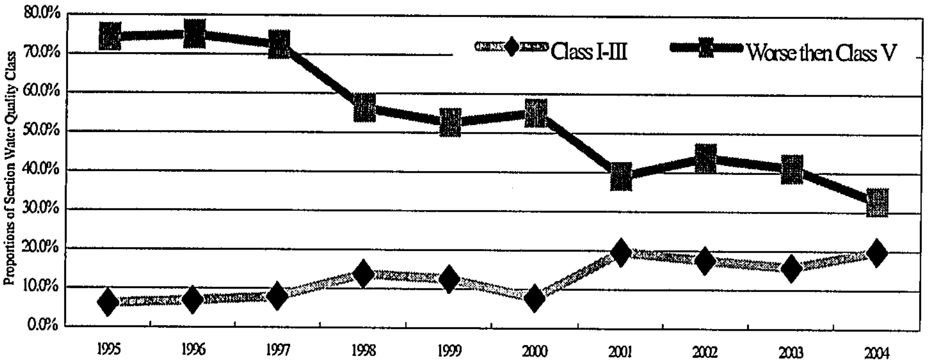
No.	Province	Control unit	Ccontrol section	Water quality classification (2005)	Compliance with the 10th FYP objective	Non-compliance indices	# of non-compliance indices
76	Jiangsu	Yan River Guanyun	Yishanbei Bridge	IV	Yes		
77	Jiangsu	Qiangwei River	Linhong Gate	V	No	COD	1
78	Jiangsu	Xiyandapu River Main stream	Xiangyang Bridge	Worse than V	No	COD, dissolved oxygen, NH_3-N, TP	4
79	Jiangsu	Paidan River Main stream	Daban Gate	Worse than V	No	COD, NH_3-N, TP	3
80	Jiangsu	Qingkou River Main stream	Batou Bridge	Worse than V	No	NH_3-N	1
81	Jiangsu	Shian River Main stream	Puxi Bridge	IV	Yes		
82	Jiangsu	Dongmen wutu River Main stream	Yangji Bridge	III	Yes		
83	Jiangsu	Xintongyang-Tongyu River	Gupen Bridge	Worse than V	No	NH_3-N	1
84	Jiangsu	Pi River	Hongnong Bridge	Worse than V	No	NH_3-N	1
85	Jiangsu	Liutang River	Shidu	Worse than V	No	NH_3-N	1
86	Jiangsu	Gushan River	Xuhuailu	V	Yes		
87	Jiangsu	Huaihongxin River	Shuanggou Bridge	III	Yes		
88	Jiangsu	Xinanxiao River	Zhangzhuang	IV	Yes		
89	Jiangsu	Jiuligou-Hangjiapu Bridge	Hangjiapu Bridge	III	Yes		
90	Jiangsu	Taixi-Honglin Bridge Jiangyan	Honglin Bridge	III	Yes		
91	Jiangsu	Taixi-Honglin Bridge Taizhou	Taidong	V	No	NH_3-N	1
92	Jiangsu	Zhuzhuang-Xinghua Taizhou	Zhuzhuang	III	Yes		
93	Jiangsu	Zhuzhuang-Xinghua Xinghua	Refrigeration Plant	III	Yes		
94	Jiangsu	Da Canal Yangzhou	Shi Bridge Lock	Worse than V	No	Dissolved oxygen, Volatile Phenol, As, Hg, Cd, Petroleum	3
95	Jiangsu	Gu Canal	Xinkai River	Worse than V	No	Dissolved oxygen, Volatile Phenol,As, Hg, Cd, Petroleum	3
96	Jiangsu	Baoshe River	Wangzhi Power plant	Worse than V	No	Hg, dissolved oxygen, NH_3-N, Volatile Phenol	4
97	Jiangsu	Tongyang Canal Yangzhou	Youku Bridge	Worse than V	No	Hg, dissolved oxygen, Cd, Pb	4
98	Jiangsu	Xintongyang Canal	Jingduxi Gate	IV	No	Petroleum (0.193)	1
99	Jiangsu	Beichengzi River	Gaoyou	Worse than V	No	NH_3-N (3.43)	1
100	Jiangsu	Rujingshuidao	Jin Lake	IV	No	Petroleum(0.25)	1
101	Jiangsu	Huai River Xuyi	Laozishan	V	No	NH_3-N (1.28)	1

No.	Province	Control unit	Ccontrol section	Water quality classification (2005)	Compliance with the 10^{th} FYP objective	Non-compliance indices	# of non-compliance indices
102	Jiangsu	Laobian River (Sui River)	Hongze Lake Linhuai	II	Yes		
103	Jiangsu	Da Canal Huaiyin	Huaiyin	Worse than V	No	Volatile Phenol(0.023), NH_3-N (5.68)	2
104	Jiangsu	Da Canal Suqian	Suqian	IV	No		
105	Jiangsu	Da Canal Pizhou	Pizhou	Worse than V	No	Petroleum(0.14), NH_3-N (2.14)	2
106	Jiangsu	Bulao River	Linjia Dam	Worse than V	No	NH_3-N (3.60), COD_{Mn} (9.55), BOD_5(6.0)	3
107	Jiangsu	Fangting River	Tushan	Worse than V	No	NH_3-N (1.56)	1
108	Jiangsu	Peiyan River	Peixian	Worse than V	No	BOD_5 (11.3), NH_3-N (4.33)	2
109	Jiangsu	Xusha River	Shajixi Gate	V	No	Petroleum(0.98)	1
110	Jiangsu	Fuxing River	Fuxing Gate	V	No	BOD_5 (7.2)	1

2.1.3 Huai River Water Quality Changes – 1995 to 2005

1 The HRB 9^{th} FYP set up 86 "Year 2000 water quality objective" control sections. As the watershed pollution control area has expanded, the 10^{th} FYP added another 24 sections for water quality objectives. Monitoring data from the comparable control sections indicate that despite certain fluctuation in the water quality the water quality of the Huai River water bodies has been improving since 1995. The proportion of Class II-III water sections has noticeably increased from the 7.7% in 1995 to 19.8% in 2004, and the proportion of Worse than Class V sections dropped from 55.1% to 32.6%. Nevertheless, the pollution in the tributaries such as the *Bulao* and *Zhushui* rivers are still daunting.

Figure 2.1.3-1 Annual Water Quality Classification Changes at the HRB Control Sections (1995-2004)



2 The overall levels of COD_{Mn}, NH_3-N and COD_5 in the Huai River water system have been declining between the benchmark years 1995 and 2004.

Figure 2.1.3-2 Annual Changes in COD_{Mn} and NH_3-N Levels in the HRB (1995-2004)

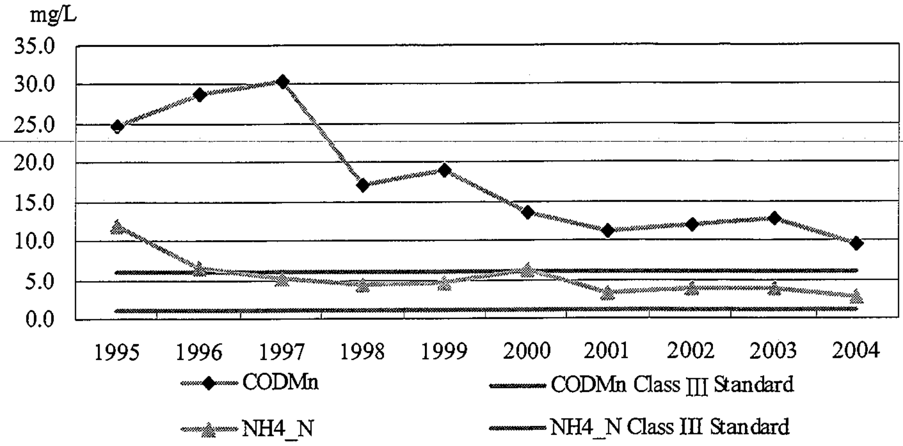
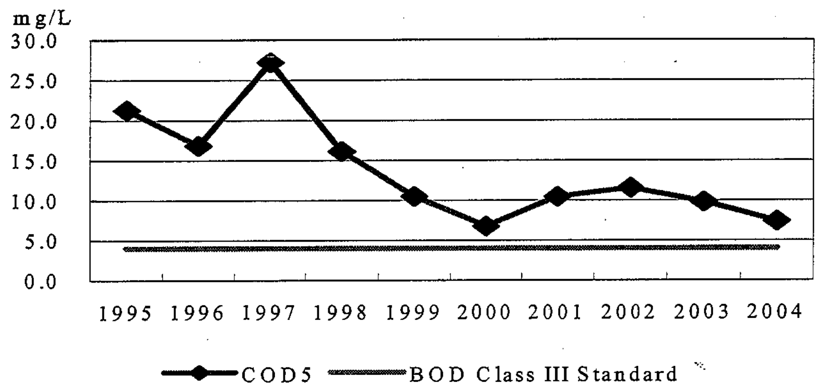


Figure 2.1.3-3 Annual Changes in COD_5 Level in the HRB (1995-2004)



2.2 Pollution TML and Load Reduction Objectives

2.2.1 Of the 9th FYP

1 According to the 9th FYP, the 1997 maximum allowed COD discharge into the HRB should be 89.02×10^4 ton, and the COD discharge into the rivers should be 36.80×10^4 ton, if the industrial sources of pollutants discharge limit were to be complied to have clear water by 2000. In reality, the 2000 the HRB COD discharge totaled 105.7×10^4 ton, and the discharge into the rivers reached 81.2×10^4 ton/year, among which domestic COD discharge approximated $67.1\text{x}10^4$ ton (63.5%). In 2000, total NH_3-N discharge reached 15.11×10^4 ton, NH_3-N discharge into the rivers reached 12.0×10^4 ton /year, among which NH_3-N discharge from domestic sources took up 61.0%.

Table 2.2.1-1 Pollutants Discharge of Provinces in the HRB (2000)

Unit: $\times10^4$ ton

Control area	Discharge in baseline year of the 9th FYP	COD discharge target of TMLL in 2000	COD discharged in 2000	% of discharge exceeding target	COD discharged into rivers in 2000	% of discharge exceeding target	NH_3-N discharged in 2000	NH_3-N discharged into rivers
Henan	38.04	12.74	30.3	137.8%	22	72.7%	5.7	4.1

Anhui	37.76	7.7	15.5	121.4%	12.4	61.0%	5.5	4.9
Shandong	47.96	6.47	25.4	292.6%	16.4	153.5%	2.1	1.3
Jiangsu	26.38	9.89	34.6	2498%	30.4	207.4%	2	1.8
Total	150.14	36.8	105.9	187.8%	81.2	120.7%	15.2	12

2 The table above indicates that the 9th FYP COD TMLL in the Huai River have been lagged behind. The major causes are likely the fast socio-economic development in the HRB during the 9th FYP and the shortfalls of the planned pollution control programs (for details, please refer to Section 4.2).

2.2.2 Of the 10th FYP

1 The *10th FYP of the HRB Water Pollution Control and Prevention* has set the TMLLs: COD discharge at 64.3×10^4 ton, discharge into the rivers at 46.6×10^4 ton; NH_3-N discharge at 11.3×10^4 ton, discharge into the rivers at 9.1×10^4 ton by 2005.

2 Table 2.2.2-1 exhibits the survey results of the 2005 provincial urban wastewater discharge in the HRB. In 2005 industrial wastewater and total urban domestic wastewater discharge reached 35.10×10^8 ton in the HRB, where total domestic wastewater discharge accounted for 65.84%.

Table 2.2.2-1 Wastewater Discharge of Provinces in the HRB (2005)
Unit: $\times10^8$ ton

Area	Industrial wastewater discharge	Domestic wastewater discharge	Total
Jiangsu	3.6108	8.0359	11.6467
Anhui	2.2426	3.7847	6.0273
Shandong	3.2419	3.7228	6.9647
Henan	2.8948	7.5661	10.4609
Total	11.9901	23.1095	35.0996

Source(s): CNEMC

3 Table 2.2.2-2 exhibits the survey results of urban COD discharge in urban areas of the HRB in 2005.

Table 2.2.2-2 COD Discharge Amount of Major Urban Areas in the HRB (2005)
Unit: Ton

Areas	Industrial COD discharge	Domestic COD discharge	Total COD discharge	COD discharge target TMLL in 10th FYP	% of COD discharge exceeding target TMLL
Jiangsu	56426.5	284414.9	340841.4	248200	37.33%
Anhui	28379.4	111080.2	139459.6	118185	18.00%
Shandong	64401.8	128678	193079.8	88970	117.02%
Henan	72059.1	200238.1	272297.2	187345	45.35%
Total	221266.8	724411.2	945678.0	642700	47.14%

Source(s): CNEMC and the 10th FYP

4 The COD discharge totaled 94.57×10^4 ton in the HRB, where 34.08×10^4 ton are in Jiangsu Province, 27.23×10^4 ton in Henan Province, 19.31×10^4 ton in Shandong Province, and 13.95×10^4 ton in Anhui Province. The COD discharge of each province has exceeded the COD TMLL of the 10th FYP, and the average non-compliance rate reached as high as 47.14%. Particularly Shandong Province has discharged an extra of 117.02% COD into the HRB.

5 The HRB major urban NH_3-N discharge amounts in 2005 are shown in Table 2.2.2-3.

Table 2.2.2-3 Pollutant Discharge of Main Urban Areas in the HRB (2005)
Unit: Ton

Area	Industrial NH_3-N discharge	Domestic NH_3-N discharge	Total NH_3-N discharge	NH_3-N discharge target TMLL in 10th FYP	% of NH_3-N discharge exceeding target TMLL
Jiangsu	4432.1	31117.8	35549.9	15800	125.00%
Anhui	9713.8	14937.7	24651.5	35500	-30.56%
Shandong	8220.0	16585.6	24805.6	16500	50.34%
Henan	12862.6	28283.5	41146.1	44953	-8.47%
Total	35228.5	90924.6	126153.1	112753	11.88%

Source(s): CNEMCand the 10th FYP

6 The NH_3-N discharge within the HRB totaled 12.62×10^4 ton, where 3.55×10^4 ton are from the Jiangsu Province, 4.11×10^4 ton from the Henan Province, 2.48×10^4 ton from Shandong, and 2.47×10^4 ton from Anhui. Measured against the NH_3-N discharge TMLL target of the 10^{th} FYP, Anhui and Henan provinces met the targets, but the rate of extra discharge of Jiangsu reached 125.00%, and Shandong reached 50.34%. For the overall watershed, the aggregated NH_3-N discharge still exceeds the TMLL target by 11.88%.

7 The major reasons that the 4 provinces in the HRB failed to reach the 10^{th} FYP TMLL targets are (1) the socio-economic development exceeding the expected rate, and (2) falling short in the implementation of the pollution control programs.

2.3 Investment in Pollution Control Programs

2.3.1 During the 9^{th} FYP

2.3.1.1 Planned Investment

1 The 9^{th} FYP has listed 303 water pollution control and prevention programs in the HRB with a total required investment of 166×10^8 yuan. The investment requirements of the programs are listed in Table 2.3.1.1-1 and Table 2.3.1.1-2.

Table 2.3.1.1-1 Investment Request List of Programs in the HRB 9^{th} FYP
Unit: 10^8 yuan

Types of program	Henan Province	Anhui Province	Shandong Province	Jiangsu Province	Total
Basic capacity building					0.83
Agriculture ecological engineering					1.34
Drinking water engineering	0	2.3	0.30	2.01	4.61
Drinking water - deep well engineering	0.39	0.6	0.69	0.68	2.36
Demonstration engineering	11.94	7.75	21.00	3.80	44.49
Industry structure improvement - Clean production engineering	1.48	4.07	1.51	2.87	9.93
Technical reform for the pollution sources	2.70	5.41	1.99	0.20	10.30
Industrial point sources control	12.84	12.25	7.54	1.98	34.61
Municipal WWTPs	23.19	9.59	15.85	8.90	57.53
Total	52.54	41.97	48.88	20.44	166.00

Source(s): The 9^{th} FY P for the HRB Water Pollution Prevention and Control

Table 2.3.1.1-2 Number of Program List in the HRB 9th FYP

Types of program	Henan Province	Anhui Province	Shandong Province	Jiangsu Province	Total
Basic capacity building					2
Agriculture ecological engineering					1
Drinking water engineering		2	1	3	6
Drinking water - deep well engineering	1	1	1	1	4
Demonstration engineering	7	3	6	1	17
Industry structure improving - Clean production engineering	4	5	3	5	17
Technical reform for the pollution sources	6	16	13	1	36
Industrial point sources control	56	25	57	15	153
Municipal WWTPs	19	17	14	17	67
Total	93	69	95	43	303

Source(s): The 9th FY P for the HRB Water Pollution Prevention and Control

2.3.1.2 Actual Investment

1 As the reliable information regarding the 9th FYP investment funding is unavailable[2], the following analysis will focus on the investment of the WWTPs construction and pollution control programs and will give special emphasis on the funding sources for the drinking water projects implementation.

2 Program implementation.

(1) Construction of the WWTPs

3 According to the requirements in the 9th FYP, the HRB should have 67 WWTPs constructed by the end of 2000. Later this number has been adjusted to 52 WWTPs. However, according to SEPA's *Progress Report on the HRB Water Pollution Control and Prevention* in June 2001, only 11 of the 52 planned WWPTs have begun operation, 28 were still under construction, and the remaining 13 were yet to be started. The total WWT capacity constructed and under construction within the 4 the HRB provinces accounts to 3125×10^4 ton/day, or 86%, of the planned capacity. By 2000, the municipal WWT capacity in the HRB was only 4.7×10^8 ton/year, and WWT rate 19%, nearly 15% below the national average.

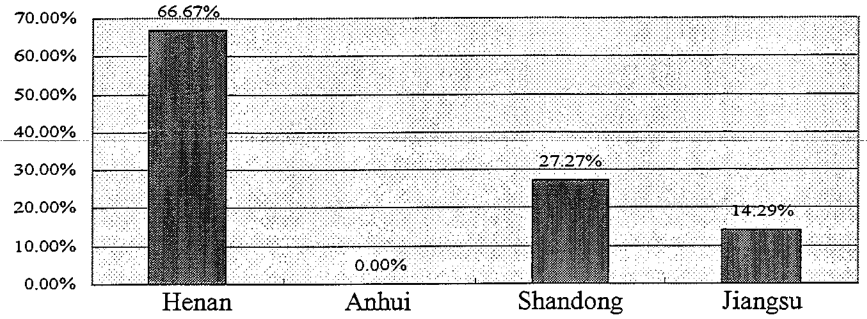
Table 2.3.1.2-1 WWTP Construction Progress in the End of the HRB 9th FYP

Province	Total # of projects (original in 9th FYP)	Total # of projects (revised)	# of projects completed	# of projects under construction	# of projects not started
Henan	19	9	6	3	0
Anhui	17	18	0	10	8
Shandong	14	11	3	8	0
Jiangsu	17	14	2	7	5
Total	67	52	11	28	13

Source(s): Report on the HRB Water Pollution Control and Prevention, SEPA, June 2001

[2] The information regarding implantation of the proposed 9th FYP investment spread throughout various offices from the central to local governments. The monitoring, administration, and summarizing are not conducted systematically. For details, please refer to the "Institutional Review and Evaluation."

Figure 2.3.1.2-1 Completion Rate of Municipal WWTPs in the HRB during the 9th FYP

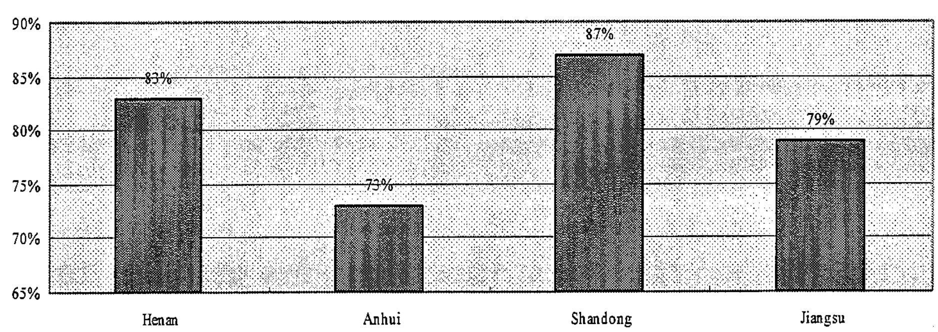


Source(s): Progress Report on the HRB Water pollution Control and Prevention, SEPA, June 2001.

(2) Pollution Control Programs.

4 Eighty-two percent of the planned pollution control programs (including drinking water guarantee, industrial restructuring, clean production, wastewater centralized treatment projects, et al.) have been completed by the end of 2000. Thirty-seven were under construction, and the remaining 32 were not yet started. The details of each province's implementation are show in the figure below.

Figure 2.3.1.2-2 Completion Rate of the Pollution Control Programs in the HRB Provinces during the 9th FYP



Source(s): Progress Report on the HRB Water Pollution Control and Prevention, SEPA, June 2001

5 Nearly 3000 wells were drilled in the 4 the HRB provinces to solve the drinking water issue of 6 million people in the heavily polluted area. Another 2.4×10^8 yuan were invested to build the water and wastewater diversion projects to resolve the drinking water issue of over 2 million people in heavily polluted areas such as Jiangsu *Xuyi*, *Lianyungang* Rose River, Anhui *Bengbu, Huainan.*

2.3.2 During the 10th FYP

2.3.2.1 Planned Investment

1 The 10th FYP has planned 488 projects under 9 categories with a total investment of 255.9×10^8 yuan in municipal WWT projects, industrial restructuring, comprehensive

industrial point sources control, integrated watershed pollution control, water and wastewater diversion project, drinking water project, capacity building, municipal solid waste treatment center, and agricultural non-point sources pollution control.

Table 2.3.2.1-1 Provincial Investment Plan in the 10th FYP

Unit: 10^8 yuan

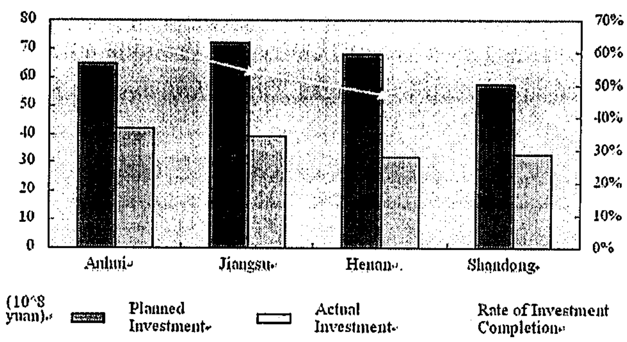
Types of program		Anhui	Henan	Jiangsu	Shandong	Total
Municipal WWT plant	# of project	29	34	46	52	161
	Investment	31.2	31.4	57.7	28.6	148.9
	Capacity ($x10^4$ ton/day)	133	149	208	123.5	613.5
Industry structure improving - Clean production engineering	# of project	19	20	5	87	131
	Investment	9.5	5	1.4	8.1	24
Technical reforms for the pollution source reduction	# of project	14	26	12	64	116
	Investment	6.1	5.9	1.7	3.6	17.3
Comprehensive watershed pollution control and ecological demonstrate engineering	# of project	9	8	5	7	29
	Investment	10.1	8.4	4.7	7.8	31
Sewage engineering	# of project	0	0	4	11	15
	Investment	0	0	6.4	6.5	12.5
Drinking water engineering	# of project	1	1	1	0	3
	Investment	1.4	0.9	0.5	0	2.8
Basic capacity building	# of projects	4	3	3	3	13
	investment	1.5	1.2	0.2	3	5.9
Municipal refuse disposal plant	# of project	4	7	3	0	14
	Investment	4.1	2.2	2.6	0	8.9
Agriculture non-point sources pollution control	# of project	3	1	1	1	6
	Investment	0.9	1	1	1	3.9
Total	# of project	83	100	80	225	488
	Investment	64.8	56.1	76.4	58.6	255.9

Source(s): the HRB Water Pollution Control and Prevention 10th FYP

2.3.2.2 Actual Investment

1 Figure 2.3.2.2-1 exhibits the actual investment in the HRB provinces during the 10th FYP.

Figure 2.3.2.2-1 Actual Investment in the HRB Provinces



Source(s): Progress reports of each the HRB provinces on water pollution control and prevention during the 10th FYP.

Table 2.3.2.2-1Conditions of Each Province Investment Fulfilled

Province	Investment designed ($x10^8$ yuan)	Investment fulfilled ($x10^8$ yuan)	% of fulfilled to designed investment
Anhui Province	64.78	42.10	64.99%
Jiangsu Province	72.40	40.63	56.11%
Henan Province	68.08	32.00	47.00%
Shandong Province	57.50	30.95	53.82%

Source(s): Evaluation Report on the Performance of Each Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control

2 Table 2.3.2.2-2 and Table 2.3.2.2-5 exhibit the project implementation and actual investment in each HRB province.

Table 2.3.2.2-2 Conditions of Project Completion and Investment Fulfilled for the 10th FYP of Anhui Province

No.	Types of program	# of Projects	Investment designed ($x10^4$ yuan)	Investment fulfilled ($x10^4$ yuan)	% of investment fulfilled	% of project completed	% of project started
1	WWTP engineering	29	312000	126237	40.50	13.79	48.28
2	Municipal refuse disposal plant	4	41489	11889	28.70	75.00	75.00
3	Point source control project	14	60690	60690	100	100	100
4	Industry structure improvement project	19	94958	93307.3	98.30	94.74	100
5	Regional comprehensive treatment project	9	101000	92460	91.50	55.56	100
6	Rural area non-point source control project	3	8800	7525	85.50	100	100
7	Drinking water project	1	14000	14000	100	100	100
8	Basic capacity building project	4	14869	14869	100	100	100
Total		83	647806	420977.3	65.00	62.65	80.72

Note: Ratio of project started=projects under construction and completion/all projects designed.
Source(s): Evaluation Report on the Performance of Anhui Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control

3 The table above indicates that the completion rates of the WWT and solid waste treatment center construction projects are much lower than the project starting rate. The major reason for the low completion rate is the large amount of investment required but limited sources of financing for the WWT and solid waste treatment center construction projects.

Table 2.3.2.2-3 Conditions of Project Completion and Investment Fulfilled for the 10th FYP of Jiangsu Province

No.	Types of program	# of Projects	Investment designed ($x10^4$ yuan)	Investment fulfilled ($x10^4$ yuan)	% of investment fulfilled	% of projects completed	% of projects started
1	WWTP engineering	46	577000	340741	59.05	63.04	100
2	Municipal refuse disposal plant	3	26000	11000	42.31	66.67	100
3	Comprehensive measures for the industrial pollution control	12	17000	16650	97.94	100	100

4	Industry structure improvement project	5	14000	13500	96.43	100	100
5	Rural area non-point source control project	1	10000	10000	100.00	100	100
6	Watershed comprehensive treatment project	5	50000	4230	8.46	0	100
7	Sewage project	4	64000	4000	6.25	0	75.00
8	Drinking water project	1	5000	5200	104.00	100	100
9	Environmental supervision capacity building	6	2000	950	47.50	83.33	100
Total		83	765000	406271	53.11	66.27	98.80

Source(s): Evaluation Report on the Performance of Each Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control.

4 For Jiangsu Province, except the low actual investment in WWTP and solid waste treatment construction, the actual investment in comprehensive regional pollution control programs is only 8.46% of the planned volume, due to the large investment amount required and the unsecured sources of financing. Meanwhile, the completion rate of water and wastewater diversion project investment is only 6.25%. A major reason for this is that these 4 programs are all pollution control programs under then SNWD Eastern Line program and are subject to the coordinated project preparation under Shandong SNWD Office, thus having a relatively longer project preparation period. In addition, the program requires 6 environmental protection capacity building projects, 5 of which are water quality automated monitoring stations that have been built, the 6th is the construction of the SNWD East Line Jiangsu Section Automatic Monitoring Center. Because Jiangsu Province has been building the automated environmental information automatic monitoring system, this monitoring center will not be constructed as a part of the Jiangsu Province program.

Table 2.3.2.2-4 Conditions of Project Completion and Investment Fulfilled for the 10th FYP of Henan Province

No.	Types of program	# of Projects	Investment designed ($x10^4$ yuan)	Investment □fulfilled ($x10^4$ yuan)	% of investment □fulfilled	% of projects completed	% of projects started
1	WWTP engineering	34	339504	166955	49.18	23.53	64.71
2	Municipal refuse disposal plant	7	23139	3791	16.38	14.29	28.57
3	Comprehensive measures for the industrial pollution control	26	53343	14849	27.84	80.77	88.46
6 4	Industry structure improvement - Clean production engineering	20	160627	42346	26.36	90.00	90.00
5	Watershed comprehensive treatment project	8	73000	53380	73.12	37.50	87.50
6	Rural area non-point source control project	1	10000	10000	100	100	100
7	Drinking water project – well construction	1	9125	20000	219.18	100	100

No.	Types of program	# of Projects	Investment designed (x10^4 yuan)	Investment □fulfilled (x10^4 yuan)	% of investment □fulfilled	% of projects completed	% of projects started
8	Capacity building	3	11600	18138	156.36	100	100
Total		100	680338	329459	48.43	56.00	77.00

Source(s): Evaluation Report on the Performance of Henan Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control

5 Different from the provinces mentioned above, Henan Province has low completion rates (<30%) of industrial firm-level comprehensive pollution control and industrial restructuring investment, but the overall rate of completion reached over 80%. This is because that 20 projects were not built but counted as “completed” due to significant changes in the firm conditions that the original projects could no longer been carried out.

Table 2.3.2.2-5 Conditions of Project Completion and Investment Fulfilled for the 10th FYP of Shandong Province

No.	Types of program	# of Projects	Investment designed (x10^4 yuan)	Investment fulfilled (x10^4 yuan)	% of investment fulfilled	% of projects completed	% of projects started
1	WWTP engineering	48	303800	241624.38	79.53	52.08	100
2	Point source pollution control project	64	36000	26712	74.20	100	100
3	Industry structure rectifying	87	81000	24850.3	30.68	100	100
4	Sewage project	11	65000	0	0	0	0
5	Regional comprehensive treatment project	7	78000	16300	20.90	57.14	100
6	Rural area non-point source control project	1	10000	-	-	100	100
7	Capacity building	3	30000	-	-	100	100
Total		221	603800	309486.68	51.26	83.26	95.02

Source(s): Evaluation Report on the Performance of Shandong Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control

6 In the table above, point sources control, industrial restructuring, rural non-point sources control, and capacity building programs have all been completed. The reported data often do not include the rate of investment completion, making a much lower rate of investment completion than the rate of project completion. However, the survey results suggest that due to the lack of clear implementation evaluation criteria, the current rate of project completion may not be as accurate as one wishes. Meanwhile, the original 52 WWT projects listed under the 10th FYP in Shandong Province have been adjusted to 48 (8 planned township WWTPs and the *Linyi* WWT reuse plant have been dropped, and another 5 additional WWTPs projects have been added).

3. Indicator System

3.1 Of the 9th FYP

3.1.1 9th FYP Indicator System

(1) River Water Quality Control Sections Water Quality Requirements

1 Eighty-two representative sections for drinking water source protection areas, major river downstream control sections, and province boarder sections have been selected for water quality monitoring and evaluation of the provincial compliance results.

(2) National Water Pollutants Discharge Standards Enforced for Industrial Discharge

2 Distinguish fates of different industrial pollution sources: Sources discharged into Class III functional surface water systems will adopt primary standards (Grade I); sources into Class IV and V functional surface water systems secondary standard (Grade II); and sources into the urban sewage the tertiary standard (Grade III). Non-compliance will be totally banned starting January 1st, 1998.

Table 3.1.1-1 Industrial Wastewater Discharge COD Standard in the HRB

Unit: mg/L

Class	General industry	Special Industry					
		Papermaking industry			Meat treatment	NH_3-N industry	Textile industry
		Wooden pulp	Non-wooden pulp	Paper making			
Grade I	150	100	100	100	80	100	100
Grade II	200	350	450	150	120	150	180
Grade III	500	800	900	500	500	300	500

(3) TMLL Targets for Major Indicators

3 The TMLL of the major discharge points are determined according to the surface water environment quality standards and the major objectives of the Huai River water quality.

(4) Minimum Pollution Reduction Targets at City and County Levels

4 Setting 1993 as the baseline year, the minimum pollution reduction targets are city and county levels are: 10% by 1995, 15% by 1996, and by 1997 all industrial sources of pollution should meet the discharge targets.

(5) Backward Industrial Equipment Elimination Standards

5 Factories such as pulping equipment in the paper mills with an annual production under 5000 tons, and tanneries with an annual production under 10×10^4 sheets should be eliminated by June 30th, 1996.

6 The above 5 targets should be achieved concurrently, since failure to meet any of the 5 targets will impact the overall environmental quality and affect the overall objective.

3.1.2 Analysis of the 9th FYP Indicators

1 The indicator system of the 9th FYP of the HRB water pollution control and prevention incorporates water quality, TML, program, investment. It emphases the natural attributes of the rivers and targets at a comprehensive set of water quality objectives, TMLL objectives, construction program objectives, and investment requirement objectives tailored to the various water environment issues after integrating the consideration of water quality objectives and the environmental capacity.

2 The 9th FYP the HRB objectives can only be achieved through executing the planned programs and the thorough implementation of strong environmental policies at various levels of governments. Under the scenario of a weak safeguard system for the project and policy implementation, the indicator system will be exposed to high risks – if any problem occurs in the link, the plan objectives could be threatened.

3 An interesting phenomenon during the implementation of the 9th FYP is the coupled proactive regulatory management through environmental policies with the low actual rate of project investment. Through the 2000 HRB "Condition Zero @ Zero Time (CZZT)" Action[3], the central government and the 4 provincial governments in the HRB implemented proactive environmental policies. Many planned policy guarantee tasks, such as shutting off "the "Small Fifteen"[4] at a wide scope, and the mandatory compliance of industrial discharge, have been fulfilled and brought visible results to stabilizing HRB water quality and TML reduction. Nevertheless, other problems have occurred. The implementation of various environmental policies and management measures has outpaced that of pollution control programs, leaving the actual watershed water pollution control investment and project implementation during the 9th FYP behind and the plan objectives unfulfilled.

4 In summary, the indicator system of the HRB 9th FYP is established based on an idealized implementation environment for policies and programs. It does not take into consideration the constraints from the socio-economic and environmental policy conditions and the government and public awareness. However, the lessons from the 9th FYP indicator system has provided technical reference to the later 10th and 11th FYPs, It clearly raised the importance of integrated indicator system that combines water quality, TML, programs, and investment and provides invaluable technical insights to the water pollution problem, control measures at the watershed level.

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[3] A special environmental protection action that SEPA has taken with no "conditional" situations at the dawn of the new year for the Huai River water pollution control and prevention.

[4] The "Small Fifteen" refers to the 15 types of small enterprises banned by the *Decisions on Several Issues regarding Environmental Protection by the State Council* in 1996: paper mills with an annual production under 5000 ton; tanneries with an annual production under 30000 standard cowhide; dye works with an annual production under 500 ton; coking enterprises employing backward sulfur and arsenic refining methods; smelting plants of Hg, Pb, and zinc; refineries of oil and gold with backward production methods; the election of the pesticide, dyeing, electroplating; and the production of asbestos and radioactive products.

3.2 Of the 10th FYP

3.2.1 10th FYP Indicators

1 Through the experiences from the implementation of the 9th FYP, the HRB indicator system for the 10th FYP has been adjusted to include only:

- Water environment quality indicators: COD_{Mn}; reference indicator: ammonia nitrogen (NH_3-N)
- Indicators for pollutants discharge and TMLL of discharges into the river: chemical oxygen demand (COD_{cr}), ammonia nitrogen (NH_3-N)

2 due to a number of factors: (1) the compliance rate of industrial wastewater discharge from the environmental statistics, and (2) the fact that industrial wastewater compliance to the national water pollutants discharge standards and backward industrial equipment elimination in industrial restructuring have been basically accomplished.

3.2.2 Analysis of the 10th FYP Indicators

1 The indicator system of the HRB water pollution control and prevention during the 10th FYP differs from that of the 9th FYP in several aspects: (1) It has been "simplified" from the 9th FYP indicator system in water quality and TMLL so as to increase the viability of the Plan objectives. (2) Changes posed to the watershed brought about by the SNWD program – significantly increased water quality and partially overlapping but different indicators – brought about further changes to the implementation of originally planned the HRB projects. (3) The 10th FYP on the HRB emphases more on environmental regulation and law enforcement and less on imposing "command-and-control" policies that mandate for standards higher than the national standards. The emphasis on law enforcement, discharge standards, national industrial adjustment policies, and the execution of pollution control programs is a major difference between the 10th and the 9th FYP indicator systems.

2 The implementation results of the 10th FYP suggest improvements from the 9th FYP implementation in a number of ways: more actual investments have been put into the pollution control programs than during the 9th FYP; water quality pollution has been tamed to a certain degree, and the water quality in the water bodies shows signs of restoration; and significant reduction in total pollutants discharge has been observed in 2005. However, still certain objectives are still to be met.

3 In summary, the indicator system of the 10th the HRB FYP is fine toned from the 9th FYP indicators based on the experiences and lessons learned from the former FYP. The objectives reflect better the watershed socio-economic conditions and have adjusted the expectations. By 2005, although not all the objectives have been accomplished, the rate of completion has been higher than that of the 9th FYP.

4. Sources of and Factors Impacting Pollutants Discharge

4.1 Sources of Pollutants Discharge

4.1.1 Industrial Point Sources

4.1.1.1 During the 9th FYP

1 The 2000 the HRB industrial COD discharge was 38.8×10^4 ton, or 37% of the total COD discharge. If the additional 3.2×10^4 ton industrial COD added to the watershed due to enlargement of the official water basin area were to be excluded from calculation, then the total the HRB industrial COD should be 35.6×10^4 ton, or 38% of total COD discharge.

2 Comparing to 1993, the 2000 industrial COD discharge reduced by 77%.

4.1.1.2 During the 10th FYP

1 The pollutants discharge statistics claimed by the firms suggest that in 2005 the total industrial wastewater 12.0×10^8 ton, while the figure for 2000 was wastewater 12.0×10^8 ton, indicating a reduction of 4.6×10^8 ton, or an average annual reduction of 6.3% during the 10th FYP.

2 The 2005 COD discharge from industrial wastewater totaled 22.1×10^4 ton, showing a 16.7×10^4 ton reduction from the 2000 level (38.8×10^4 ton), indicating an average annual reduction of 10.6%.

3 The 2005 NH_3-N discharge from industrial wastewater totaled $3.5\times10^4\times10^4$ ton. The detailed discharge amounts of each province can be found in Table 4.1.1.2-1. A comparison between the 2005 and 2000 NH_3-N discharge is unavailable due to the lack of 2000 NH_3-N statistics.

Table 4.1.1.2-1 Industrial Wastewater and Pollutant Discharge of the Provinces in the HRB (2005)

Province	Wastewater discharge ($x10^8$ ton)	Ratio (%)	COD discharge ($\times10^4$ ton)	Ratio (%)	NH_3-N discharge ($\times10^4$ ton)	Ratio (%)
Jiangsu	3.61	30.11	5.6	25.50	0.4	12.58
Anhui	2.24	18.70	2.8	12.83	1.0	27.57
Shandong	3.24	27.04	6.4	29.11	0.8	23.33
Henan	2.89	24.14	7.2	32.57	1.3	36.51
Total	11.99	100.00	22.1	100.00	3.5	100.00

Source(s): CNEMC

4.1.2 Domestic Wastewater Discharge

4.1.2.1 During the 9th FYP

1 The 2000 the HRB domestic COD discharge was 67.1×10^4 ton, or 63% of the total COD discharge. If the additional 8.6×10^4 ton domestic COD added to the watershed due to

enlargement of the official water basin area were to be excluded from calculation, then the total the HRB domestic COD should be 58.5×10^4 ton, or 62% of total COD discharge.

2 Comparing to 1993, the 2000 domestic COD discharge reduced by 107%.

Table 4.1.2.1-1 Trend of COD Discharge in the HRB during the 9th FYP

Year	1993	1997	2000
COD discharge (x10^4 ton/year)	188	92	94
Industrial COD discharge (x10^4 ton/year)	160	47	36
Ratio (%)	85	51	37
Domestic COD discharge (x10^4 ton/year)	28	45	58
Ratio (%)	15	49	62

3 Table 4.1.2.1-1indicates fast growth of domestic COD discharge: a mere 15% of total COD discharge in 1993 grew into near 50% in 1997 and a majority 62% in 2000.

4.1.2.2 During the 10th FYP

1 In 2005, the total COD discharge in the HRB was 94.57×10^4 ton, of which domestic discharge took up 76.6%; the total NH_3-N discharge was 12.62×10^4 ton, of which domestic discharge took up 72.1% (Table 4.1.2.2-1).

Table 4.1.2.2-1 Ratio of Domestic Pollutants to Total Amount in 2000 and 2005 the HRB

Item	Total COD discharge	Domestic COD discharge	Total NH3-N discharge	Domestic NH3-N discharge
Total discharge in 2000 (x10^4 ton)	105.74	67.06	15.11	9.22
Ratio		63.5%		61.0%
Total discharge in 2005 (x10^4 ton)	94.57	72.44	12.62	9.09
Ratio		76.6%		72.1%

Source(s): CNEMC

2 The table above indicates that by both COD and NH_3-N, the pollutants discharge from domestic wastewater in the HRB has exceeded 60% of total pollutants discharge in the HRB by 2000. Accordingly, the 10th FYP has set the pollution control of domestic sources in the HRB as the priority of pollution control.

3 Table 4.1.2.2-2 summarizes domestic wastewater and pollutants discharge of each province in the HRB in 2005 from the survey results.

Table 4.1.2.2-2 Domestic Wastewater and Pollutant Discharge in 2005 the HRB

Province	Wastewater discharge (x10^8 ton)	Ratio (%)	COD discharge (x10^4 ton)	Ratio (%)	NH3-N discharge (x10^4 ton)	Ratio (%)
Jiangsu	8.04	34.77	28.4	39.26	3.1	34.22
Anhui	3.78	16.38	11.1	15.33	1.5	16.43
Shandong	3.72	16.11	12.9	17.76	1.7	18.24
Henan	7.57	32.74	20.0	27.64	2.8	31.11
Total	23.11	100.00	72.4	100.00	9.1	100.00

Source(s): CNEMC

4 The urban residential domestic wastewater discharge in the HRB totaled 23.11×10^8 ton in 2005, where 8.04×10^8 ton was from Jiangsu Province, 3.78×10^8 ton from Anhui Province, 3.72×10^8 ton Shandong Province, and 7.57×10^8 ton from Henan Province.

5 The 2005 domestic COD discharge in the HRB totaled 72.4×10^4 ton, a 15% increase compared to 2000. Of the total discharge, Jiangsu Province contributed 28.4×10^4 ton, Anhui Province 11.1×10^4 ton, Shandong Province 12.9×10^4 ton, and Henan Province 12.9×10^4 ton.

6 In 2005, the total domestic NH_3-N discharge in the HRB was 9.1×10^4 ton, where Jiangsu Province contributed 3.1×10^4 ton, Anhui Province 1.5×10^4 ton, Shandong Province 1.7×10^4 ton, and Henan Province 9.1×10^4 ton.

7 Compared to 2000, the total NH_3-N discharge in the HRB decreased from 15.11×10^4 ton to 12.62×10^4 ton; however, the percentage of domestic NH_3-N discharge increased from 62.0% to 72.1%.

4.1.3 Agricultural Non-Point Sources Discharge

4.1.3.1 Non-Point Sources and Pollution Pathways in the HRB

1 The major non-point sources in the HRB include the livestock raising and husbandry, farmland nutrients loss, rural domestic, plantation wastes, and aquaculture. The survey results suggest that there is no systematic monitoring of non-point sources pollution in the HRB; therefore, reliable data on non-point sources discharge and the intensity of the discharged pollutants and their contribution to the water body pollution are not available. Particularly, important indicators of non-point source pollution such as N and P were not selected as mandatory monitoring indicators in the past decades; therefore, no systematic or comprehensive data are available either N or P, leaving insufficient clue to estimate the percentage share of point and non-point source pollutions. Only rough estimation through the production of the 5 major non-point sources and the pathways of pollutants entering the water bodies suggests that the most significant contributing non-point sources of the HRB be livestock raising and husbandry, farmland nutrients loss, and rural domestic living.

2 The HRB has a long history of livestock raising and husbandry. The number of stocks raised on per unit land is approximately 4 times that of the national average (Table 4.1.3.1-1). The trend line from 1995 to 2004 shows that the number of large livestock (cattle, horses, and mules) is reducing as a result of increased mechanization that reduces the need of cattle, horses, and mules. On the other hand, the number of pigs and poultry has been increasing constantly. An MOA survey in 2005 indicates that

3 The livestock manure generation in the 4 the HRB provinces totals to 4.1×10^8 ton, approximately 24% of the national total's; however, its actual collection rate[5] is lower than 60%, and the rate of utilization of livestock raising and husbandry wastes is lowered than 44% (MOA survey data, 2005).

[5] The effective collection rate refers to the rate of utilization after the Manures are collected.

Table 4.1.3.1-1The Large Livestock, Pig and Poultry Quantity of Unit Area in the HRB
Unit: head/km^2

Type	Total of the 4 provinces in the HRB	Jiangsu	Anhui	Shandong	Henan	Nationwide average
1995						
Large Livestock	65.5	11.6	51.6	93.2	85.8	16.7
Pig	155.2	198.6	111.7	158.3	161.2	46.5
Poultry	2598.4	3064.3	1209.2	4171.6	1981.7	432.2
2000						
Large livestock	56.6	7.0	39.9	72.6	87.3	15.9
Pig	177.8	188.9	132.6	169.4	216.7	47.0
poultry	4510.7	5369.2	3320.0	6951.1	2650.3	851.9
2004						
Large livestock	54.8	6.9	33.1	69.3	90.1	16.6
Pig	264.1	280.2	180.6	275.7	313.5	65.0
Poultry	5553.3	5461.4	3443.0	9349.4	3797.2	954.1

Source(s): China Agricultural Yearbook, 1996, 2001, 2005. Note: The head number of large livestock, pig and poultry is the amount of livestock on hand in the end of the year.

4 As a major area of crop production of China, the HRB has been using N- and P-fertilizers intensively. Since 1995, its N-fertilizer usage (including N-fertilizer and N in the compound fertilizer) is some 37%-63% higher than the national average; its P-fertilizer usage (including P-fertilizer and P in the compound fertilizer) is some 45%-79% higher than the national average (Table 4.1.3.1-2). Between 1995 and 2004, the N-fertilizer usage in unit sowed land has increased although the increase is insignificant in the HRB. Jiangsu and Shandong provinces even saw decrease in usage in 2004. The two major reasons for the stabilized usage are the soaring price of fertilizers since 1999 and the low marginal effectives after the persistent high usage of N-fertilizer over a relatively long period of time. During the same period, the 4 the HRB provinces continued to see intensity increase of P-fertilizer usage per unit sowed land in the HRB, with the only exception of Jiangsu Province between 2000 and 2004, where the P-fertilizer usage has stabilized. The soil in the HRB has relatively low water retention ability, and N and P tend to be washed away with the surface runoff. However, the survey results suggest that currently there are no effective methods employed to estimate the loss of N and P nutrients in the watershed.

Table 4.1.3.1-2 Dosage of Chemical Fertilizer in Unit Plantation in the 4 Province of the HRB
Unit: KgN, P_2O_5/ha

Year	1995	2000	2004	1995	2000	2004
	Nitrogen fertilizer			Phosphor fertilizer		
4 Provinces in the HRB	291.6	309.6	319.1	96.2	136.9	150.9
Jiangsu	397.2	425.9	417.3	99.1	153.0	151.6
Anhui	246.8	235.8	239.7	91.6	108.9	121.8
Shandong	282.4	314.6	312.1	80.3	131.5	146.2
Henan	259.8	286.5	323.0	112.7	152.7	176.4
Nationwide average	212.9	189.7	201.8	66.6	76.6	87.5

Source(s): China Agricultural Yearbook, 1996, 2001, 2005.

Table 4.1.3.1-3 Rural Population of Unit Area in the 4 Province of the HRB

(population/km^2)

Year	1995	2000	2004
The 4 Province of the HRB	458.4	425.1	447.1
Jiangsu	592.6	449.7	492.0
Anhui	353.2	360.2	371.0
Shandong	453.1	418.1	448.4
Henan	466.1	470.8	481.4
Nationwide average	96.4	96.2	99.1

Source(s): China Agricultural Yearbook, 1996, 2001, and 2005.

5 The HRB has a high rural population density. Registered rural population per unit area between 1995 and 2004 approximates 3.4-4.8 times that of the national average (Table 4.1.3.1-3). However, since quite a share of the total labor in the Anhui, Henan, Shandong and northern Jiangsu provinces within the watershed has been working in the urban areas away from home, the actual population intensity on the land will be lower than the statistics would suggest. Most of the domestic solid wastes are not collected or treated, creating another source of non-point pollutions.

6 The HRB has a high production of straw, and most of the straw harvest has been used as fuel or animal feed; those remaining in the field would be considered as wastes and burnt on site. Such treatment creates air pollution, and part of the NO_x from burning will return to the ground with precipitation and enter the water bodies. However, there is no monitoring data to illustrate its impact on the water quality.

7 The total freshwater aquaculture in the 4 provinces in the HRB accounts to approximately 30% of the national total. Jiangsu and Anhui are the major provinces freshwater aquaculture in the area and have been having steadily increasing freshwater aquaculture between 1995 and 2004 (Table 4.1.3.1-4). Currently the aquaculture technologies are developing into an industry of high density, high inputs, and high outputs. The various feeds, fertilizers, and medicines added to the water and the excreta and feed residuals have become important sources of water pollution.

Table 4.1.3.1-4 Areas of Freshwater Aquaculture in the 4 Provinces in the HRB

Unit: ha

Year	1995	2000	2004
The 4 Province in the HRB	1338080	1545376	1704372
Jiangsu	467290	561873	633966
Anhui	496810	549262	589133
Shandong	199720	245091	277547
Henan	174260	189150	203726
Nationwide total	4669340	5277732	5663800

8 Among the 5 major non-point pollution sources, livestock husbandry, farmland nutrients loss, rural domestic discharge, plantation wastes, and aquaculture, only wastewater from husbandry near the rivers and aquaculture in the rivers could be discharged directly into the rivers. The major pathway for the HRB non-point pollution to enter the rivers is through the surface runoff. A small portion would penetrate through the groundwater (Table 4.1.3.1-5).

Table 4.1.3.1-5 HRB Major Non-Point Sources Pollution Pathways

Non-point Sources	Pollution Pathways
Livestock	Except for direct discharge of wastewater from aquacultural sites near the rivers, a major pollution pathway is through the surface runoff from washing off the casual stacking of organic wastes.
Nutrient loss from farmland	N and P nutrients enter the water bodies through surface runoff.
Household	Rural domestic wastewater, human excreta and rural domestic solid waste enter into the water bodies mainly through surface runoff.
Aquaculture	In freshwater aquaculture in the rivers, excessive feed and excreta from fish sink directly into rivers; in other aquaculture, pollutants enters into the water bodies though pond cleaning or discharges.
Planting waste	NOx from burning returns to the ground with precipitation and enters the water bodies.

4.1.3.2 Production of Non-Point Source Pollution and Amounts Discharged into the Environment

1 The discharge intensities of livestock raising and husbandry, farmland nutrients loss, rural domestic living have been estimated using the data items available in the Chinese statistics – rural population, numbers of large livestock, number of pigs, number of poultry, area of freshwater aquaculture, N-fertilizer usage, P-fertilizer usage (Table 4.1.3.2-1), the non-point sources' pollutants discharge coefficient from references and survey data (Table 4.1.3.2-2) and the unit non-point sources pollution generation intensity (Table 4.1.3.2-3).

Table 4.1.3.2-1 the HRB Statistics[1]

Area	Rural population ($x10^4$)	Large livestock ($x10^4$ head)	Pig ($x10^4$ head)	Poultry ($x10^4$ head)	Freshwater breed area ($x10^4$ ha)	N-fertilizer ($x10^4$ ton N)	P-fertilizer ($x10^4$ ton P)
1995							
Jiangsu	6321.0	123.3	2119.0	32688.0	46.7	176.7	19.3
Anhui	4949.5	723.7	1565.6	16944.0	49.7	105.9	17.2
Shandong	7115.9	1463.3	2485.4	65515.3	20.0	189.1	23.5
Henan	7715.2	1420.5	2667.7	32804.0	17.4	176.8	33.5
HRB	**26101.6**	**3730.8**	**8837.7**	**147951.3**	**133.8**	**648.5**	**93.4**
2000							
Jiangsu	4797.1	74.5	2015.0	57275.3	56.2	215.6	33.8
Anhui	5048.0	559.4	1858.4	46521.3	54.9	140.8	28.4
Shandong	6565.8	1140.3	2660.3	109168.0	24.5	241.9	44.2
Henan	7793.0	1445.7	3587.7	43872.3	18.9	232.3	54.1
HRB	**24204.0**	**3219.9**	**10121.4**	**256836.9**	**154.5**	**830.7**	**160.5**
2004							
Jiangsu	5248.0	74.1	2988.6	58258.7	63.4	211.2	33.5
Anhui	5198.0	464.4	2531.3	48245.3	58.9	143.1	31.8
Shandong	7042.5	1089.1	4330.2	146835.0	27.8	240.0	49.1
Henan	7968.8	1491.2	5189.0	62858.0	20.4	261.9	62.5
HRB	**25457.3**	**3118.8**	**15039.1**	**316197.0**	**170.4**	**856.3**	**176.8**

Note: 1. The statistics is of the entire provinces of Anhui, Shandong, Jiangsu and Henan.
Source(s): China Agricultural Yearbook, 1996, 2001, 2005.

2 The major non-point sources pollutants discharge coefficients[6] of the HRB are obtained through the MOA partial regional survey and references. The aquaculture scale in the 4 provinces in the HRB is relatively small, leaving a high wastes pollutants discharge coefficient. Moreover, the HRB freshwater aquaculture adopts intensive fish farming. For example, the feed intensity in the Southern Four Lakes in Shandong is 4090 kg/ha, and about 30-40% of the feed enters into the environment (internal survey data). The CODcr discharge per unit freshwater aquaculture area should also be high. However, due to data unavailability, the estimation of the CODcr discharge from freshwater aquaculture is unviable.

Table 4.1.3.2-2 Non-Point Sources Pollutants discharge Coefficient in the HRB

Type of the non-point sources	Items	HRB (%)			Data sources
		CODcr	TN	TP	
Livestock	Large livestock excrement	40	40	40	Survey data of MOA, 2005
	Large livestock stale	90	90	90	ditto
	Pig excrement	65	65	65	ditto
	Pig stale	90	90	90	ditto
	Poultry excrement	40	40	40	ditto
Nutrient loss from farmland	N-fertilizer	0	2.741	0	Yang Linzhang, etc. 2003
	P-fertilizer	0	0	0.64*	Yang Linzhang, etc. 2003
Household	Rural domestic wastewater	100	100	100	Survey data of MOA, 2005
	Human excrement	25	25	25	ditto
Aquaculture	Freshwater breed	-	6.7	4.1	Yang Linzhang, etc. 2003

Note: 1. This coefficient is from the testing in TLB.

Table 4.1.3.2-3 Generation Intensity of Non-Point Source Pollutant [1]

Type of non-point sources	Items	CODcr (g/kg)	TN (g N/kg)	TP (g P/kg)	Annual amount generated (kg/head, kg/ha)	Data sources
Livestock	Large livestock excrement	3.17	3.83	0.95	9855	China Organic Fertilizer Records, 1998; Survey data of MOA, 2005; Study on Control and Management of Rural Non-Point Source Pollution in the PRC TA No. 3891-PRC
	Large livestock stale	38.04	5.01	0.17	4380	
	Pig excrement	3.99	5.47	2.45	730	
	Pig stale	31.92	1.66	0.22	1204.5	
	Poultry excrement	24.44	10.32	4.13	43.8	
Nutrient loss from farmland	N-fertilizer	-	-	-	-	-
	P-fertilizer	-	-	-	-	-
House-hold	Rural domestic wastewater	0.35	0.012	0.0017	18250	Survey data of MOA, 2005; Study on Control and Management of Rural Non-Point Source Pollution in the PRC TA No. 3891-PRC
	Human excrement	7.27	6.43	1.06	693	China Organic Fertilizer Records, 1998
Aqua-culture	Freshwater breed	-	568.9	75.0	-	Yang Linzhang, etc. 2003

[6] That is the discharge into the environment divided by the total pollutants generated.

Notes: 1. The generation intensity of non-point source pollutant means the intensity of pollutants discharge to environment including land, water or any other types of places.

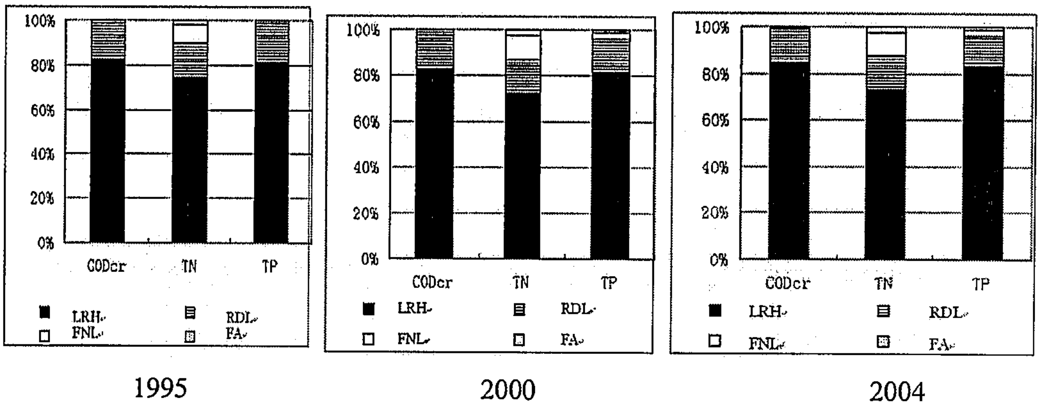
2. The unit of TN, TP generation intensity from freshwater breading is kg/hm^2 freshwater area.

3 The discharge intensities of CODcr, TN and TP entering into the environment from livestock raising and husbandry, farmland nutrients loss, rural domestic, aquaculture in the HRB in 1995, 2000, and 2004 (Table 4.1.3.2-5) have been estimated using the agricultural statistical data of the HRB, the major non-point sources pollutants discharge coefficient, and the production intensity of the major non-point sources pollutants.

4 Table 4.1.3.2-5 lists the intensity of non-point source CODcr, TN, and TP in the HRB in 1995, 2000 and 2004. The figures suggest that since the 9th FYP, pollutants from non-point sources show the tendency of increase.

5 Figure 4.1.3.2-1 below suggests that the ranks of rate of contribution of CODcr in the HRB are livestock raising and husbandry, rural domestic; the ranks of the rate of contribution of TN are livestock raising and husbandry, rural domestic, farmland nutrients loss, aquaculture; and the ranks of the rate of contribution of TP are livestock raising and husbandry, rural domestic, farmland nutrients loss, and aquaculture. Therefore, livestock raising and husbandry is the most significant contributor of non-point source pollution in the HRB, followed by rural domestic, farmland nutrient loss, and freshwater aquaculture.

Figure 4.1.3.2-1 Rates of Contribution of Non-Point Source CODcr, TN and TP that Enter into the Environment in the HRB[7]



LRH: Livestock Raising and Husbandry RDL: Rural Domestic Living

FNL: Farmland Nutrient Loss FA: Freshwater Aquaculture

Table 4.1.3.2-4 Amount of Non-Point Source Pollutant Entering Environment in the HRB

[7] The rates of contribution of non-point source CODcr, TN, and TP that enter into the environment in the HRB refer to the ratio of CODcr, TN, and TP from the 4 sources that have entered into the watershed to the total pollutants from all non-point sources. As there is no systematic monitoring of non-point sources pollution in the HRB, the data on the proportion of final pollutants entering into the water bodies is unavailable. Thus it has been difficult to estimate the CODcr, TN, TP that have entered the Huai River water body from non-point sources and the rates of contribution of CODcr, TN, and TP from point and non-point sources in the HRB.

Unit: $\times 10^4$ ton

Non-Point Sources	Livestock	Household	Nutrient loss from farmland	Freshwater breed
1995				
CODcr	930.0	199.6		
TN	169.5	34.8	17.8	5.1
TP	29.1	5.6	0.6	0.4
2000				
CODcr	894.9	185.1		
TN	157.7	32.3	22.8	5.9
TP	28.8	5.2	1.0	0.5
2004				
CODcr	1058.6	194.7		
TN	176.1	33.9	23.5	6.5
TP	35.4	5.5	1.1	0.5

Table 4.1.3.2-5 Discharge Intensity of Non-Point Source Pollutant to Environment in the HRB (1995, 2000 and 2004)

Unit:×10^4 ton COD, N, P

Area	CODcr				TN					TP				
	Livestock	Household	Freshwater breed	Total	Livestock	Household	Nutrient loss from farmland	Freshwater breed	Total	Livestock	Household	Nutrient loss from farmland	Freshwater breed	Total
1995														
Jiangsu	97.69	48.33		146.02	13.74	8.43	4.84	1.78	28.79	3.57	1.36	0.12	0.14	5.19
Anhui	174.86	37.84		212.71	32.17	6.60	2.90	1.89	43.56	5.42	1.06	0.11	0.15	6.74
Shandong	329.05	54.41		383.46	62.19	9.49	5.18	0.76	77.62	10.05	1.53	0.15	0.06	11.79
Henan	328.43	58.99		387.42	61.36	10.28	4.84	0.66	77.15	10.06	1.66	0.21	0.05	11.99
the HRB	930.02	199.58		1129.60	169.46	34.79	17.77	5.10	227.12	29.10	5.60	0.60	0.41	35.71
2000														
Jiangsu	86.20	36.68		122.88	11.69	6.39	5.91	2.14	26.13	3.25	1.03	0.22	0.17	4.67
Anhui	159.15	38.60		197.75	27.85	6.73	3.86	2.09	40.53	5.15	1.08	0.18	0.17	6.58
Shandong	283.39	50.20		333.59	51.88	8.75	6.63	0.93	68.19	8.94	1.41	0.28	0.08	10.71
Henan	366.21	59.59		425.79	66.33	10.39	6.37	0.72	83.80	11.48	1.67	0.35	0.06	13.56
the HRB	894.95	185.07		1080.02	157.75	32.26	22.76	5.89	218.66	28.82	5.20	1.03	0.48	35.52
2004														
Jiangsu	121.68	40.13		161.81	15.96	7.00	5.79	2.42	31.16	4.61	1.13	0.21	0.19	6.15
Anhui	168.29	39.74		208.04	27.51	6.93	3.92	2.25	40.60	5.68	1.12	0.20	0.18	7.18
Shandong	336.39	53.85		390.24	57.59	9.39	6.58	1.06	74.61	11.12	1.51	0.31	0.09	13.03
Henan	432.23	60.93		493.16	75.03	10.62	7.18	0.78	93.61	13.96	1.71	0.40	0.06	16.13
the HRB	1058.59	194.65		1253.24	176.08	33.93	23.46	6.50	239.98	35.36	5.46	1.13	0.52	42.48

Non-Point Source Contribution to the HRB Water Pollution

1 According to the survey results, there are no existing quantitative researches, models, or methods on the affect of the non-point sources on the water bodies. The connection between the amount of pollution in the water bodies from the non-point sources and the amount of total discharge from the non-point sources has not been established. Such situation is largely due to (1) the requirement for comprehensive monitoring and testing of the river hydraulic process, surface runoff and its characteristics, water and soil erosion, the dissolving, transfer, and migrating process of pollutants, and (2) insufficient attention from the governments to the non-point sources. According to the above estimates, from the dawn of the 9th FYP to the end of the 10th FYP, the non-point source COD, NH3-N, and TP entering into the environment show an upward trend indicating no sign of effective control or reduction.

2 Consequently, the existing estimates on the HRB non-point source discharges alone are insufficient to deduce quantitatively their contributions to the HRB water pollution. Qualitatively, however, HRB's uneven rainfall distribution across a year favors the non-point source pollutants migration through surface runoff. The flood season (June-September) accounts for 50-80% of the total annual precipitation, and the rainstorms cluster from June to August, covering a large area and lasting for a long period of time, particularly for the Huai River mainstream and its south region. Lasting concentrated rainstorms can easily transfer the non-point sources pollutants from the field to the water bodies. Therefore the HRB non-point pollution is likely an important source of water pollution, especially as point source pollutants are being diminished gradually. Non-point source pollution will eventually become a main factor of the water pollution.

4.2 Factors Impacting Pollutants Discharge

4.2.1 Development Level

1 The table below compares the wastewater and pollutants discharge of the HRB at the end of the 9th FYP (2000) and the 10th FYP (2005) to the China average and those of the major developed countries. The results shows that by 2005 the wastewater and pollutants discharge per unit GDP in the HRB has reduced significantly compared to its 2000 level, and compared to the China average discharge level, the HRB levels are only as half as the national average. This shows that the HRB discharge intensity is low **within China**. However, the GDP per unit area in the HRB is high – over 3 times that of the national average in 2000, over 4 times in 2005, and equivalent to 95% of the US level in 2003. And the pollutant discharge intensity compared to the **developed countries** is no longer low. Even for year 2005, where the per unit GDP pollutants discharge had been low in the HRB, its unit COD discharge had been 10 times more than that of the UK in 1996 and 20 times more than that of USA, France, or Germany. Therefore, a relatively low unit GDP PDI (compared to the Chinese levels) still leads to a large amount of pollutants. There is still a long way to go for the HRB in controlling PDI.

Table 4.2.1-1 Pollutants Discharge of Unit GDP in the HRB and Nationwide Area

Area	the HRB		Nationwide Area	
Year	2000	2005	2000	2005
GDP (x10^8 yuan)	9302.04	24232.69	99214.6	183,084.8
GDP of unit territory area (x10^4 yuan/km^2)	345	898	103	191
Wastewater (x10^8 ton)	-	35.1	415.2	524.5
COD (x10^4 ton)	105.9	94.57	1445	1414.2
NH_3-N (x10^4 ton)	15.2	12.6	-	149.8
Wastewater /GDP(kg/×10^4yuan)	-	14.48	41.85	28.65
COD /GDP(kg/×10^4yuan)	11.38	3.90	14.56	7.72
NH_3-N /GDP(kg/×10^4yuan)	1.63	0.52	-	0.82

Source(s): China Statistics Yearbook 2006, China Environmental Statistics Yearbook 2006.

Table 4.2.1-2 Pollutants Discharge of Unit GDP in Developed Countries

Country	Year	COD (kg/day)	GDP (million USD$)	COD /GDP (kg/×10^4yuan)	GDP of unit territory area (x10^4yuan/km^2)
France	1996	585,382	1,540,100	0.17	2,232
	2003	281,747	1,757,613	0.07	2,547
Germany	1996	811,315	2,353,200	0.16	5,273
	2003	1,020,145	2,403,160	0.19	5,385
Britain	1996	695,784	1,145,801	0.28	3,741
	2003	615,410	1,794,878	0.16	5,861
USA	1996	2,559,947	7,341,900	0.16	627
	2003	1,897,480	10,948,547	0.08	935

Source(s): World Development Indicator (1998, 1999, 2003-2006)

4.2.2 Economic Growth

4.2.2.1 Growth during the 9th FYP

1 The National Economic and Social Development FYP is an important basis for the water pollution control and prevention planning. A review of the *9th National Economic and Social Development FYP* (9th FYP) objectives and its implementation will help understand the water pollution control and prevention plan and implementation. The following paragraphs will analyze the achievement of the economic development objectives of the *National Economic and Social Development 9th FYP and Outline of Development Vista of the Year 2010* for the provinces in the HRB by looking at the provincial GDPs and the outputs from the primary, secondary, and tertiary industries of the provinces in the HRB. The Henan Province will be left out of this analysis due to the lack of data.

2 Data on the provincial economic development come from the *55-Year Compiled Statistics of the PRC 1949-2004*. The economic development objectives and data in the 9th FYP based on the 1995 price will be adjusted using the consumer price index (CPI) to reflect the 2000 price level.

Table 4.2.2.1-1 Economic Development Target and Result in the End of 9th FYP in the HRB

($x10^8$ yuan) (2000 price)	Province	GDP	Primary industry	Secondary industry	Tertiary industry
Target of 9th FYP	Jiangsu	9826.5	1080.9	5208.1	3537.6
	Anhui	4100.2	697.0	2107.5	1295.7
	Shandong	8914.5	1437.5	4279.0	3198.1
Result in 2000	Jiangsu	8582.7	1031.2	4435.9	3115.7
	Anhui	3038.2	732.2	1296.3	1009.7
	Shandong	8542.4	1268.57	4244.4	3029.47

3 The table above indicates that all 3 provinces failed to meet the economic development objectives for both GDP and the industry outputs. The percentage shortages are listed below.

Table 4.2.2.1-2 Deviation of the Result in the End of 9th FYP from the Target

Province	GDP	Primary industry	Secondary industry	Tertiary industry
Jiangsu	-12.66%	-4.60%	-14.83%	-11.92%
Anhui	-25.90%	5.05%	-38.49%	-22.07%
Shandong	-4.17%	-11.75%	-0.81%	-5.27%

4 Among the 3 provinces, Anhui showed the widest gap from its 9th FYP objectives due to lagged secondary and tertiary industries. Jiangsu and Shandong provinces ran short on the secondary and primary industries.

5 On the contrary, all HRB provinces exceeded the pollutants discharge objectives during the 9th FYP (Table 4.2.2.1-2). In particular, all provinces have exceeded the COD discharge objectives by over 100%. Jiangsu Province even had a stunning number of 2498%. Given the fact that the provinces fell short on economic performance, it is hard to argue that fast economic growth had led to the fall-short on the 9th FYP environmental objectives. What remains on the top list of the major causes are the completed percentage of projects and investments. The detailed analysis will be presented in future paragraphs.

4.2.2.2 Growth during the 10th FYP

1 Similarly, a review of the *10th National Economic and Social Development FYP* (10th FYP) objectives and its implementation will help understand the water pollution control and prevention plan and implementation. The following paragraphs will analyze the achievement of the economic development objectives of the *National Economic and Social Development 9th FYP and Outline of Development Program of the Year 2010* for the provinces in the HRB by looking at the provincial GDPs and the outputs from the primary, secondary, and tertiary industries of the provinces in the HRB based on data availability.

2 Data on the provincial economic development between 2000 and 20005 come from the *55-Year Compiled Statistics of the PRC 1949-2004* and the provincial statistical yearbooks. The economic development objectives and data in the 10th FYP based on the 2000 price will be adjusted using the consumer price index (CPI) to reflect the 2005 price level.

Table 4.2.2.2-1 Economic Development Target and Result in the End of 10th FYP in the HRB

($x10^8$ yuan, 2005 price)	Province	GDP	Primary industry	Secondary industry	Tertiary industry
Target of 10th FYP	Jiangsu	13681.8	1368.2	6840.9	5472.7
	Anhui	4664.4	932.9	2099.0	1632.5
	Shandong	13373.6	1471.1	6553.0	5349.4
	Henan	7861.7	1572.3	3537.8	2751.6
Result in 2005	Jiangsu	18305.7	1461.5	10335	6489.2
	Anhui	5375.84	959.61	2234.23	2182
	Shandong	18468.3	1927.6	10620.3	5920.4
	Henan	10535.2	1843	5539.3	3152.8

3 The table above indicates that all 4 provinces have exceeded the economic development objectives for both GDP and the industry outputs. The percentage differences are listed below.

Table 4.2.2.2-2 Deviation of the Result in the End of 10th FYP from the Target

Province	GDP	Primary industry	Secondary industry	Tertiary industry
Jiangsu	33.80%	6.82%	51.08%	18.57%
Anhui	15.25%	2.87%	6.44%	33.66%
Shandong	38.10%	31.03%	62.07%	10.67%
Henan	34.01%	17.21%	56.58%	14.58%

4 Among the provinces, Anhui greatly exceeded the expectation for the development of its tertiary industry. Other provinces all performed surprisingly in the growth of the secondary industry. Shandong Province notably had an eye-catching growth in its primary industry.

5 A simulation analysis below calculates the pollutants discharge in the HRB provinces, assuming a constant unit GDP PDI and an economic growth scenario consistent with the 10th FYP. The results are presented in Table 4.2.2.2-3 and 4.2.2.2-4.

Table 4.2.2.2-3 Simulated COD Discharge at the Planned GDP Level at the End of the 10th FYP

Province	Total COD discharge	Deduced COD discharge	Target of COD discharge TMLL	Ratio of exceedance (deduced value over target value) to target
Jiangsu	340841.4	254747.1	248200	2.6%
Anhui	139459.6	121003.5	118185	2.4%
Shandong	193079.8	139816.4	88970	57.2%
Henan	272297.2	203196.8	187345	8.5%

Table 4.2.2.2-4 Simulated NH_3-N Discharge at the Planned GDP Level at the End of the 10th FYP

Province	Total NH3-N discharge	Deduced NH3-N discharge	Target of NH3-N discharge TMLL	Ratio of exceedance (deduced value over target value) to target
Jiangsu	35549.9	26570.2	15800	68.2%
Anhui	24651.5	21389.1	35500	-39.7%
Shandong	24805.6	17962.7	16500	8.9%
Henan	41146.1	30704.5	44953	-31.7%

6 Table 4.2.2.2-1 and 4.2.2.2-2 show that if the economic growth had not exceeded the planned objectives, the COD discharge of the HRB provinces would be much lower than their current level, and the ratio of exceedance could have been much lower. Except Shandong Province, who had an

exceedance ratio of 57% of its COD discharge, other provinces could have achieved the planned COD TMLL targets. This suggests that the unexpected fast economic growth without sufficient pollution control measures has been one of the major reasons for the excessive COD discharge in the HRB by the end of the 10th FYP.

7 For NH_3-N discharge, Anhui and Henan provinces would have exceeded the planned TMLL by 66% and 46% even under the simulated scenario. This suggests that underestimated economic growth could not explain their underperformance in NH_3-N TML control. The actual project investment and implementation could have had a significant influence. Later paragraphs will discuss in further details.

4.2.3 Factors Impacting Industrial Point Source Discharge

4.2.3.1 Discharge Non-Compliance

1 According to the background description of the 9th FYP, in 1993 COD discharge into the rivers (of which 85% belonged to industrial discharge) totaled 150×10^4 ton. Among the 150×10^4 ton, approximately 60×10^4 ton (~60%) belonged to over discharge. The initial industrial point sources discharge compliance rate at the beginning of the 9th FYP was quite low.

2 By the end of the 9th FYP, following the *Interim Regulations on the HRB Water Pollution Control and Prevention*, universal compliance to the industrial wastewater discharge limits should have been achieved in 1998 through the "CZZT" Action. However, the expert panel has not been able to locate comprehensive and reliable monitoring data to support to reject this claim. The media has frequently reported "bounceback" of pollutants discharge and non-compliance industrial wastewater discharge around year 2000. The cases in Anhui and Shandong below in 2000 indicate certain non-compliance discharges.

"Bounceback" of Industrial Wastewater Non-Compliance Discharge

Immediately after the 1998 "CZZT" Action, non-compliance discharge continued at Shandong Linyi Paper Mill and some other enterprises. On January 4th, 1998, sources of pollution entered the Middle Canal through the Picang Diversion Canal, further entered the Bulao River, and deteriorated the water quality in the Bulao River Jiangsu Xuzhou Section. Water in sections below the Jietai Gate bubbled, COD_{Mn} reached 12.36 mg/L; COD_{Mn} at the Liushan Gate reached 23.89 mg/L. The Xuzhou No. 2 Water Supply Plant, a water supply facility with a daily capacity of 20×10^4 ton whose source water comes from right below the Jietai Gate, was forced to temporarily shut down due to severe source water pollution, leaving 400000 urban residents with insecure drinking water supply, partial area completely out of water, and 18 enterprises including the Xuzhou Towel Plant forced to shut down. The daily industrial output is estimated to reach 1500×10^4 yuan.

Source(s): Huai River Hydraulic Committee. Huai River Region Water Resource Commonique (1998)

In 2000 a severe water pollution incident in the Fuyang City led to 6 deaths and 5 injuries. The investigation posterior the incident and the on-site pollution compliance discharge test on May 28th at the Fuyang Pharmaceutical revealed a stunningly high COD level at 1200 mg/L and an SS level of 10000 mg/L. Both severely exceeded the discharge standards.

Source(s): Huai River Hydraulic Committee. Huai River Region Water Resource Commonique (2000)

3 At the end of the 10th FYP, SEPA dispatched 3 inspection teams to check in secret the industrial sources of pollution of the key industrial sources, urban domestic WWTPs and key river sections of 21 prefectures, cities, and 91 counties in the 4 HRB provinces during May 28th - June

11th, 2004. A total of 165 key industrial sources of pollution have been inspected. The results showed that 123 (74.5%) were in regular production[8]; 42 temporarily shut down; among the 123 in production, 52 (42.3% of the 123, 31.5% of the 165) severely exceeded the discharge limits. This result is in accordance with the results from a monitoring action in 2003 (37.1%).

4 The number and proportion of enterprises who reached the secondary discharge standards[9] of COD and NH_3-N and who failed in both indicators calculated using the self-reported industrial pollutants discharge statistics of 2005 have been listed in Table 4.2.3.1-1, 4.2.3.1-2, and 4.2.3.1-3.

Table 4.2.3.1-1 COD Compliance Condition (2005)

Province	Total # of enterprises	# of compliant enterprises	Rate of compliance
Jiangsu	1079	822	76.2%
Shandong	817	683	83.6%
Henan	781	553	70.8%
Anhui	348	283	81.3%

Table 4.2.3.1-2 NH_3-N Compliance Condition (2005)

Province	Total # of enterprises	# of compliant enterprise	Rate of compliance
Jiangsu	290	255	87.9%
Shandong	482	408	84.6%
Henan	596	396	66.4%
Anhui	195	145	74.4%

Table 4.2.3.1-3 Dual Compliance in COD and NH_3-N (2005)

Province	Total # of enterprises	# of compliant enterprise	Rate of compliance
Jiangsu	290	203	70.0%
Shandong	482	334	69.3%
Henan	596	369	61.9%
Anhui	195	127	65.1%

Note: Some enterprises did not have the data regarding NH_3-N discharge.

Source(s): CNEMC

5 The above table shows that in 2005 the provincial compliance rate of pollutants (COD and NH_3-N) discharge in the HRB ranged somewhere between 70-80%. Among the provinces, Henan had the lowest number of enterprises reaching the compliance level in both COD and NH_3-N. Shandong had a relatively high proportion of firm-level compliance in COD, and Jiangsu in NH_3-N. They also had relatively high proportion for the combined compliance rate.

6 The proportion at compliant enterprises resulting from the statistics in 2005 (70-80%) has been much higher than the results of checking in secret by SEPA in 2004 (42.3%). A number of

[8] The water discharge samples of 113 of 123 enterprises were collected.

[9] The *Comprehensive Wastewater Discharge Standard (GB8978-1996)* demands for secondard standards for the Class IV and V water discharged into GB 3838 and wastewater discharged into Class III water bodies in GB3097.

factors could explain the discrepancy: (1) The 2005 statistics reflects the year-round situation, while the 2004 survey represented a one-time shot; (2) Although limited by the temporal scope of the survey, the 2004 inspection results could speak more about the truth, as it has covered 165 key enterprises with no notice of inspection; the 2005 statistics, however, represents self-reported data, thus creating the issue of data reliability.

7 In conclusion, the compliance rate for industrial point sources discharge has significantly improved during the 9th and 10th FYPs, however, non-compliance – of at least 20-30% of the enterprises in 2005 – still persists in the HRB.

8 Our study survey has identified the following issues that have led to the persistent non-compliance: (1) Some "Small Fifteen" enterprises still exist. Small paper mills have been spotted in Jiangsu and Anhui. (2) Many WWTPs are not in operation. (3) Significant, persistent pollutants/wastewater discharge secretly. By installing valves, shutter, a tunnel beneath, culverts, dilution tube, et al., at the discharge ends, untreated wastewater can be discharged with less possibility of being exposed. (4) Local Protectionism by the local governments.

9 Major causes for the issues mentioned above include:

(1) Local Protectionism

10 Certain local governments in relatively underdeveloped areas have considered environmental protection as counter economic development and would exchange temporary and localized economic interests at the expenses of environmental quality. Some local governments even issued "localized policies" that conflict with the environmental regulations to embark on production programs with processes that the central government has ordered to eliminate. Such highly polluting programs often if not for certain fail to infuse local economic development but tend to plant deep seeds for poverty and underdevelopment, while increasing the difficulties to control the HRB pollution.

(2) Pollution Costs as Externality and Low Pollutants discharge Fee

11 The current accounting system does not incorporate the cost of pollution, and the pollution control expenses are not reflected in the prices of the final goods and products. The cost of pollution has not been internalized. Moreover, for an enterprise, the pollutants discharge fee is far less than the cost of pollution control, thus creating disincentive for pollution control. Enterprises could prefer paying the pollutants discharge fee so as to pollute legally to investing in WWT facilities; some with existing treatment facilities would choose not to operate them.

(3) Inadequate Law Enforcement

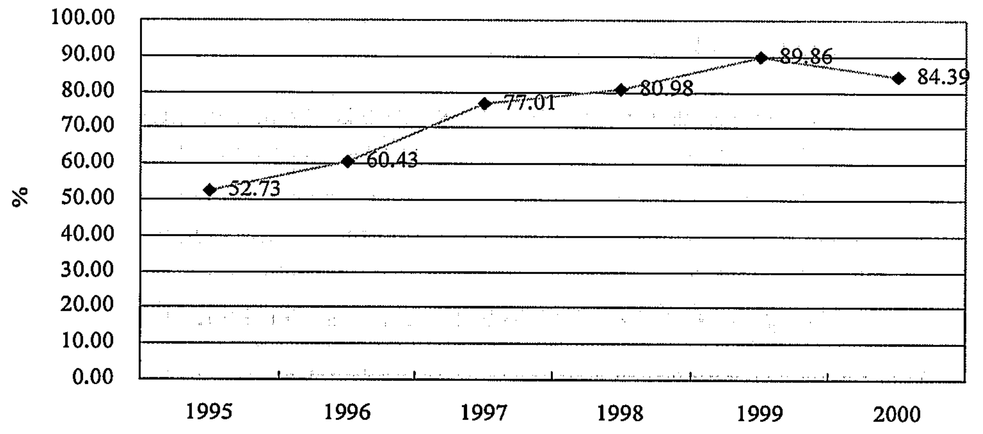
12 The environmental regulatory agencies have only limited legal authority granted by the environmental protection regulations. The cost of legal offense is low, while the cost of law enforcement has been high, and the law enforcement has been inadequate.

13 The following paragraphs present a case analysis of the compliance rate of industrial wastewater discharge in Anhui and Shandong provinces.

- During the 9th FYP

14 Figure 4.2.3.1-1 exhibits the compliance rate of wastewater discharge in Anhui Province during the 9th FYP. Lower than 60% in the beginning of the 9th FYP, the compliance rate of wastewater discharge has increased significantly between 1996 and 2000. Starting from 1998, the rate has exceeded 80%.

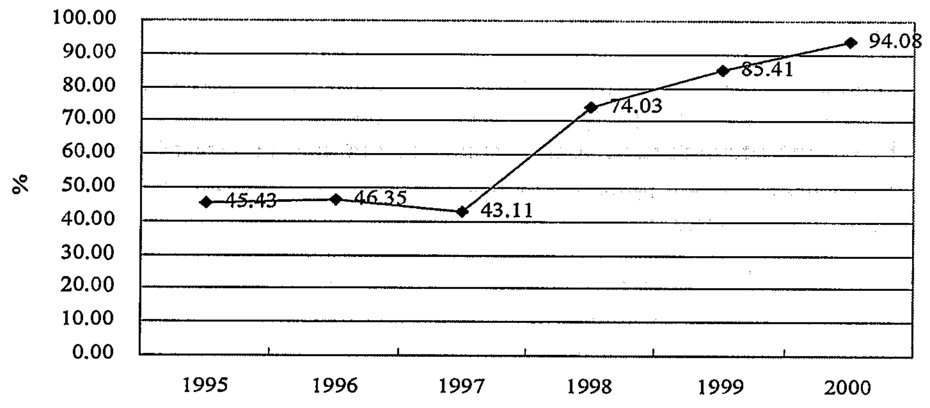
Figure 4.2.3.1-1 Compliance Rate of Industrial Wastewater Discharge in Anhui Province during the 9th FYP



Source(s): Anhui Statistics Yearbook 1996-2001

15 Figure 4.2.3.1-2 exhibits the compliance rate of wastewater discharge in Shandong Province during the 9th FYP. At merely 45% in the beginning of the 9th FYP, the compliance rate of wastewater discharge has increased significantly since 1998. In 2000, the rate reached 94%.

Figure 4.2.3.1-2 Compliance Rate of Industrial Wastewater Discharge in Shandong Province during the 9th FYP



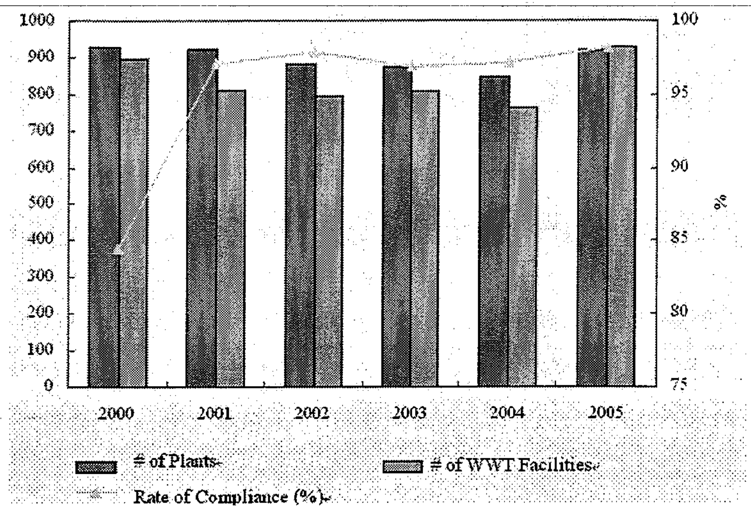
Source(s): Shandong Statistics Yearbook 1996-2001

16 The overwhelming number of "Small Fifteen" type of enterprises in the HRB is one of the major causes for the Huai River pollution. The compliance rate of industrial wastewater discharge has been low at the beginning of the 9th FYP due to lack of supervision from the government. Since the "CZZT" Action, a significant proportion of the "Small Fifteen" enterprises have been shut down, and the government has strengthened the supervision toward industrial pollutants discharge. The compliance rate of industrial wastewater discharge of the provinces significantly improved.

- During the 10th FYP

17 Figure 4.2.3.1-3 exhibits the compliance rate of industrial wastewater discharge in Anhui Province during the 10th FYP. Its compliance rate increased from 84% to 96-98% since 2000.

Figure 4.2.3.1-3 Pollution Control of Industrial Wastewater in Anhui Province during the 10th FYP



Source(s): Anhui Statistics Yearbook 2001-2006

Table 4.2.3.1-4 Industry WWT of Anhui Province in the 10th FYP

Year	# of enterprises	# of WWT facility	Compliance Rate of industrial wastewater discharge (%)
2000	926	896	84.39
2001	924	813	97.09
2002	884	797	97.93
2003	875	806	96.93
2004	847	763	97.21
2005	918	927	98.24

Source(s): Anhui Statistics Yearbook 2001-2006

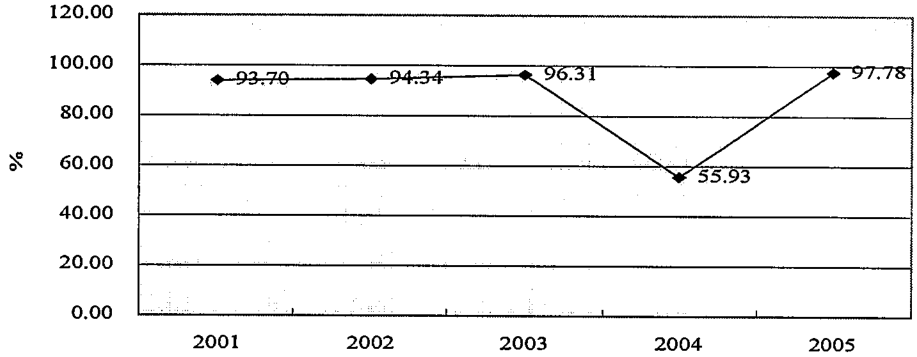
18 Table 4.2.3.1-5 exhibits the industrial WWT in Shandong Province during the 10th FYP. The compliance rate of wastewater discharge is shown in Figure 4.2.3.1-4. The rate as increased from the 93.7% of 2001 to 97.78% of 2005.

Table 4.2.3.1-5 Industrial WWT of Shandong Province during the 10th FYP

Year	# of WWT facilities	WWT O&M Cost ($\times 10^4$ yuan)	COD removed from wastewater (ton)	NH_3-N removed from wastewater (ton)
2001	1510	143779.5	755752.5	18071.6
2002	1625	96675.8	642565.2	16638.3
2003	1590	121265.9	650529.7	16624.6
2004	1545	98250.1	699091.3	18038.1
2005	1633	134252	752275.0	20510.0

Source(s): Shandong Statistics Yearbook 2002-2006

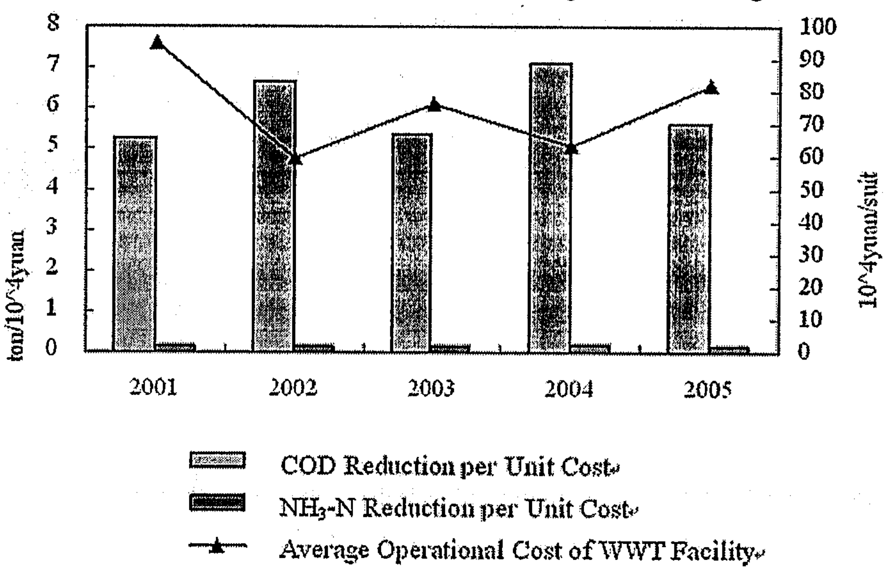
Figure 4.2.3.1-4 Compliance Rate of Industrial Wastewater Discharge in Shandong Province during the 10th FYP



Source(s): Shandong Statistics Yearbook 2002-2006

19 Figure 4.2.3.1-5 indicates a relatively flat annual average operational cost of industrial WWT with minor increase in the unit cost of COD and NH3-N removal in Shandong Province during the 10th FYP.

Figure 4.2.3.1-5 Cost of Industrial WWT in Shandong Province during the 10th FYP



Source(s): Shandong Statistics Yearbook 2002-2006

Table 4.2.3.1-6 O&M Cost of Industrial WWT in Shandong Province in 10th FYP

Year	Unit cost of COD removal (ton/ x 10^4yuan)	Unit cost of NH_3-N removal (ton/ x 10^4yuan)	WWT O&M Costs (x 10^4 yuan)
2001	5.256	0.126	95.218
2002	6.647	0.172	59.493
2003	5.364	0.137	76.268
2004	7.115	0.184	63.592
2005	5.603	0.153	82.212

Source(s): Shandong Statistics Yearbook 2002-2006

4.2.3.2 Impact of the Economic Growth on the Industrial Wastewater Discharge

1 A possible cause for untamed industrial pollutants discharge could be that the actual economic growth during the 10th FYP greatly exceeded the expected rate in the Plan. Similar simulative analysis as presented in Section 4.2.2.2 is applied to the analysis of the industrial wastewater discharge here.

2 Assuming constant PDI per unit industrial VA, the analysis compares the simulated difference in industrial wastewater and key pollutants discharges between 2 scenarios: one with an economic development level at the planned rate; another at the actual level. The results are presented in Table 4.2.3.2-1 below.

Table 4.2.3.2-1 Simulated Industrial Wastewater and Pollutants Discharge Assuming the 10th FYP Target GDP Level

Province	Actual wastewater discharge ($x10^8$ ton)	Simulated industrial wastewater discharge ($x10^4$ ton)	Actual COD discharge ($x10^4$ ton)	Simulated COD discharge ($x10^4$ ton)	Actual NH_3-N discharge ($x10^4$ ton)	Simulated NH_3-N discharge ($x10^4$ ton)	Rate of reduction
Jiangsu	8.04	5.32	28.4	18.8	3.1	2.1	33.8%
Anhui	3.78	3.55	11.1	10.4	1.5	1.4	6.1%
Shandong	3.72	2.30	12.9	8.0	1.7	1.0	38.3%
Henan	7.57	4.83	20	12.8	2.8	1.8	36.1%

3 The table above indicates that if the economic development had only reached the planned level, the industrial wastewater and pollutants discharges could have decreased. Except Anhui Province, the other 3 provinces could have experienced a reduction rate over 30%. This indication suggests that reliable economic projection could be crucial to effective reduction in the industrial wastewater discharge.

4.2.3.3 Impact of the Industrial Structure on its Wastewater Discharge

1 The following paragraphs analyze the sectoral industrial wastewater discharge and the PDI per unit economic output of each of the HRB provinces using the sectoral industrial economic and pollutants discharge statistics.

2 Major data sources include the 9th FYP, the local statistics yearbooks and the China Environmental Yearbook during the 10th FYP. For the local statistics, only Shandong Province has monitored not only the industrial wastewater discharge but also the pollutants discharges from various sectors. Other provinces only monitored the industrial wastewater discharge.

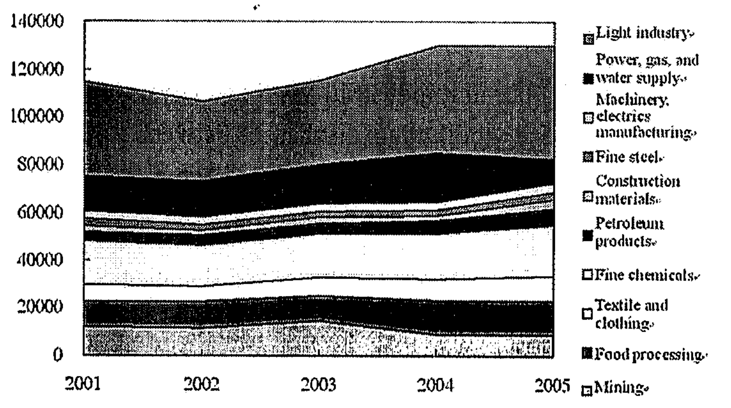
(1) Sources of Wastewater

3 The provinces represent differences in the sources of wastewater: In Shandong and Henan provinces, light industries take over 30% and 40% of the total provincial industrial wastewater discharge respectively; in Anhui Province fine steel and fine chemical industries both take over 20% of their provincial industrial wastewater discharges and have become the major contributors to the industrial wastewater discharge in the provinces; in Jiangsu Province the fine chemical

industry take some 30-40% share of the total provincial industrial wastewater discharge.

4 Each province exhibits distinctive trends in sectoral pollutants discharge growth.

Figure 4.2.3.3-1 Sectoral Industrial Wastewater Discharge in Shandong Province



Source(s): Shandong Province Statistics Yearbook (2002-2006)

5 Compared to 2001, in 2005, except that the mining industry and the gas, electricity, and water production had noteworthy reduction rates at 28% and 32%, other sectors in Shandong Province had shown growth in wastewater discharge. Especially, the growth in the petrochemical reached 80%.

Figure 4.2.3.3-2 Sectoral Industrial Wastewater Discharge in Anhui Province during the 9th FYP

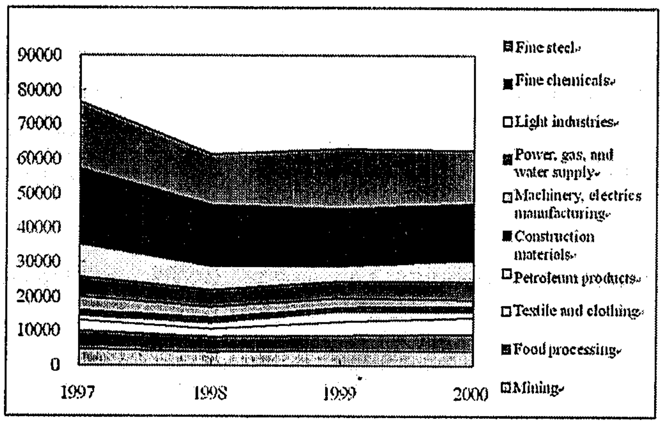
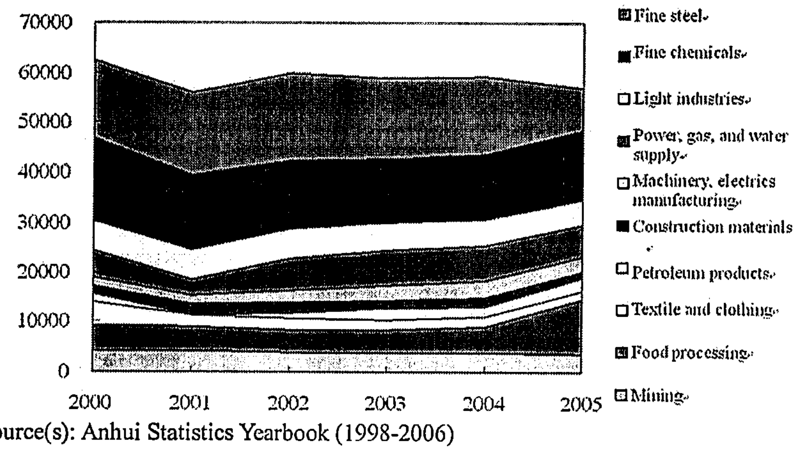


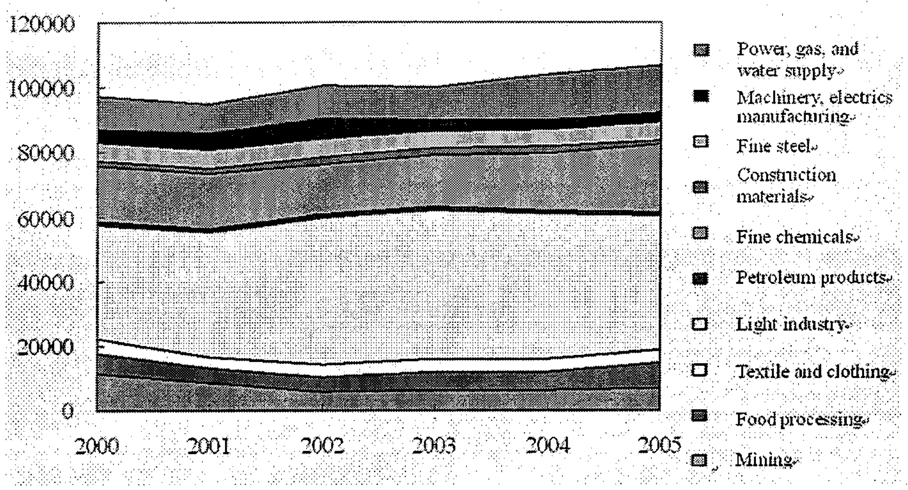
Figure 4.2.3.3-3 Sectoral Industrial Wastewater Discharge in Anhui Province during the 10th FYP



Source(s): Anhui Statistics Yearbook (1998-2006)

6 In Anhui Province, wastewater discharge had decreased from 1997 to 2000 with the exception of the textile and clothing, and petrochemical industries. They had wastewater discharge increase by 59% and 26% respectively. During the 10th FYP, the wastewater discharge increased in food processing, petrochemicals, and the gas, electricity, and water production sectors from 2000 to 2005. The rate of increase in the food processing industry even reached 101%. Discharge in other sectors, however, had decreased, and the textile and clothing experienced the largest percentage reduction, 59%.

Figure 4.2.3.3-4 Sectoral Industrial Wastewater Discharge in Henan Province



Source(s): Henan Statistics Yearbook (2001-2006)

7 The gas, electricity, and water production and the food, drinks and tobacco industry had the highest growth in wastewater discharge in Henan Province during the 10th FYP – 46% and 28% respectively. The fine chemical and light industries also experienced increase in wastewater discharge from 2000 to 2005. The mining industry, on the contrary, had the highest discharge reduction of 42%. This had been followed by 33% reduction by the machinery, electric, and electronics manufacturing.

Figure 4.2.3.3-5 Sectoral Industrial Wastewater Discharge in Jiangsu Province during the 9th FYP

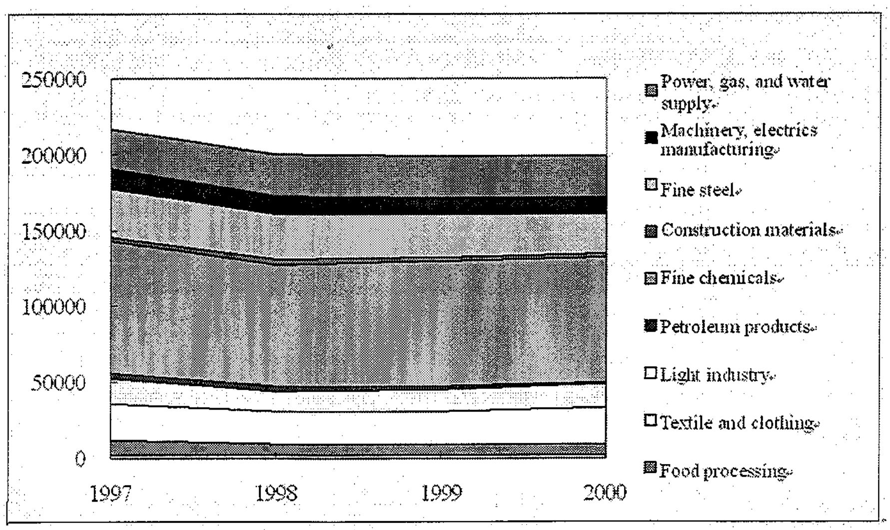
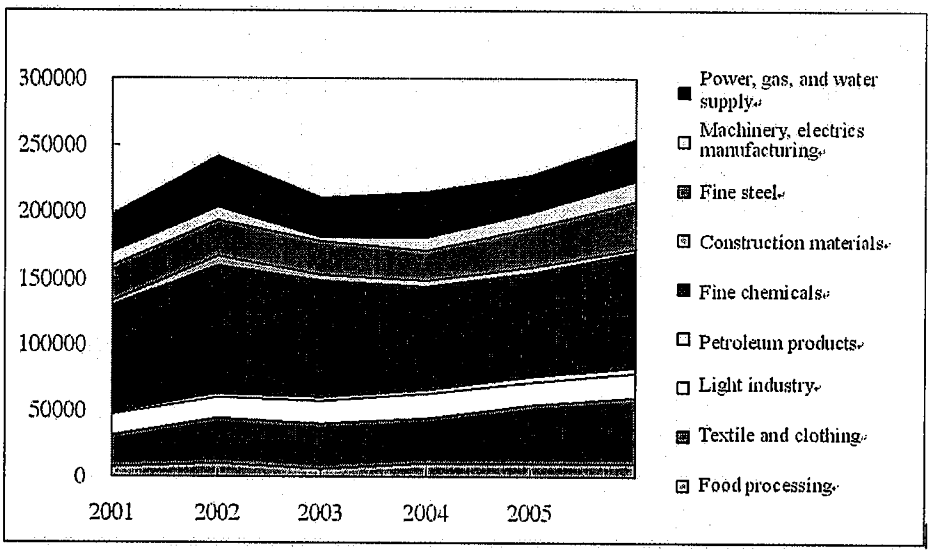


Figure 4.2.3.3-6 Sectoral Industrial Wastewater Discharge in Jiangsu Province during the 10th FYP



Source(s): Jiangsu Statistics Yearbook (1998-2006)

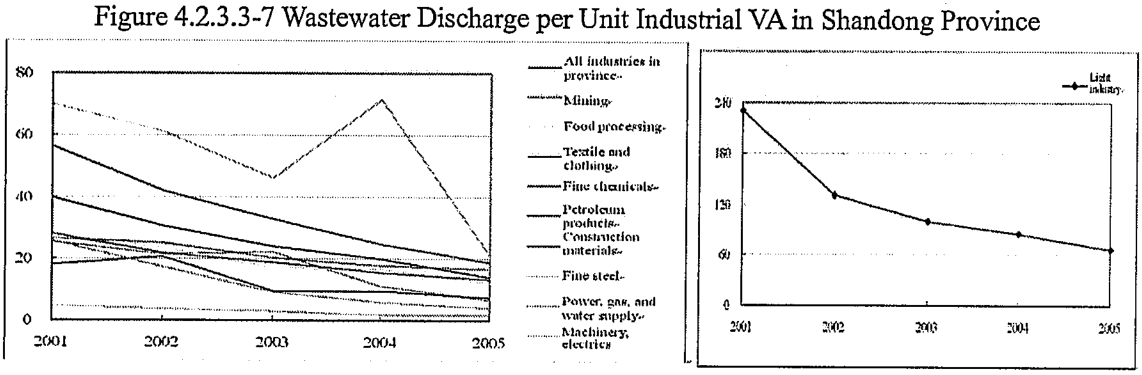
8 Most of the sectors in Jiangsu Province had experienced reduction in wastewater discharge between 1997 and 2000. The a few sectors with discharge increase had experienced minor increases, such as 9.5% for the machinery, electronics, electric equipment manufacturing, and 8.5% for food processing. Nevertheless, the situation changed during the 10th FYP. From 2000 to 2005, the wastewater discharge of almost all sectors had increased. Among those, the food processing industry had the highest increase of 103%.

(2) Wastewater Discharge Intensity per Unit Economic Production

9 In general the wastewater discharges per 10000-yuan industrial VA of the provinces have been decreasing steadily except for Jiangsu Province in 2001. This indicates a gradually more reasonable industrial structure.

10 Specifically, only wastewater discharge intensity of the gas, electricity, and water production has been increasing. Among those whose pollutants discharge intensities are decreasing, those of the chemicals and light industries remain at a relatively high level – e.g., at 400 ton/x10^4 yuan for light industry in Henan Province during the 10th FYP. The same index for other sectors in the 4 provinces is typically below 300 ton/x10^4 yuan.

Figure 4.2.3.3-7 Wastewater Discharge per Unit Industrial VA in Shandong Province



Source(s): Shandong Statistics Yearbook (2002-2006)

11 The 2005 Shandong Province data indicates that the light industry and the gas, electricity and water supply have wastewater discharge per 10000 yuan VA much higher than other industries. Fortunately, these two sectors have a relatively low percentage share in the provincial industrial production, and the machinery, electronics, and electric equipment manufacturing – the largest sector in Shandong in terms of industrial production – has a relatively low discharge intensity.

Figure 4.2.3.3-8 Wastewater Discharge per Unit Industrial VA in Anhui Province

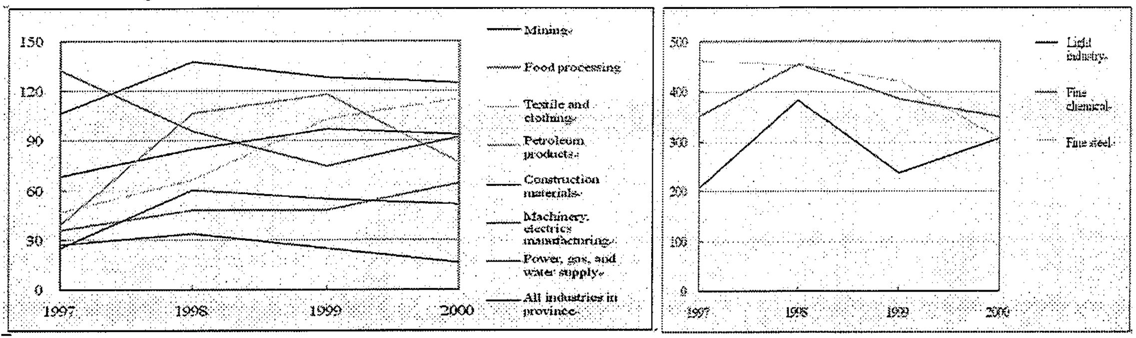
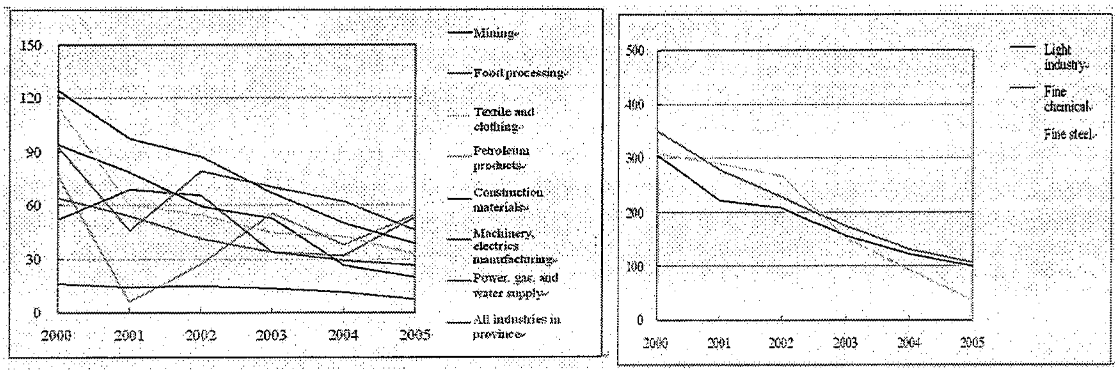


Figure 4.2.3.3-9 Wastewater Discharge per Unit Industrial VA in Anhui Province during the 10th FYP

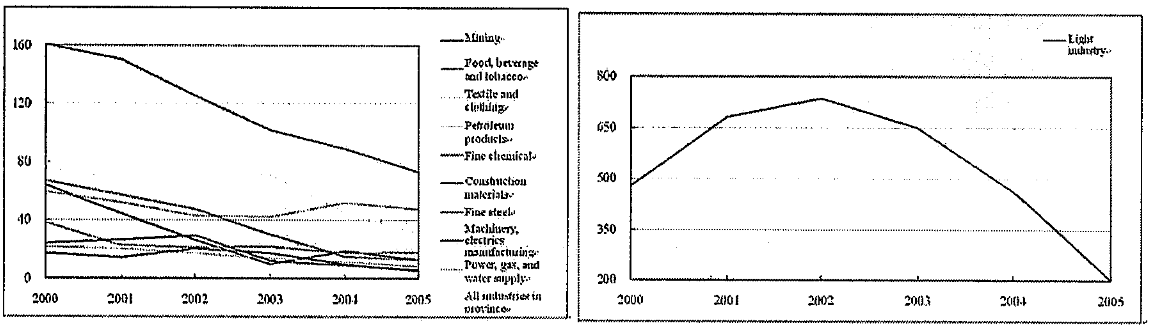


Source(s): Anhui Statistics Yearbook (1998-2006)

12 Between 1997 and 2000, Anhui Province saw PDI per unit economic production increase except the light industry, fine chemical and fine steel, who produce relatively high industrial added value.

13 During the 10th FYP, discharge intensities in most sectors have decreased with the exception of the food processing and petrochemical industries. The machinery, electronics, and electric equipment manufacturing, food processing, and fine steel industries are the biggest industrial producers. The PDI per unit industrial VA of the fine steel sector is relatively high. In terms of the PDI alone, the fine chemical and light industry top the list, although they only account for 8% and 4% of the industrial production.

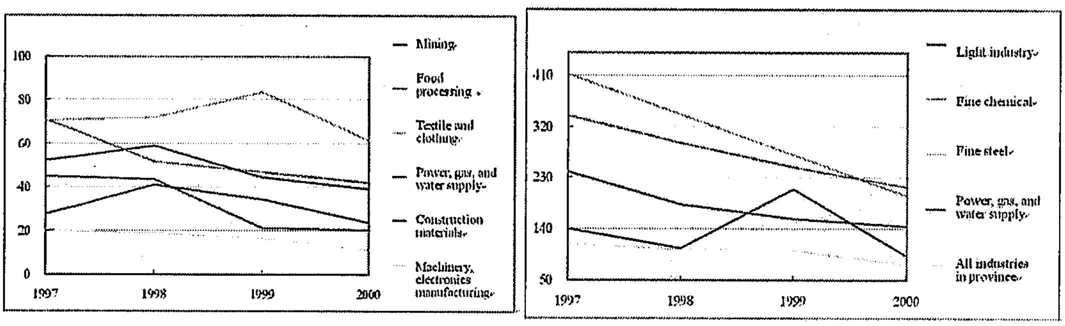
Figure 4.2.3.3-10 Wastewater Discharge per Unit Industrial VA in Henan Province



Source(s): Henan Statistics Yearbook (2001-2006)

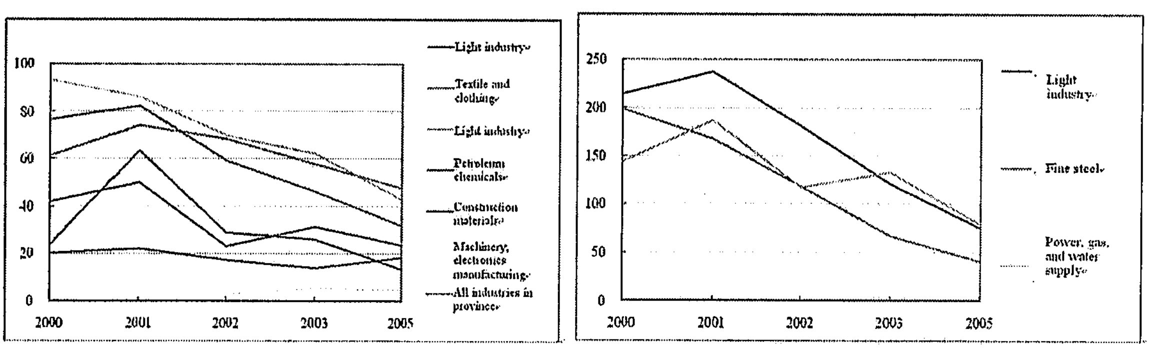
14 The light industry in Henan Province had the highest PDI per unit industrial VA to begin with. Although the intensity has been decreasing relatively quickly. By 2005, this figure has dropped to approximately 200 ton/x10^4 yuan. The fine chemical industry follows the light industry. Those two industries, however, produce only 4% and 9% of the total VA of the industrial production. The intensities for the largest VA producers – the mining industry and the machinery, electronics, electric equipment manufacturing – are relatively low.

Figure 4.2.3.3-11 Wastewater Discharge per Unit Industrial VA in Jiangsu Province



Source(s): Jiangsu Statistics Yearbook (1998-2001)

Figure 4.2.3.3-12 Industrial Wastewater Discharge per Unit VA in Jiangsu Province during the 10th FYP



Source(s): Jiangsu Statistics Yearbook (1998-2006)

15 Jiangsu Province saw steady reduction in the PDI in all industrial sectors through the 9th and 10th FYPs. Among the sectors, the gas, electricity, and water supply has the highest PDI, although

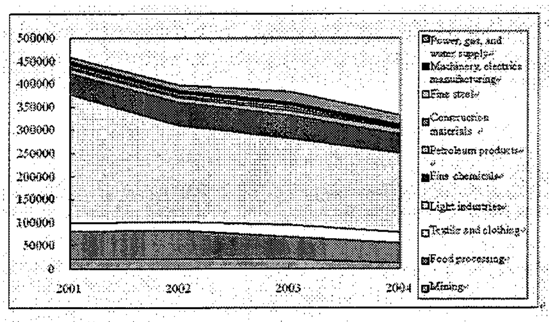
this sector contributes to only 5% of the total provincial industrial outputs. The machinery, electronics, and electric equipment manufacturing, which contributes to 39% of the provincial industrial outputs, on the contrary, has the PDI that is almost the lowest of all.

16 The above analysis indicates similar situations in the 4 provinces: Although the PDI per unit industrial VA has been decreasing, the rate of reduction is relatively low. The sector with the highest PDI by the end of the 10th FYP often accounts for a small percentage in the total industrial output, which the sector of the largest contribution to the provincial VA usually has a low PDI. Further reduction in PDI and eventually total pollutants discharge may rely on the further industrial structure adjustment.

(3) Pollutants Discharge

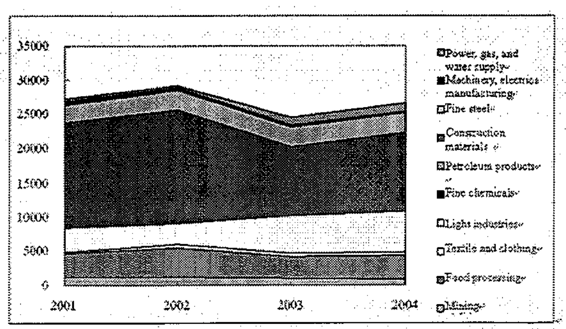
17 The following industrial sectoral pollutants discharge analysis of Shandong Province indicates that: (1) The light industries and fine chemical are the largest sources of pollutants –52.8% of the provincial COD discharge comes from the light industries, and 43.9% of the NH_3-N discharge comes from fine chemical industry. (2) In terms of trends, between 2001 and 2004, the gas, electricity, and water supply industry saw a COD discharge growth of 102%; the textile and clothing and the petrochemical sectors saw a growth rate of over 35%; the construction materials, on the contrary, experienced the most significant reduction of 56%; the food processing and fine chemical also experienced relatively significant reductions. For NH_3-N discharge, the gas, electricity, and water supply and the textile and clothing experienced dramatic growth of 383% and 139% respectively; the most significant reductions lay in the fine steel and the petrochemical sectors.

Figure 4.2.3.3-13 Industrial Sectoral COD Discharge in Shandong Province



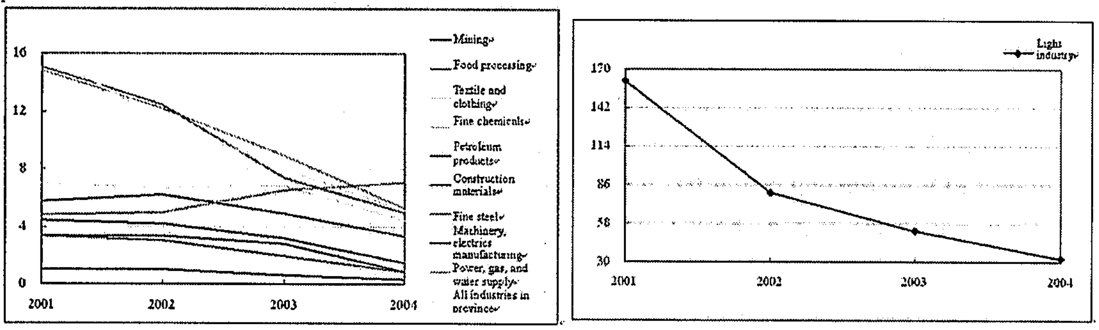
Source(s): Shandong Province Statistics Yearbook (2002-2006)

Figure 4.2.3.3-14 Industrial Sectoral NH_3-N Discharge in Shandong Province



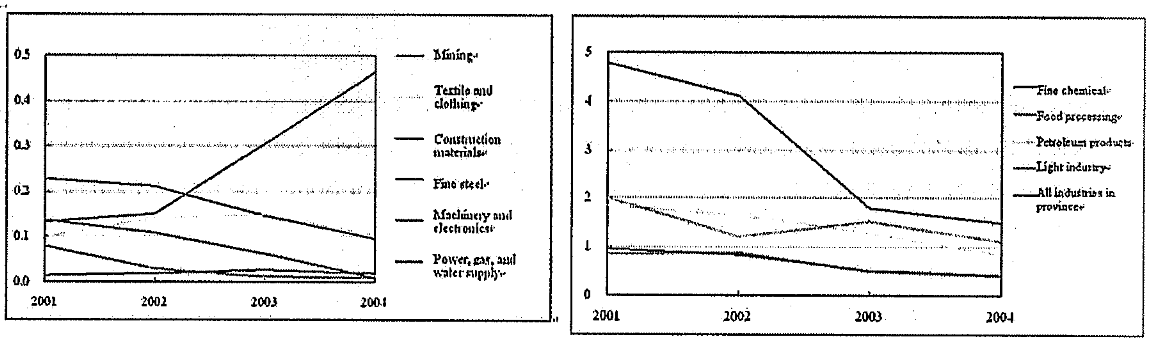
Source(s): Shandong Province Statistics Yearbook (2002-2006)

Figure 4.2.3.3-15 COD Discharge per Unit Industrial VA in Shandong Province



Source(s): Shandong Province Statistics Yearbook (2002-2006)

Figure 4.2.3.3-16 NH_3-N Discharge per Unit Industrial VA in Shandong Province



Source(s): Shandong Province Statistics Yearbook (2002-2006)

18 Provincial-wide, the pollutants discharge load per 10000-yuan industrial VA has been decreasing. Sectoral-wise, the overall COD and NH_3-N discharges are decreasing in almost all sectors except the gas, electricity, and water supply. Currently, the highest COD discharge intensity appears in the light industry, and the fine chemical sector has the highest NH_3-N discharge intensity. The most significant contributor to the industrial VA, the machinery, electronics, and electric equipment manufacturing, has almost the lowest COD and NH_3-N discharge per unit industrial VA.

4.2.4 Factors Impacting Urban Domestic Wastewater Discharge

4.2.4.1 Lagged Municipal WWTP Construction

1 A reduction of 113.2×10^4 ton in the COD discharge was needed from the 1993 discharge of 150×10^4 ton to meet the 2000 HRB TMLL target, 36.8×10^4 ton. The total 21.7×10^4 ton COD reduction capacity of the planned 52 WWTPs accounted for 20% of the expected reduction. Therefore, the municipal WWTPs will have crucial influence on fulfilling the 2000 discharge TMLL targets.

2 According to the data presented in Table 4.2.4.1-1, only 9 (17%) of the 52 planned municipal WWTPs have been completed by the end of 2000. Thirteen of the planned WWTPs have not even

been started. No reliable data[10] has been collected on the treatment capacity of the constructed WWTPs.

Table 4.2.4.1-1 Construction Progress of WWTP in the HRB (as of July 2000)

Province	# of WWTP planned	# WWTP completed	# of WWTP under construction	# of WWTP not started
Jiangsu	13	2	6	5
Anhui	18	0	10	8
Henan	9	5	4	0
Shandong	12	2	10	0
Total	52[1]	9	30	13

Note: 1. The number of WWTPs was 67 in the original plan.

Source(s): Statistic Data, SEPA July 2000.

3 According to the "*On 2005 Implementation of the HRB Water Pollution Prevention and Control Tasks*" by SEPA in May 2006, 161 urban WWT projects have been planned for the 10th FYP with a total investment of 148.9×10^8 yuan, planned annual COD reduction capacity of 40.3×10^4 ton and NH3-N reduction capacity of 4.6×10^4 ton, and an overall urban WWT rate of 70%. By the end of 2005, 140 urban WWTP projects have been launched with a total investment of 128.6×10^8 yuan; 62 have been completed, added a daily treatment capacity[11] of 410×10^4 ton.

4 Data from the provincial HRB 10th FYP Completion Report is tabulated in Table 4.2.4.1-2 below. By the end of the 10th FYP, the number of constructed WWTPs only accounted for 41% of the planned. The ratio of actual installed to planned capacity in Henan, Shandong, and Jiangsu provinces are 24.16%, 108.10% and 42.31% respectively. Anhui Province did not have statistics on actual installed capacity.

Table 4.2.4.1-2 WWTP Construction in the HRB (end of 10th FYP)

Province	# of WWTPs planned	Capacity planned (10^4 ton/day)	# of WWTPs completed	# of WWTP under construction	# of WWTPs not started	Capacity installed[12] (10^4 ton/day)	% of installed to planned capacity
Henan	34	149	8	14	12	36	24.16%
Anhui	29	133	4	10	15	-	-
Shandong	52	123.5	25	27	0	133.5	108.10%
Jiangsu	46	208	29	17	0	88	42.31%
Total	161	613.5	66	68	27	-	-

Source(s): Report on Shandong Province 10th FYP Implementation, Report on Henan Province the 10th FYP Implementation, Report on Anhui Province the 10th FYP Implementation, Report on Jiangsu Province the 10th FYP Implementation

5 The above analysis has clearly showed that the actual construction of the WWTPs has been

[10] The data might be available in offices under the MOC; however, it has been quite difficult to obtain the data through coordination from the environmental protection offices.

[11] Treatment capacity refers to the aggregated municipal WWT capacity of the existing and newly added facilities.

[12] The installed capacity here actually already includes both the completed capacity and the capacity currently under construction.

much slower than the planned during the 9th and 10th FYPs. This is one of the major causes that the planned objectives were not fulfilled.

4.2.4.2 Rapid Urban Population Growth and Urbanization

1 Another key factor leading to the domestic wastewater and pollutants growth is the rapid actual urban population growth and urbanization. Table 4.2.4.2-1 tabulates the actual and the projected population of the HRB provinces specified in the *Guideline of the 9th National Economic and Social Development FYP and 2010 Long-Term Vision* and the *Guideline of the 10th National Economic and Social Development FYP.* Table 4.2.4.2-2 exhibits the actual urban population growth in the HRB provinces

Table 4.2.4.2-1 Population Objectives – Plans and Reality

Period	Province	Population objectives planned ($\times 10^4$)	Reality in 2000	Gap between reality and objectives
9th FYP	Jiangsu	7281	7438	2.16%
	Anhui	6400	6276	-1.94%
	Shandong	9000	9079	0.88%
	Henan	9200	9256	0.61%
10th FYP	Jiangsu	7626	7474.5	-1.99%
	Anhui	6600	6516	-1.27%
	Shandong	9300	9248	-0.56%
	Henan	9860	9768	-0.93%

Note: The Population objectives planned of Jiangsu Province (9th and 10th FYP) and Zhejiang Province (10th FYP) were calculated based on the population increasing rate planned. The actual population in the end of 2000 and 2005was from the China Chain-Operation Yearbook 2006 and China Insurance Yearbook 2006.

Table 4.2.4.2-2 Variation of Total Population and Urban Area Population in the Provinces of the HRB

Unit: $\times 10^4$ person

Year	Jiangsu		Anhui		Shandong		Henan	
	Total	Urban area	Total	Urban area	Total	Urban area	Total	Urban area
1995	7066	1929	6000	1145	8705	2170	9100	-
1996	7110	1942	6054	1314	8738	2263	9172	-
1997	7148	2134	6109	1345	8785	2310	9243	1729
1998	7182	2262	6152	1374	8838	2296	9315	1746
1999	7213	2520	6205	1614	8883	2322	9387	1827
2000	7438	3041	6278	1758	9079	2409	9256	2201
2001	7355	3133	6325	1853	9041	2517	9555	2334
2002	7381	3299	6369	1955	9082	2634	9613	2480
2003	7406	3464	6410	2051	9125	2833	9667	2630
2004	7433	3568	6461	2164	9180	2951	9717	2809
2005	7475	3775	6516	2313	9248	-	9768	2994
2006	-	-	6593	2446	-	-	9820	-

Source(s): China Statistics Yearbook, Provinces Statistics Yearbook (1995-2006)

2 Table 4.2.4.2-1 shows that although the actual total population of the provinces do not show significant deviation from the planned population, but the urban population does. And the growth in urban population is much higher than that of the total population, as shown in Table 4.2.4.2-2. The unexpected fast growth in urban population has led to underestimated domestic wastewater

generation deteriorated domestic WWT rate.

3 Meanwhile, rapid urbanization adds additional burden to domestic WWT. Massive rural population floods into the urban area. They add extra demand to the urban water supply and generate additional solid waste and wastewater discharge, creating direct and indirect water pollution.

4 The HRB has historically been an agricultural area. The average urbanization rate of the area surrounding the Huai River was lower than 30% at the end of the 20th Century. Nevertheless, small towns and medium and small cities around the Huai River have boomed in the recent decade. Registered residential population of prefecture-level cities usually exceeds 300000. Average registered residential population of county town and county-level cities usually reaches 100000, and small towns with a residential population around 10000 have mushroomed.

5 As the per capita daily urban domestic wastewater reached about 0.2 ton, and the registered population around the Huai River area reached 1.68×10^8, each additional 1% of urban population will lead to an added annual urban domestic wastewater discharge of 12264×10^4 ton, or 3.4% of the total 1993 total watershed wastewater discharged into rivers.

6 Rapid urbanization in the HRB has been one of the key causes for the domestic wastewater growth.

4.2.4.3 Improper Operation of WWTPs

1 A number of factors have caused the low operation rate or improper operation of the constructed WWTPs:

(1) Lack of Wastewater Distribution Networks

2 Most of the constructed WWTPs do not have matching wastewater collection network, thus the wastewater collection rate remains low. The actual pollution removal falls far behind the designed capacity, and the HRB domestic wastewater pollution control far behind its planned targets. Table 4.2.4.3-1 shows the scale and efficiency of the WWTPs during the 9th and 10th FYPs (1996-2005) in the HRB. The centralized treatment rates in WWTPs in the HRB provinces are generally lower than 50%. As of 2005, the centralized treatment rate in the WWTPs of Anhui Province was only 26.31%; Shandong Province, which presumably has a relatively high centralized treatment rate in the WWTPs, had a rate of merely 54.48%; for Jiangsu and Anhui, about only half of the treated wastewater is treated in the WWTPs. Table 4.2.4.3-1 indicates that the growth in annual wastewater treatment quantity falls far behind the growth in WWTPs daily treatment capacity but well correlates to the growth in drainage pipe length. This suggests that the lagged network construction has directly limited the effective centralized treatment at municipal WWTPs.

3 In June 13-17, 2004, MOC Urban Construction Division conducted an inspection of the construction and operation of the urban WWTP projects in *Huainan, Bengbu, Suzhou, Huaibei, Bozhou, Jieshou,* and *Fuyang* of Anhui and *Zhengzhou (Wangxinzhuang, Wulongkou* WWTPs*), Changge, Xuchang, Yuzhou, Ruzhou, Zhoukou, Xiangcheng,* and *Luohe* of Henan. The inspection results show that in *Xiangcheng* City although the designed capacity of the municipal WWTP has

reached 4×10^4 ton, but the actual daily wastewater treatment lingers between 3000 and 8000 ton. Only 1 of the city's 4 pollutants discharge outlet has been connected to the WWTP; wastewater from other 3 unconnected outlets has been discharged directly to the water systems without passing through the WWTP. Consequently, most of *Xiangcheng* City's daily wastewater (~12×10^4 ton) enters into the *Shaying* River without treatment. The case in Xiangcheng, although dramatic, is by no means rare. A significant proportion of the WWTPs have been underfed with wastewater or not fed at all, while the wastewater flows in the environment. The environmental and social benefits that the large investment in WWTPs should have brought up were not realized.[13]

Table 4.2.4.3-1 WWTPs and their Capacity during 9-10th FYP in the HRB

Province	Year	Length of drainage pipe (km)	Length of sewers (km)	Annual wastewater discharge ($x10^4$ m^3)	Annual WWT ($x10^4$ m^3)	WWT rate (%)	Municipal WWTP			
							# of Plants	Treatment capacity ($x10^4$ m^3/day)	Annual centralized treatment quantity ($x10^4$ m^3)	Centralized treatment rate (%)
Jiangsu	1996	8859.6	-	245698	104941	42.71	28	104.25	-	-
	1997	8812	-	247609	117491	47.45	31	129.89	-	-
	1998	9574.34	-	260810	122843	47.1	53	228.88	-	-
	1999	10382.05	-	252089	146556	58.14	64	266.18	-	-
	2000	11096.81	-	257720	159242	61.79	64	263.36	-	-
	2001	13919.8	-	295984.3	193185.8	65.27	72	261.7	46859.3	15.83
	2002	16743.73	4173.98	328093.07	216239.39	65.91	89	304.92	61390.67	18.71
	2003	20342.54	5428.38	317473.33	221828.56	69.87	90	362.15	79270.93	24.97
	2004	25537.49	7065.8	318073.75	241965.14	76.07	99	414.54	103810.29	32.64
	2005	28568	8640	319189	245042.5	76.77	105	442.6	121858.8	38.18
Henan	1996	4772	-	166070	13088	7.88	9	41.23	-	-
	1997	5166.38	-	169319	16897	9.98	10	20.73	-	-
	1998	5483.44	-	161388	19553	12.12	14	23.33	-	-
	1999	5761.47	-	154572	18362	11.88	14	23.33	-	-
	2000	6069.63	-	154902	16681	10.77	17	80.13	-	-
	2001	6589.6	-	144738.2	36348.8	25.11	25	147	28149.8	19.45
	2002	7188.31	2650.17	147712.1	44149.75	29.89	21	153.23	35282.75	23.89
	2003	7801.3	2693.58	145903.55	50738.1	34.78	25	202.3	41958.6	28.76
	2004	8622.55	2884.11	146483.58	65361.7	44.62	28	224.5	58214.2	39.74
	2005	10201	3418	146518	67182.7	45.85	30	250.7	62637.2	42.75
Shandong	1996	9840	-	151790	18961	12.49	21	68.92	-	-
	1997	10632.61	-	155620	23179	14.89	24	92.4	-	-
	1998	10793.5	-	168898	35335	20.92	35	150.7	-	-
	1999	11682.23	-	171551	48899	28.5	27	163	-	-
	2000	12131.94	-	163369	55539	34	33	206.4	-	-
	2001	13556.7	-	152630.4	63300.6	41.47	42	264.3	56949.1	37.31
	2002	15257.29	5874.68	169208.8	77344.8	45.71	60	359.8	68060.3	40.22
	2003	18152.58	6698.65	172704.09	85693.86	49.62	68	384.8	75053.56	43.46
	2004	20082.52	7407.75	190559.2	98698.27	51.79	75	422.34	89760.6	47.10
	2005	23288	8714	198710	118928.6	59.85	85	472.4	108255.2	54.48
Anhui	1996	3258	-	129634	44084	34.01	10	16	-	-
	1997	3565.89	-	109750	46887	42.72	11	15.75	-	-
	1998	3781.37	-	111060	45282	40.77	8	19.75	-	-

13 www.h20-china.com. June 23rd, 2004.

Province	Year	Length of drainage pipe (km)	Length of sewers (km)	Annual wastewater discharge ($x10^4$ m^3)	Annual WWT ($x10^4$ m^3)	WWT rate (%)	Municipal WWTP			
							# of Plants	Treatment capacity ($x10^4$ m^3/day)	Annual centralized treatment quantity ($x10^4$ m^3)	Centralized treatment rate (%)
	1999	3998.17	-	111813	49298	44.09	8	19.75	-	-
	2000	4199.79	-	104871	40660	38.77	8	19.75	-	-
	2001	4604	-	110662	48121.5	43.49	10	55.4	6545.0	5.91
	2002	5006.59	712.76	114432	52484	45.86	14	90.35	16260	14.21
	2003	5982	945.35	121008	57156.71	47.23	18	125.62	15707.71	12.98
	2004	6680.2	850.88	129752	58208	44.86	18	140.64	23151	17.84
	2005	7606	1159	126761	66346.6	52.34	21	158.2	33354.6	26.31

Notes:

1. Source(s): *China Urban Construction Statistics Yearbook* (1996-2005) (by MOC Comprehensive Accounting Division);
2. The provinces in the HRB include: Jiangsu, Henan, Shandong, and Anhui; the statistical data refers to the figures of the entire provinces.
3. "-"represents missing values in the *China Urban Construction Statistics Yearbook* (1996-2005);
4. The *China Urban Construction Statistics Yearbook* (1996-2001) does not include the "length of wastewater pipes (kilometer)"; the *China Urban Construction Statistics Yearbook* (1996-2000) does not include the "WWTPs treatment quantity ($x10^4$ m^3)";
5. No reliable official data has been found for the network wastewater collection rate, numbers of regular, semi, and non-operation WWTPs.

(2) Lack of Maintenance

4 Limited by operational funds and personnel technical proficiency, some installed facilities experience rapid aging, corrosion, and hidden danger on safe operation.

(3) Over Polluted WWTP Inlet Water

5 A universal problem persists for the quality of the WWTP inlet water in almost all the cities. For example, the inlet water of the Wangxinzhuang WWTP of Zhengzhou has a COD density 1.49 times as high as the maximum allowed density; 1.36 times for BOD, and 1.73 times for SS. The over polluted inlet water affects the operations of the WWTPs and leads to non-compliance outlet water quality.

(4) Insufficient Operational Cost Recovery[14]

6 Except the Wangxinzhuang WWTP of Zhengzhou, other WWTPs in Henan Province have encountered the problem of insufficient operational cost recovery. In order to remain in operation, some have kept raising debts; others have relied on government subsidies. Those who cannot even repay the construction costs have been forced out of operation.

(5) Low Collection Rate of Local Municipal WWT Fee

7 Low WWT fee collection. Under the national regulations, the local governments have made municipal WWT fee collection policies. The WWT fees are mostly collected from 2 channels: incorporated with water fee and collected by the water supply companies from the municipal

[14] How Could Centralized Urban Wastewater Treatment Enter a Virtuous circle? A Financial Perspective

water users, or collected from the users of self-supplied well by the Water Conservation Office of the Hydraulic Bureau. The MOC inspection (mentioned above) results indicate that the WWT fees collected from the first channel run higher than the second.

8 However, in general most of the cities face difficulties in WWT fee collection, especially the fees from firms and users of self-supplied water sources, and have low WWT fee collection rates. For example, the WWT fee collection rates in *Huaibei, Suzhou, Bozhou,* and *Jieshou* in Anhui and *Changge* in Henan are all lower than 40%. A total of 496 firm municipal water users in *Huainan* City of Anhui have overdue water fees, and 1/3 of the highly polluting ones among those have been shut down, leaving their debts as bad debts. Since the operation of the WWTs have been designed to mostly rely on the collection of the WWT fees, the actually collected WWT fee is far from sufficient to support the WWTP operation. A large proportion of the WWTPs now partially rely on the government subsidies.[15]

(6) Lack of Economic Incentive[16]

9 The rates of the water tariff and WWT fees have been set relatively low to take into consideration the affordability of the urban residents. The fees are also set at fixed rates, which will not float with the amount of water use or wastewater discharge, thus creating little or no incentive for the users to reduce wastewater discharge.

4.2.4.4 Capacity, Effectiveness and Efficiency of Municipal WWTPs

(1) Environmental Benefits

1 Due to the lack of data of the installed WWTP treatment capacity during the 9th FYP, the following analysis will look at the benefits from the treatment capacity of the municipal WWTPs installed during the 10th FYP.

2 Analysis of the pollutants removal capacity of the constructed WWTPs (Table 4.2.4.4-1) will be limited to the COD and NH3-N reduction capacity in Henan and Shandong during the 10th FYP due to limited data availability.

Table 4.2.4.4-1 Capability of COD and NH_3-N Removal of the WWTPs Constructed during the 10th FYP in Henan and Shandong

Province	# of WWTPs completed	Planned investment ($x10^4$yuan)	Actual investment ($x10^4$yuan)	COD removal capability (ton /year)	NH_3-N removal capability (ton /year)	Planned COD removal ($x10^4$ ton /year)	Planned NH_3-N removal ($x10^4$ ton/year)
Henan	8	339504	111085	50310	5421	8.3	1.21
Shandong	25	286000	207464.4	194910	14618	12.6	1

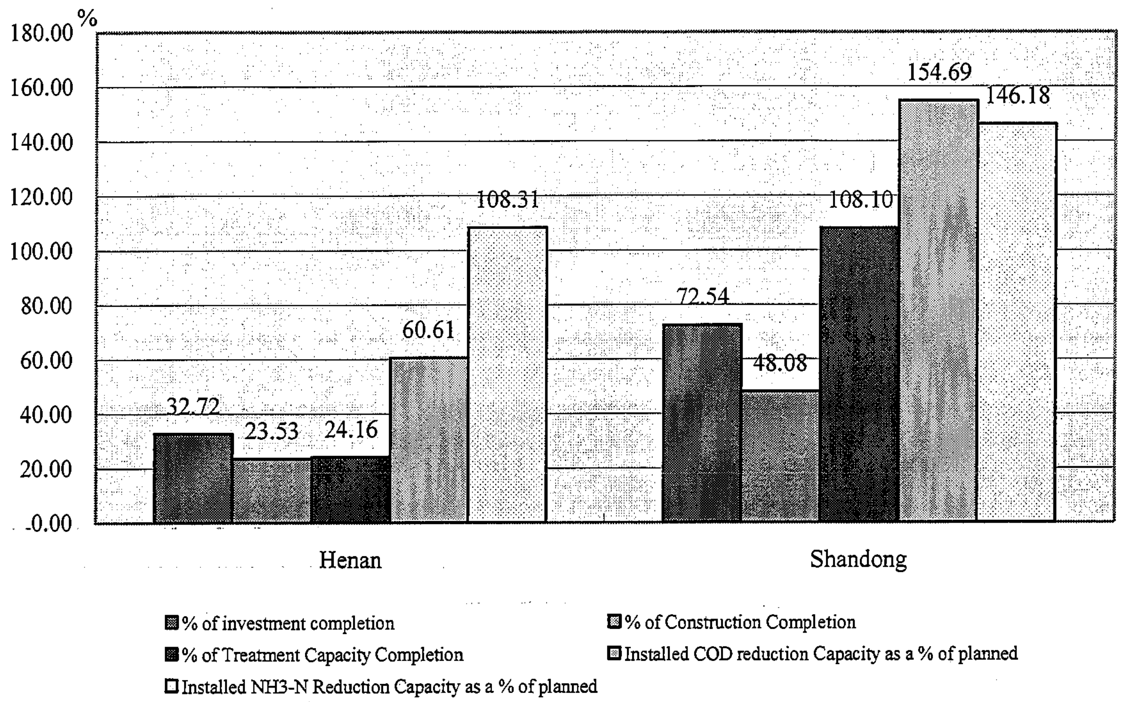
Source(s): Evaluation Report on the Performance of Shandong/Henan Province Regarding the 10th FYP of the HRB Water Pollution Prevention and Control

[15] www.h2o-China.com, June 23rd, 2004.

[16] Study on Fee Collection from the Centralized Urban Domestic Wastewater Treatment

3 Figure 4.2.4.4-1 exhibits the WWTPs rate of investment completion, rate of construction completion, and the installed to the planned COD and NH3-N reduction capacity in Henan, Shandong.

Figure 4.2.4.4-1 WWTPs Investment and Construction in Henan and Shandong



Source(s): Implementation Evaluation Report of the 10th HRB Water Pollution Control and Prevention FYP of Henan Province, Implementation Evaluation Report of the 10th HRB Water Pollution Control and Prevention FYP of Shandong Province

4 For Henan Province, even with only 24.16% of the planned capacity being installed using 32.72% of the planned investment, the COD and NH3-N reduction rates have reached 60.61% and 108.31% of the FYP objectives respectively.

5 Similarly in Shandong Province, 72.54% of the planned investment has generated 108.10% of the planned reduction capacity and 154.69% and 146.18% of COD and NH3-N removal of the planned levels.

(2) Economic Benefits

6 WWTPs require huge investments. For a WWTP with a daily treatment capacity of 10×10^4 m^3 (approximately equivalent to the discharge of a population of 50×10^4), the construction investment in its WWT facilities would reach 1.5×10^8 yuan. Huge operational costs would follow once the WWTP starts operating. Generally, the O&M costs of WWTPs include labor, equipment, materials coasts, operations, and management costs. The analysis of the average operational costs

of WWTPs of various scale and processes[17] are shown in Table 4.2.4.4-2.

Table 4.2.4.4-2 Average WWTP O&M Cost

Capacity	Treatment process	O&M average cost (yuan/m3)	
		Depreciation included	Depreciation excluded
Small scale WWTP	Traditional activated sludge	1.01	0.85
	Oxidation ditch	1.08	1.08
	A_2O process	0.77	0.74
	AO process	0.55	0.42
Medium scale WWTP	Traditional activated sludge	0.77	0.55
	AO process	0.93	0.47
	AB process	0.67	0.46
	Oxidation ditch	0.76	0.50
Large scale WWPT		0.99	0.76

Source(s): The O&M cost analysis of the WWTP in east area of China. China Water and Wastewater, 2001

7 The operational cost of WWTPs correlates not only closely to the treatment processes selected but also the operational rate of the WWTPs. A low operation rate will lead to a much higher operational cost than it should have been. And besides the lack of wastewater distribution networks, the over design in treatment capacity has also led to the low operation rate of the WWTPs. This is particularly evident in newly developed urban areas. Although the WWTPs have been built, the relatively low population density and insufficient source wastewater will lead to at least partial idle facilities.

8 Currently, the major source for WWTPs' operational expenses is the collected WWT fee. The 2004 *Circular on the Issues Concerning WWT Fee Collection in the Four Provinces in the HRB* by the NDRC has required that the 4 provinces increase the rate of WWT fees to recover operational costs by the end of 2005. This has led to a WWT fee rate of 0.8 yuan/m^3. For regions where a rate of 0.8 yuan/m^3 is infeasible for the moment, a localized rate will be required to meet operational cost recovery. In the 8 prefectures in Jiangsu province that belongs to the HRB, the rate of WWT fee has been increased to or above 0.8 yuan/m^3 in most of the counties and county-level cities to ensure the recovery of operational costs. In Henan Province, the rate of WWT has increased to an average of 0.7 yuan/m^3, with which the most basic operation of the WWTPs could be covered.

9 Nevertheless, the actual collection rate of the WWT fees has been low, due to inadequate wastewater discharge regulations and billing to the self-supplied water users, bad economic performances of certain firm water users. Most of the WWTPs still rely on governmental subsidies. The collection rate in Henan Province WWT fee usually lingers around 40-50%[18], while in

[17] Analysis of Municipal WWTP Operational Cost in Southeast China. China Water Supply & Sanitation, 2001, 17(8): 29-30.

[18] Henan Province Construction Bureau. "Accelerate the Construction of Urban Wastewater and Solid Waste Treatment Projects; Promote the Sustainable Economic and Social Development," 2002.

Shandong due to wealth of self-supplied wells only 10-30% of the WWT fee has been collected from the self-supplied water users[19]. In Fuyang City of Anhui Province, even for the best year, only some 500×10^4 yuan out of the 1500×10^4 billable WWT fee has been collected.

10 Local WWT fees are mostly collected through 2 channels: incorporated with water fee and collected by the water supply companies from the municipal water users, or collected from the users of self-supplied well by the Water Conservation Office of the Hydraulic Bureau. The WWT fees collected from the first channel run higher than the second.

11 Some of the big water users with self-supplied wells do not provide creditworthy numbers on their water usage, and the Drainage Office does not have the capacity to check. Since the Water Resource Management Division belongs to the Water Authority, the Drainage Office does not have access to the actual water usage of the self-supplied wells. Consequently, a large proportion of the WWT fee from the firms and residents with self-supplied wells could not be collected.

12 In contrast, some BOT (Build-Operate-Transfer) WWTPs show significant economic return; some have an investment rate of return of 8%[20]. This suggests that the building and operating WWTPs with market-oriented approaches could resolve two 2 key issues: source of the initial investment and sustained healthy operation. For BOTs, the managing and operating company finances the construction of the WWTPs, taking off the issue of investment financing off the worry list of the municipalities. The company secures the WWT fee collection through various contracts, keeps the WWTP in good conditions, and executes the contracts to ensure its own revenues.

Case of Market-Oriented WWTP

Xuzhou City No. 1 WWTPs is the first large scaled municipal WWTP in the HRB with a history of 14 year. Anhui Guozhen Environmental Protection & Energy Conserving Technology Co., Inc. acquired its 30-year franchise in 2004 for 1.6×10^8 yuan. And this has become the first TOT (Transfer-Operate-Transfer) WWTP.

Currently the Xuzhou Guozhen WWPT treats 15×10^4 ton wastewater from the Kui River region at daily basis. The Kui River is a tabulate of the Huai River that passes through the densely populated industrial and domestic area in south Xuzhou. The wastewater from the plants and residents along the river threatens both Jiangsu and the downstream Anhui.

The Xuzhou Guozhen WWTP has a stable monthly revenue between 350×10^4-500×10^4 yuan, while previous before TOT the monthly revenue never exceeded 80×10^4 yuan.

Source(s): Xuzhou WWTP Franchised at 1.6×10^8 yuan for 30 years with TOT. China Environmental Press, 2004.

4.2.5 Factors Impacting Non-Point Source Discharge

1 During the 9th FYP, the government did not pay much attention to the non-point sources

19 Shandong Province Construction Bureau. Reply to the Proposal on "One of the Keys to Solve the Water Pollution Control Problem in Underdeveloped Areas Lies in Resolving the Operational Costs of WWTPs", 2006

20 Xuzhou WWTP Franchised at 1.6×108 yuan for 30 years with TOT. China Environmental Press, 2004.

pollution. The 9th FYP did not specify objectives and tasks regarding non-point sources pollution control. Although the MOA launched programs in establishing demonstrative ecological agricultural county, promoted water and soil retention, wetland conservation, and comprehensive pesticide control, both the scope and intensity had been far from enough to tackle non-point sources.

2 The 10th FYP has specified its non-point sources pollution control objective specifically as "resolving the non-point source pollution at the Southern Four Lakes" as well as the principle to be adopted, "prohibiting or restricting the use of pesticides and inorganic fertilizers in the surrounding area of the Southern Four Lakes, promoting low-or-null environmental impact, green, and organic agriculture." In addition, 29 watershed comprehensive pollution control projects with a total investment of 31.0×10^8 yuan, 6 agricultural non-point source pollution control projects with a total investment of 3.9×10^8 yuan have been implemented in the 4 HRB provinces. Among those, Henan Province established 4 ecological demonstrative zones or wetland ecological protection zones and 1 comprehensive agricultural non-point sources pollution control program; Anhui Province implemented 5 agricultural non-point sources pollution control projects and 15 regional comprehensive pollution control projects.

3 Nevertheless, the agricultural non-point sources discharge during the 9th and 10th FYPs remained high due to intense and wide usage of fertilizers and pesticides, direct discharge of large proportions of livestock and husbandry wastes. The key HRB non-point sources pollution control and ecological agricultural demonstration projects remained limited in scope and impacts and have been "demonstrative" in nature. The lack of sufficient funding sources, large investment requirements, and complicated inter-agency coordination have further deterred the non-point source pollution control.

4 Realizing the lack of basic understanding of the non-point sources pollution, in 2005 MOA conducted a rural non-point sources pollution survey in the HRB. However, limited by funding and other resources, this survey alone did not provide sufficient information to understand the non-point sources pollution situations. As no monitoring of the non-point sources pollution in the HRB exists, the 10th FYP non-point source pollution control methods remain "in principle", and the non-point source pollution control programs face no strict project completion and performance criteria. Even with the official data it will be difficult to judge the implementation of the 10th FYP non-point source control program and to conclude the contribution rate of the non-point sources to the Huai River water body pollution.

5 Table 4.2.5-1describes the HRB agricultural non-point sources pollutants in the environment. Data in the table suggests that agricultural non-point sources COD that entered into the enviornment is approximately 10-13 times that of the point sources during the 10th FYP. Although unlike point sources, most of the non-point sources pollutants entering into the enviornmenta will eventually not enter into the water bodies, the massive non-point pollution in the environment faces almost no pollution control measures. The agricultural non-point sources pollution has become a serious threat to the HRB water bodies.

Table 4.2.5-1 Agriculture Non-Point Source COD Discharge into Environment of the HRB

Item	1993/1995[1]	2000	2004/2005[2]
Agricultural non-point source COD discharged to the environment ($x10^4$ ton)	1129.6	1080.0	1253.2
Point source COD discharge to the environment ($x10^4$ ton)	201.12	105.9	94.57
Ratio of non-point to point source COD	5.6	10.2	13.3

Notes:

1. Agriculture non-point sources COD discharged to environment was the estimated data of 1995. The point source COD discharged was statistic data of 1993 (baseline year of 9thFYP).

2. Agriculture non-point sources COD discharged to environment are the estimated data of 2004. The point source COD discharged was statistic data of 2005.

6 Besides the agricultural non-point sources, the urban non-point sources will also pollute the water bodies. However, since almost no previously existing studies or data could be found for the urban non-point sources in the HRB, this study will not be able to draw conclusions on the impact from the urban non-point sources.

7 In summary, (1) during the 9th and 10th FYPs, agricultural non-point sources pollution has not been effectively controlled; (2) the agricultural non-point sources pollution has become a noteworthy threat to the HRB water bodies; and (3) the studies and understanding of the HRB agricultural and urban non-point sources pollution are still quite limited.

5. Water Resources

5.1 Water Resource and its Impact on Water Environment

5.1.1 Change of the Water Resources

1 The Huai River water system upward of Honghekou are counted as upper reaches with an area of 3.06×10^4 km^2; the part further downward of Honghekou up till the exit of Hongze Lake, and Zhongdu are the middle reaches, stretching to an area of 15.8×10^4 km^2; as for the lower reaches and outlet to Yangtze River, it runs from Zhongdu to Sanjiangying. The area above the Sanjiangying totals to 16.46×10^4 km^2. The middle and lower reaches of the Huai River represent an asymmetric sector with an inclination to flowing southwards for the mainstreams. Among all the tributaries, the Shanying River ranks as the largest with a 4×10^4 km^2 of itself. To the east of the Li Canal at the Huai River downstream lie the coastal rivers such as the Sheyang Harbor, Huangsha Harbor, Xinyang Harbor, and Doulong Harbor, with a watershed area of 2.5×10^4 km^2, which divert the runoff from the Lixia River and coastal rainfall. Big lakes in the Huai River water system include the Hongze Lake, Gaoyou Lake, and Shaobo Lake. The multi-year average annual amounts of water resources of the sub-watersheds are listed in the Table 5.1.1-1 below.

Table 5.1.1-1 Multi-Year Average Water Resource in the HRB

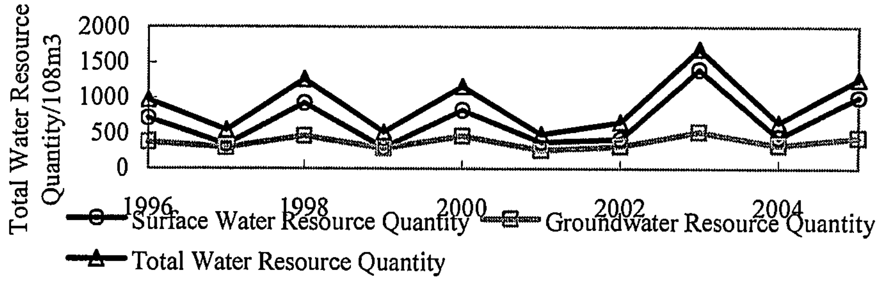
Unit: 10^8 m^3

Area	Surface water	Groundwater	Overlap value	Total water resource
Upstream of Wangjia Dam	101	44	23	122
Wangbang section	201	121	46	276
Banghong section	73	53	15	111
Upstream of Hongze Lake	375	218	84	509
Downstream of Huai River	78	41	10	109
Huai River	453	259	94	618
Southern Four Lakes area	36	51	12	75
Yi-Shu water system	132	64	35	161
Yi-Shu-Si water system	168	115	47	236
the HRB	621	374	141	854

Source(s): the HRB Hydraulic Manual, 2003

2 The Huai River water system multi-year average natural surface water resource amounts to 621×10^8 m^3, where the groundwater resource amounts to 374×10^8 m^3. By deducting the 141×10^8 m^3 double counted, the HRB water resource totals to 854×10^8 m^3. The HRB water resource fluctuates greatly from year to year. The variations indicated by the data over the past decade (Figure 5.1.1-1) suggest variations over 100% in neighboring years.

Figure 5.1.1-1 Water Resource in the HRB during the 9th and 10th FYPs

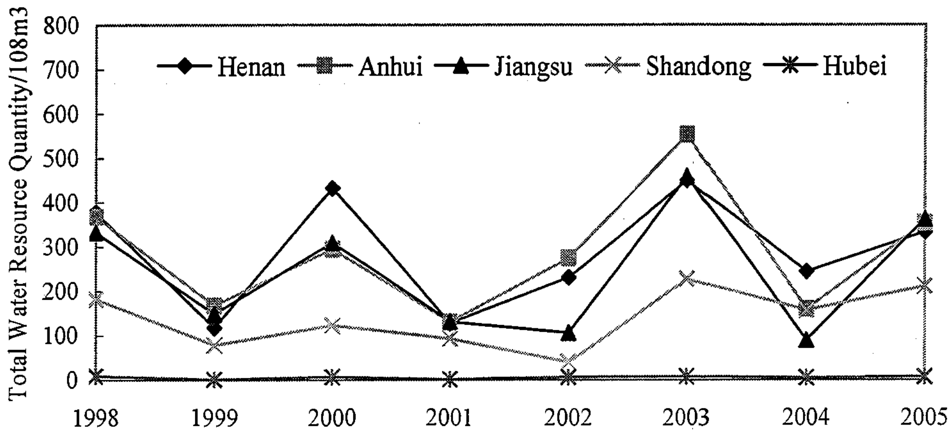


Source(s): Huai River Water Resource Communiqué

Year	Surface water resource	Groundwater resource	Total water resource
1996	712.8	372.6	971.7
1997	340.7	297.7	546.1
1998	927	462.1	1269.6
1999	292.3	285.6	514.7
2000	828.9	458.3	1164.7
2001	374.96	264.68	482.96
2002	414.37	317.25	656.58
2003	1400.69	519.65	1695.04
2004	440.43	330.31	653.2
2005	1009.72	439.06	1265.89

3 The HRB surface water exhibits significant variations spatially. Figure 5.1.1-2 shows the annual variations in water quantity in the provinces in the HRB. Shandong and Hubei provinces have a relatively small share of the total water quantity; Henan, Anhui and Jiangsu provinces take a relatively bigger share. The provinces show a similar fluctuation of water quantities, although the annual variations have been significant for each of the provinces.

Figure 5.1.1-2 Water Resource of each Province in the HRB



Source(s): Huai River Water Resource Communiqué

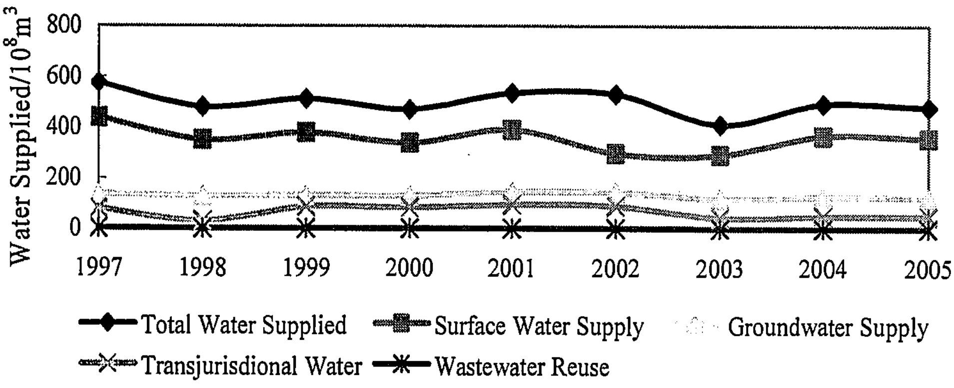
Province	2005	2004	2003	2002	2001	2000	1999	1998
Henan	333.07	243.82	449.29	230.75	127.77	431.87	117.65	377.80
Anhui	353.80	159.33	552.64	273.74	129.59	294.32	167.83	367.80
Jiangsu	361.65	89.00	458.80	105.97	131.49	308.81	149.13	332.70
Shandong	210.57	156.80	226.73	39.92	92.88	122.96	78.68	182.40
Hubei	6.81	4.25	7.57	6.20	1.23	6.70	1.41	8.90

4 The water resource in the HRB peaks during the flood season, when its runoff alone accounts to approximately 50-80% of the year-round runoff. Further, the level of concentration increases from south to north within the watershed.

5.1.2 Watershed Water Usage Variations

1 Compared to the natural water resource variations in the HRB, its water supply and usage are relatively stable across the years (Figure 5.1.2-1).

Figure 5.1.2-1 Water supply in the HRB



Source(s): Huai River Water Resource Communiqué

Year	Total water supply	Surface water supply	Groundwater supply	Water transfer between watershed	WWT and reuse
1997	575.19	438.23	136.96	80.26	2.68
1998	480.82	351.12	129.7	30.88	1.65
1999	512.21	378.59	132.35	87.87	1.23
2000	470.97	338.5	130.63	83.75	1.84
2001	536.8	390.49	145.24	95.48	0.86
2002	530.42	296.87	143.53	89.26	0.76
2003	410.87	291.93	118.32	43.28	0.63
2004	493.19	366.59	125.94	50.4	0.66
2005	479.63	356.42	122.64	50.27	0.66

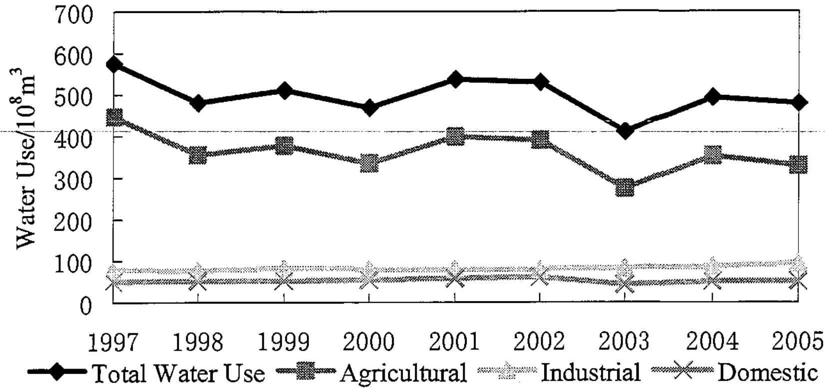
2 The water reuse in the HRB water is relatively low; watershed water supply and usage are basically in balance (Table 5.1.2-1).

Table 5.1.2-1 Variation of Water Supply and Usage in the HRB

Year	Water supply (108 m3)	Water usage (108 m3)
1996	476.60	-
1997	575.20	575.40
1998	480.82	480.53
1999	512.20	511.20
2000	470.97	468.98
2001	536.80	536.80
2002	530.42	530.41
2003	410.87	410.87
2004	493.19	493.19
2005	479.63	479.63

3 Over 70% of the HRB water resources have been used as agricultural irrigation water (Figure 5.1.2-2).

Figure 5.1.2-2 Water Usage in the HRB



Source(s): Huai River Water Resource Communiqué

Year	Total Water Usage	Agricultural Use	Industrial Use	Domestic Use
1997	575.40	447.70	77.77	49.94
1998	480.53	354.00	75.94	51.10
1999	511.19	377.21	82.30	51.68
2000	468.98	334.31	80.60	53.86
2001	536.8	398.41	80.48	57.90
2002	530.41	390.50	79.79	60.12
2003	410.87	273.94	83.77	43.08
2004	493.19	353.04	86.85	50.11
2005	479.63	329.31	95.18	51.51

4 With the accelerating urbanization in the HRB, the increase in urban population and number of manufacturers poses high demand for the water supply capacity in the watershed. In the conditions that the watershed surface water quality cannot meet the requirements of various water uses, higher expectations will be posed to the watershed groundwater utilization. With a relatively stable water table, the quantity of ground water resource in the HRB with a mineralization level lower than 2 g/l is $341\times10^8 m^3$, and that with a mineralization level lower than 5 g/l is $353\times10^8 m^3$. The multi-year average groundwater replenishment to the groundwater in the watershed in plain area of the HRB totals to $302\times10^8 m^3$, the groundwater quantity is $292\times10^8 m^3$, of which the exploitable quantity is $208\times10^8 m^3$ (Ning Yuan, et al., 2003). The replenishment, groundwater resource quantity, and exploitable quantity in plain areas are listed in Table 5.1.2-1.

Table 5.1.2-2 Groundwater Replenishment, Resource and Exploitation in Plain Area of the HRB

Unit: $10^8 m^3$

Area	Replenishment	Groundwater resource	Available for exploitation	Replenishment module (104m3/km2)	Available for exploitation module (104m3/km2)
Upstream of Hongze Lake	188	182	123	18	11.7
Downstream of Huai River	25	22	20	12	9.4
Huai River water system	214	204	143	17	11.4

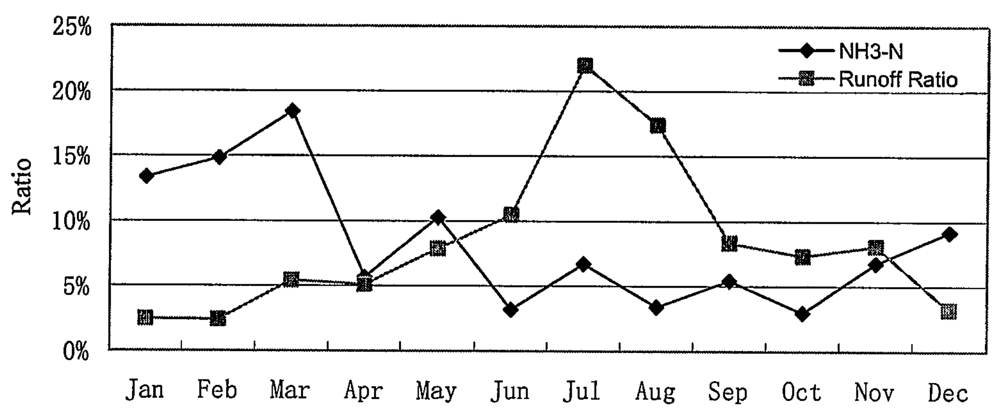
5 Year 1997, 1999, 2001 and 2004 are typical low water years for the HRB. Year 2000 saw spring drought and autumn flood. The significant yearly and monthly water quantity variation posed serious conflicts with the relatively stable industrial, agricultural and domestic water demands.

5.1.3 Impact from Water Quantity Change on Water Quality

1 The conditions of the water resource have direct impact on the self-purification capacity of the watershed water bodies and the water environment capacity. With constant pollutants discharge, the temporal and spatial distribution of the water resource will have direct impact on the water environment and influence the water pollution control and prevention projects. In recent years the HRB has experienced frequent low water years, highly concentrated water flows during the flood seasons, and, most severely, water shortages during the low water seasons of the high water years. The water shortages in the HRB has led to reduced water body environmental capacity and negative impacts on the watershed water pollution control and prevention projects.

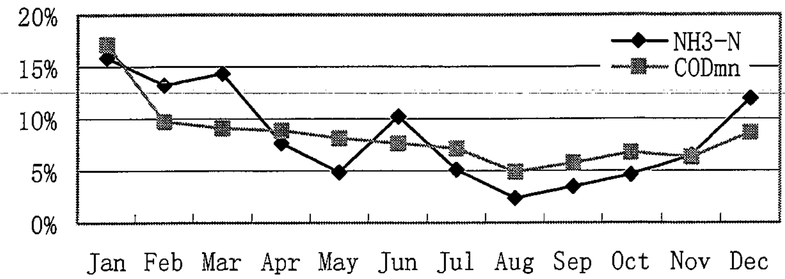
2 Year 1997 through 2002 have been generally dry expect 1998, 1999, and 2000 (Figure 5.1.1-1). In 1999 the precipitation during the regular flood season (June–September) was only 62.5% of the normal quantity. And 2001 has been a thorough dry year from spring to winter. Its flood season average rainfall of the entire watershed reduced by 33% compared to other years. At Bengbu Gate, for example, its water quantity of the entire year was only 73.86×10^8 m^3, approximately 25% of the regular years; the total flood season (May-September) water quantity ran 9.6×10^8 m^3 less than that of 1978, a recorded drastic dry year. The dry weather during the flood season, topped with previous draughts and frequent water reservation at reservoir, the major water gates and dams at the Huai River all experienced zero flows. Water pollution control and prevention in the watershed faced serious challenges. Figure 5.1.3-1 indicates the negative correlation between the multi-year average monthly NH_3-N density and the runoff – indicators of water quality and quantity – at the Huaibin Station on the Huai River mainstream.

Figure 5.1.3-1 Relation between NH_3-N and Runoff at Huaibin Station



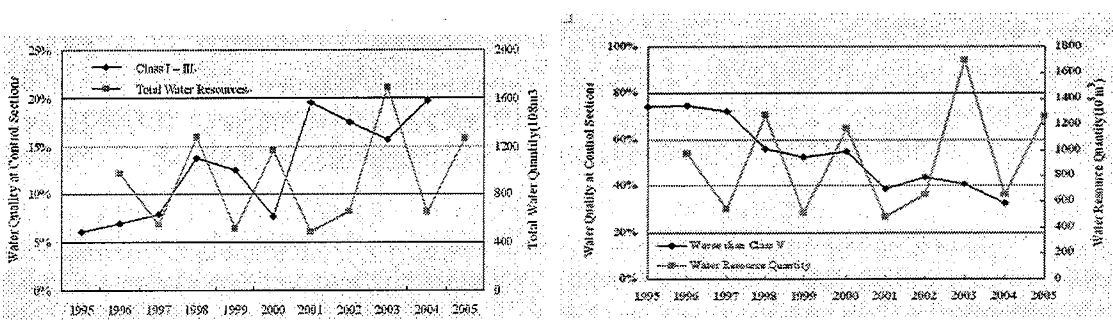
3 Figure 5.1.3-2 exhibits the multi-year average monthly NH_3-N and COD_{Mn} densities at Wangjiaba Station and indicates that the high water season, June to September, corresponds to the lowest level of the multi-year average density for typical water quality indicators.

Figure 5.1.3-2 Multi-Year Average Monthly Variations of Typical Water Quality Indicators at the HRB Wangjiaba Station



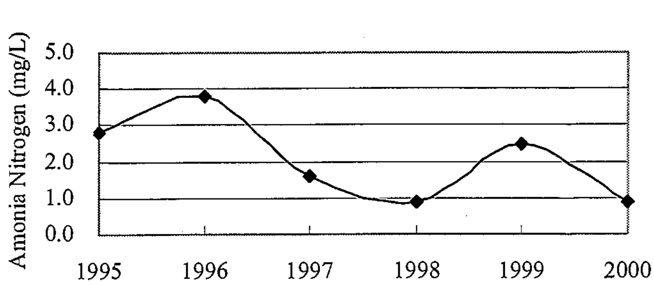
4 Figure 5.1.3-3 plots the watershed water quantity and the proportion of water quality classes at the control sections between 1996 and 2004. A number of factors, such as the dramatic temporal and spatial variations in water quantity distribution, may have blurred the relation between the aggregated water quantity changes and proportion of water quality classes.

Figure 5.1.3-3 HRB Surface Water Quantity and Proportion of Water Quality Classes at Control Sections



5 Watershed water quantity variation is an important impact factor to the water environment conditions. Year 2000 has been a relatively high water year for the HRB. The year-round watershed natural runoff totaled 828.9×10^8 m^3, a 39.1% increase from yearly average and a 183.6% increase from the previous year. The HRB groundwater quantity reached 458.3×10^8 m^3, 60.5% higher than the previous year. In general conditions during high water seasons favor watershed water pollution prevention and control. Variations in annual NH_3-N density at Bengbu Gate (Figure 5.1.3-4) shows that the NH_3-N density peaked during 1996 and 1999, the low years, and stayed low at the high water years.

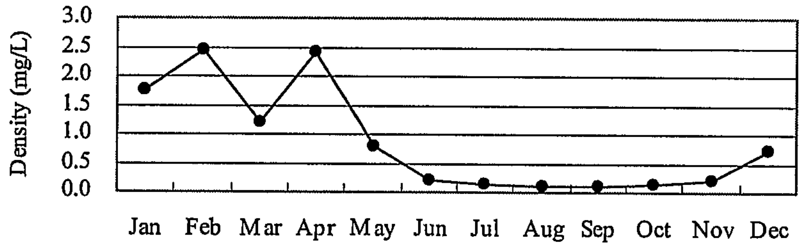
Figure 5.1.3-4 Annual Variations of NH_3-N Density at Bengbu Gate



6 Noteworthy is Year 2000. Its spring and early summer saw a dramatic 60% reduction of rainfall compared to regular years. The monthly average water levels at Xi County, Wangjiaba, Bengbu and Yi River Linyi Stations, the major control stations of the Huai River had broken the record low since 1949. Bengbu Wujiadu even broke the record low water level since 1916. Following this dramatic spring draught was an autumn flood rare to the HRB history.

7 Figure 5.1.3-5 shows the NH_3-N density at Bengbu Gate across the seasons of year 2000. The NH_3-N density during the 2000 spring draught had been significantly higher than the density during the autumn floods – the NH_3-N density visibly dropped in June when the spring draught ended. Year 2000 illustrates that the seasonal variations in the HRB water quantity bring negative impact to the watershed water environment control and prevention.

Figure 5.1.3-5 NH_3-N Density Change at Bengbu Gate in 2000



8 Immediately after the biggest since 1954 in 2003, 2004 saw a relatively dry year in Huai River region. The HRB natural year-round runoff totaled 440.43×10^8 m^3, showing a 26.0% drop from regular years. Nevertheless the overall relatively dry year of 2004 still experienced regional rainstorms. From July 16 to 20, 2004, rainstorms around the upper stream area of the Shaying River, Hong River, and Wo River, main tributaries of the Huai River, created a 5.4×10^8 ton, 130-140 km water mass with high pollutant contents rushing through the Huai River

9 The uneven spatial and temporal distribution of the water resource, as a consequence of the characteristics of transitional climate zone, has been an important natural impact factor for the HRB watershed water environment problem during the 9th and 10th FYPs. Despite the high aggregated multi-year average water quantity in the HRB, the unevenness of HRB water resources has had significant impact on the watershed water environment, especially during the dry years (such as 1999 and 2004) and years of extreme variations (e.g., 2000).

5.2 Impact of Hydraulic Facilities on Water Environment

1 The uneven spatial and temporal distribution of the HRB water flow leads to frequent floods and draughts. To relieve the tension between the natural water quantity variation and the industrial and domestic water demand, a number of hydraulic engineering projects have been launched in the HRB.

5.2.1 Hydraulic Facilities

1 The hydraulic engineering in the HRB emphasizes on "coordinated storage and diversion" with its main objectives in flood prevention and diversion, water supply, and shipping. The *Decision on Further Pollution Control of the Huai River and the Tai Lake by the State Council* in

1991 further emphasized the objective of flood prevention and diversion in the watershed water resource management and enhanced hydraulic engineering. The existing watershed hydraulic engineering include the following types:

(1) Reservoirs

2 Table 5.2.1-1 provides the details on the scale and major functions of the current major reservoirs in the HRB. Besides, reservoirs with functions of flood prevention, irrigation, water supply and aquiculture have been built for Hongze Lake, Southern Four Lakes and Luoma Lake. Currently, the major goals of the watershed reservoirs are flood prevention and ensuring agricultural irrigation water.

Table 5.2.1-1 Reservoir in the HRB

Reservoir	Location	River connected	Catchment area (km2)	Total storage capacity (108 m3)	Usable storage capacity (108 m3)
Zhaopingtai	Henan Lushan County	Sha River	1430	7.13	3.94
Baiguishan	Henan Pingdingshan	Sha River	2740	7.31	3.21
Suya Lake	Henan Runan	Ru River	4498	16.56	2.66
Nanwan	Henan Xinyang	Shi River	1100	16.3	6.3
Nianyushan	Henan Shangcheng County	Guan River	924	9.16	5.12
Banqiao	Henan Miyang County	Ru River	768	6.75	2.56
Fuziling	Anhui Huoshan County	Pi River	1840	4.96	3.84
Mezitan	Anhui Huoshan County	Pi River	570	3.37	1.9
Xianghongdian	Anhui Jinzhai County	Pi River	1400	26.32	14.13
Meishan	Anhui Jinzhai County	Shi River	1970	23.37	12.45

(2) Artificial New Canals

3 Against problems of insufficient capability for flood discharge of main stream, many artificial new canals have been excavated out in the HRB to relieve the pressure that Huai River main stream has burdened for flood discharge. Traits of the main artificial new river in the HRB are shown in Table 5.2.1-2. All artificial new rivers carry the function of flood prevention and diversion; a few concurrently carry the function of irrigation.

Table 5.2.1-2 Artificial River in the HRB

Artificial river	Location	Length (km)	Function	Design standards	Construc-tion date
Cihuaixin River	From Pu gate of Ci river to Jinshan Southern Entry of Huaiyuan County	134.2	Major in flood diversion, combined with irrigation, shipping and urban water supply (the main drinking water source for Fuyang)	Remove waterlog occurred once 5 years, prevent flood occurred once 20 years	1970s
Huaihong New River	Huaiyuan-Guzhen-Wuhe-Sihong	135.0	Flood prevention, remove waterlog	Remove waterlog	1970s
Xinbian River	Qilingzi of Suzhou to Lihewa of Hongze Lake	127.1	Flood prevention, remove flooded fields, and irrigation, shipping, water supply and aquiculture	Remove waterlog occurred once 5 years, prevent flood occurred once 20 years	1960s
Taizhou Intake	From Changjiang River to	24.0	Draw Changjiang River water to Lixia River region, combined with	Intake water from Changjiang river 600	1995-2002

Artificial river	Location	Length (km)	Function	Design standards	Construc-tion date
River	Xingtongyang Canal		drain waterlog, shipping functions	m3/s	
Tongyu River	From Nantong to Ganyu of Lianyungang	415.0	Draw water, shipping, rinse silt to protect port, control/ drain waterlog; South Water to North east-line main project	Intake water 100m3/s	1990
Xuhong River	From Gule river of Hongze Lake to Fangting river		Draw water, combined with drain waterlog, flood prevention and shipping functions; South Water to North east-line branch, water-transport line		1993
Subei Irrigation Channel	From Hongze Lake to Biandanxiang	169.0	Major in irrigation, combined with flood prevention, drain waterlog, shipping and electricity generation functions	Flood discharge 800m3/s	1950s
Channel to the sea	From Hongze Lake to Biandanxiang	163.5	Flood prevention, drain waterlog	Flood discharge 2270-7000m3/s	1999-2003

(3) Dikes

4 Currently, there are various dikes exceeding 5×10^4 km in the HRB, in which main ones are 1.1×10^4 km. Office of State Flood Control and Drought Relief Headquarters specified protected banks include North Huai River levee, Hongze Lake levee, Li Canal levee and the important industrial and mineral bank circle along Huai River as well as two city bank circles of South Huai River and Bengfu. The important dikes include West Hu levee of Southern Four Lake, Yi River, Shu River, New Yi River, dike of New Shu River, Hongru River, Shaying River, Wo River, dike of Cihuai New River, as shown in Table 5.2.1-3.

Table 5.2.1-3 Main First Class Dikes in the HRB and their Functions

Main first class dike	Start and ending position	Length (km)	Population in protection area ($x10^4$ person)	Plantation area protected ($x10^4$ Mu)
Huaibei Levee		633.6	1000	1081
Wuoxi Levee	Ci river to Xiyangji	400.2	-	569.7
Wuodong Levee	Qingyanggou to Xiacaowan	233.4	-	511.3
Hongze Lake Levee	Jiangsu Huaiyin Matou Township	67.25	2000	3000
Li canal Levee	Qingpu of Jiangsu Huai'an to Jiangdu	157.05	1316	1500
Right bank of irrigation channel	Gaoliangjian gate of Hongze County Jiangsu toSheyang County	161.02	1361	1657
Right bank from Huai River to Yi River	Er River of Huaiyin Jiangsu to Shuyang County	98.08	552	636

(4) Water Gates

5 The water gates in the HRB include water control gates, discharging water gates, flood diversion water gates, upsurge block water gate and inlet water gate. Among those, many are water control gates. They block and store river water, regulate the channel runoff, irrigate, and replenish groundwater and water supply. On the contrary, the flood diversion water gates solely target at regulating the entire area's flood and ensuring flood prevention. Currently there are over 5000 units of various water gates in the HRB, where over 600 are large- and medium-scale water

gates. The important water gates of Huai River water system are the flood feeding water gates of Wangjiaba Dam and of Wang River Dam in floodwater storage areas, Bengfu water gate at the Bengfu hinge, Sanhe water gate and Erhe water gate at Hongze Lake outlet (Table 5.2.1-4).

Table 5.2.1-4 Main Gates in the HRB and Their Functions

Main gate	Position	Location	Functions	Designed max. flow-through at gate (m3/s)
Wangjia dam gate	Anhui Funan County	Huai River	Store floodwater	1626
Chengxihu gate	Anhui Huoqiu County	Huai River	Store floodwater	6313
Bengbu old gate	Anhui Bengbu	Huai River	Irrigation, shipping, power generation	8650
Bengbu new gate	Anhui Bengbu	Huai River	Irrigation, shipping, power generation	3410
Malanwan gate	Henan Wuyang County	Sha River	Irrigation, shipping, power generation	3000
Sanhe gate	Jiangsu Hongze County	Watercourse to river	Flood discharge, water store, power generation	13000
Erhe gate	Jiangsu Hongze County	Er river	Flood prevention, irrigation	9000
Sea mouth gate	Jiangsu Binhai County	Watercourse to sea	Block upsurge, flood prevention	2270

(5) "Key 19 HRB Pollution Control Hydraulic Projects"

6 Since the dramatic flood in 1991, the HRB kicked off the "Key 19 HRB Pollution Control Hydraulic Projects" (Table 5.2.1-5), emphasizing the watershed-wide industrial and domestic water use. By the end of 2005, 9 of the 19 projects have been completed.

Table 5.2.1-5 "Key 19 HRB Pollution Control Hydraulic Projects"

Project Name	Location	Objective	Status (up to 2005)
River channel and dike	Middle and upstream of the HRB	Flood prevention	Under construction
Floodwater storage and discharge safety	Store/discharge area in the HRB	Floodwater control	Under construction
Huaihongxin river	Anhui: Huaiyuan, Guzhen, Wuhe; Jiangsu: Sihong.	Floodwater discharge	Completed
Water entrance reinforce	Jiangsu: Huaiyin, Yangzhou; Anhui: Tianchang.	Floodwater discharge	Completed
Divide Huai water to Xi River	From Hongze Lake to Xinxi River	Flood prevention	Completed
Hongze Lake anti-seism	Hongze Lake dike	Flood prevention	
Reservoir	Four reservoir construction	Flood prevention and water supply	Partial completion
Xishusi River floodwater control	Jiangsu Province, Shandong Province	Flood prevention	Under construction
Reservoir reinforcement	Reservoirs	Flood prevention, water supply	Partial completion
Water channel to the sea	Jiangsu Province, Huai'an, Yancheng	Flood prevention	Completed
Linhuaihang floodwater	Anhui Province, Linhuaigang	Flood prevention	Completed

Project Name	Location	Objective	Status (up to 2005)
control	Huoqiu county		
Fenquan River preliminary repair	Around the boundary of Hennan and Anhui Provinces	Flood prevention, waterlogging remove,irrigation, shipping	Completed
Baohui River preliminary repair	Around the boundary of Hennan and Anhui Provinces	Flood prevention, waterlogging remove, irrigation, shipping	Completed
Wuo River preliminary repair	Wuo River	Flood prevention	Under construction
Kuisui River preliminary repair	Kuisui River	Flood prevention	Under construction
Hongru River preliminary repair	Hongru River	Flood prevention	Near completion
Shayin River preliminary repair	Shayin River	Flood prevention	Under construction
Huwa preliminary repair	Low-lying area of the basin	Flood prevention, waterlogging remove	Under construction
Other	the HRB	Flood prevention	Under construction

7 Prior to the 9th and 10th FYPs, the objectives of the HRB hydraulic facility construction and operation have been ensuring the industrial, agricultural and domestic water use and flood prevention, flood deviation, and irrigation. It was not until the 10th FYP when the negative impacts on the water environment incurred by the hydraulic facility construction and operation been noticed.

5.2.2 Features of Hydraulic Facilities

1 Limited by the objectives of the HRB hydraulic engineering construction and operation, the current spatial distribution of the existing hydraulic facilities does not coordinate with need and planning of the pollution control in the watershed.

2 The reservoirs, aimed at harnessing water resources with minimum construction, mostly sit at the upper stream hilly areas. One third of the hilly areas are influenced by the reservoirs. Hongze Lake, Southern Four Lakes, and Luoma Lake, however, are plain reservoirs, i.e., reservoirs at the plain area.

3 Since the major tributaries of the Huai River join into the Huai River in its middle reaches, where the river bed slope is small. Floods rush into the Huai River but divert slowly, making the Huai River downstream area a major area of flood control.

4 Directed by the HRB flood prevention and water supply objectives, most of the water gates and artificial new rivers have been located at the major tributaries and the downstream of the Huai River. The Huai River downstream hydraulic engineering, though, emphasizes on the waterways and flood prevention through storage and diversion.

5 The existing hydraulic engineering construction and planning do not fully take into consideration the factors of watershed pollutants discharge and impacts on the HRB water environment.

5.2.3 Impacts from Hydraulic Operations

1 The existing HRB hydraulic engineering construction and operation have largely been built for flood prevention, flood diversion, water supply and waterway shipping by even out the spatial and temporal variations in the HRB water resource distribution to meet the demands of industrial, agricultural, and domestic water use for the HRB socio-economic development. The gap between the objectives of the hydraulic operation and of the water pollution control and prevention and ecological protection has negatively influenced the HRB water environment at various degrees.

(1) Water Supply Facility Construction and Operation

2 The HRB water supply engineering consists of mainly the upper stream reservoir and middle reach control gate. They provide relatively stable agricultural irrigation water, industrial and domestic water supply in the low water seasons by water reserve during the flood seasons and release at the low water seasons.

3 The major objectives of the HRB water supply engineering are to research Huai River water to ensure the needs of irrigation, water supply and navigation. The widely distributed control gates will be shut off to reserve water to ensure the industrial, agricultural and domestic water usage during the dry seasons. Both the watershed water environment of the upper stream and downstream will be impacted by the watershed water supply hydraulic engineering: (1) Water reserving in the upper stream reduces the water body liquidity and the water flow turbulent flow diffusion, and further reduces the water environment capacity, leading to the stock-up of pollutants in front of the gates and dams. (2) Water reserve in the upper stream reduces the water quantity downstream, thus reduces the environmental capacity of downstream water bodies.

4 On the other hand, hydraulic engineering water reservation leads to the reduction or even zero quantity in the downward water volume in the downstream areas and lowers the water environment capacity of the downstream water bodies. Both impacts incur negative influence to the watershed water pollution control and prevention.

Cases of Water Supply Engineering Project Impacting the Water Environment

During the 2000 spring draught, in order to ensure the agricultural irrigation water in the upper stream area, The Xinshu River flood diversion gate remained shut to retain a water level of 50.55 m and reserved water volume of $400\times10^4 m^3$. Testing results of the water quality of the water body above the Gate on June 22 returned results of COD_{Mn} level as high as 24mg/L and dissolved oxygen level of 1.19mg/L.

Long draughts have persisted in 2001, leaving the Bengbu Gate of the Huai River mainstream with zero flow for a total of 176 days from May 24 to December 10.

(2) Engineering and Operation of Flood Prevention

5 The HRB flood prevention engineering consists mainly of the reservoirs at the upper stream, water gates and dams at the middle reach. Flood prevention adjusts the water volume by diverting

the flood peak time through storing the flood water and releasing during relatively dry times.

6 Due to the alternating volume of the HRB water quantity between high and low water seasons and the relatively even water supply needs across seasons, the flood diversion during the flood seasons often accumulates the pollutants from the reserved water during the dry seasons and creates concentrated discharge. When the hydraulic operations face little constraints from water pollution prevention requirements, the flood diversion flow inevitably becomes a significant source of pollution for the downstream.

Case of HRB Flood Prevention Engineering Impacting Water Environment

The 1990s saw the Huai River mainstream polluted by the released previously stored floods from its major tributaries. A particularly serious incident in July 1994 has been remembered for the severe pollution in the Huai River middle reach triggered by the flood release from the Shaying River. The release of 774×10^4 m^3 polluted flood water from the Kuaidian Gate at the Ying River upper stream in Henan Province on July 2nd, 2003 has caused the a 228% surge of NH_3-N density at the boarder area with Anhui Province on the Ying River. Impacted by the dramatic pollutants increase, the Fuyang City No. 2 WWTP was forced to shut down for 2 days (Zhu Yu, et al., 2005).

A proportion of the polluted water at the Flood Diversion Gate at the Xinshu River was released to the Shilang River reservoir during the flood season in late June 2000. The polluted water triggered a severe water pollution incident. An on-site survey on June 28 indicated that at Nanchen of Shilang River Town, Donghai County alone, approximately 70×10^4 kg fish in all of the 1350 aquaculture boxes have died; the direct economic toll reached over 300×10^4 yuan.

(3) Engineering and Operation of Flood Diversion

7 Major HRB flood diversion engineering is designed to divert floods by widening and constructing new river way in the middle reach by creating artificial new river and downstream watercourse.

8 However, the artificially widened river ways will alter the natural river and river bank wetland structures and reduce the point and non-point source pollutants degradation of the water environment, thus incur the reduction of the river water body self purification capacity.

(4) Coordinated Water Quality and Quantity Operation

9 The HRB hydraulic facilities have altered the watershed hydraulics while meet the watershed industrial, agricultural and domestic water demands. They have reduced the self purification and water environment capacity of the water bodies and altered the ecological conditions of the natural habitats. With increasing evident water environment problems, the impacts from the hydraulic facilities on the water environment have received attention. Among the efforts to relieve the negative impacts, the coordinated water quality and quantity operation has become an important approach to integrating environmental objectives with the HRB industrial, agricultural, domestic and ecological water demands. This approach strives to avoid severe water pollution incidents caused by the concentrated downward flow of the polluted water while ensuring water supply during the low water seasons and flood prevention during the flood seasons through operation by

the hydraulic facilities.

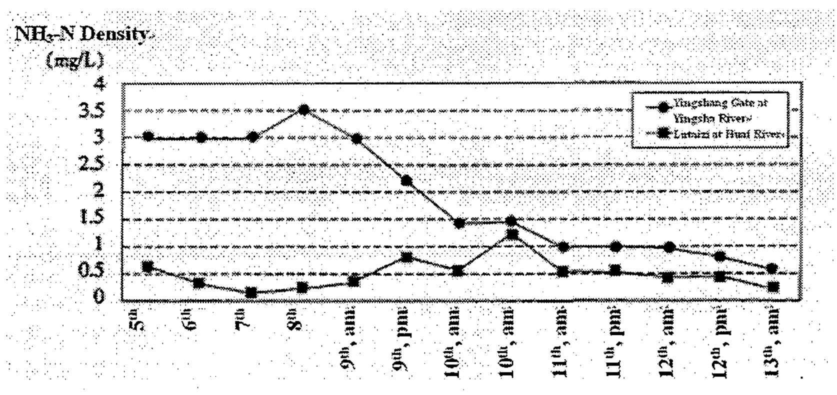
10 The joint water pollution prevention of the Huai River and Shaying River is a typical example of the coordinated HRB water quality an quantity operation. Shaying River is the largest tributary of the Huai River. It receives pollutants discharge and wastewater from 31 cities of county-level or above, which account to 43% of the pollutants of the entire Huai River water system. Throughout the late 1980s, the Huai River mainstream has suffered the pollution from the Shaying River flood releases. The current coordinated operation adjusts the volume of stored water and controls the speed and time span of the flood releases to avoid concentrated pollutants flow and relieve the pollution to the Huai River mainstream by the Shaying River. The adjusted operation objectives have changed the impacts on the water environment from the hydraulic engineering.

Case of Coordinated Water Quality and Quantity Operation in HRB

December 2004, Huai River entered into its low water season; pollutants density in Huai River and its major tributaries, Shaying and Wo rivers, gradually increases. Watershed-wide coordinated water quality and quantity operation kept a sustained small downward flow adjusted according to water quantity and quality conditions in the mainstream from the Yingshang Gate, where the Shaying River joins the Huai River mainstream, so that the downstream flow can fully take the advantage of the pollution absorption capacity of the Huai River mainstream as well as avoid severe water pollution.

By July 2005, when floods arrived in Shaying River, a total of $10.6 \times 10^8 m^3$ water with pollution has flowed down the Shaying River, which has avoided the stocking up of pollutants from the Shaying River pollutants and alleviated the water pollution from flood season flood diversion.

Impacts on the Huai River Mainstream Water Quality From the Shaying River Flood Release



Nevertheless, notably is that although the sustained small down flow of tributary water has avoided concentrated flush of pollution during the flood season, it has added to the pollution in the Huai River mainstream low water season in 2005.

Source(s): Cheng Xushui, et al., 2005

11 The uneven distribution of the water resources has been a natural impact factor of the HRB water environment problems. Nevertheless, the hydraulic engineering aimed at flood prevention, water supply, and waterway shipping without integrating consideration of water environment protection objectives has become a notable human impact factor. The integrated approach of the

coordinated operation has to a certain degree eased the negative impacts on water quality by the hydraulic engineering.

12 The current negative impacts on the HRB water environment and ecological conditions from the hydraulic engineering are caused by the divergence between the objectives of hydraulic engineering and the water environment and ecological protection. The planning and implementation of watershed-wide water pollution control and prevention program should integrate the natural water resource conditions and the impacts from the spatial distribution of the hydraulic facilities. Meanwhile, the hydraulic engineering also needs to incorporate the objectives of increasing water environment capacity and ensuring the ecological water demand of various levels in the engineering design and planning and the current hydraulic operations, while meeting the watershed industrial, agricultural, and domestic water demands and the flood prevention objectives.

13 It is recommended that a set of unified watershed-wide water resource and quality management policy, plans, and implementation objectives should be established through a coordinating mechanism of comprehensive watershed-wide water resource, water environment and water ecological management.

6. Legal Review and Evaluation

6.1 Laws

6.1.1 Basic Legislative Framework of China's Transjurisdictional Water Environment Management and Disputes Resolution

1 China's legislation on transjurisdictional water environment management mainly include:

(1) Constitution on water environment management

2 The Constitution is the fundamental law of China. It is the country's ultimate statute authenticated by the highest authority of the PRC. In China's legal system, Constitution has the highest legal status and authority. Article 9 of the *Constitution* of the PRC specifies: "All natural resources including minerals, streams, forests, mountains, grassland, wasteland, and shoals belong to the State, that is, all the people." Its Article clearly defines that "The State protects and improves the living and ecological environment, and prevents pollution and other public hazards. The state organizes and encourages afforestation and the protection of existing forests and trees. "

(2) Legal specifications of transjurisdictional water environment management and disputes resolution

3 The National People's Congress and its Standing Committee execute the state legislative authority. The legal status and effectiveness of its laws are under the *Constitution* but are higher than the regulatory statutes by other state agencies. They are the legal basis of other laws.

4 a. ***General Principles of the Civil Law*** (issued on April 12, 1986, enacted on January 1, 1987) Article 83 and 124.

5 b. ***Property Law*** (issued on March 16, 2007, to be enacted on October 1, 2007) Article 32, 33, 35-38, 117, 118-123.

6 c. ***Criminal Law*** (issued on March 14, 1997 and enacted on October 1, 1997) Article 338-346, and Article 408. Prior to the Criminal Law revised on March 14, 1997 and effective on October 1, 1997, no criminal conducts have been defined in China's environmental offense. As a result, environmental offenses are resolved with administrative means such as fines, shutting of plants, and dismissal of the heads. The 1997 revision of the Criminal Law has set the severe destruction of land, air, water bodies, forests and other natural resources as crimes. In Part II Specific Provisions of the Criminal Law, Chapter VI Section 6 "Crimes of Undermining Protection of Environmental Resources" clearly spells out environmental crimes of various types and the punishments for severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health.

7 d. ***Environmental Protection Act***. The Environmental Protection Act spells out the basic principles and institutions of environmental protection in China. The Chinese environmental legislative and law practices have regarded it as the environmental basic law of China. It has clearly defined the environmental protection authorities, subject of water pollution control, and the transjurisdictional pollution prevention and control.

8 For example, **Article 7** reads that "The competent department of environmental protection administration under the State Council shall conduct unified supervision and management of the environmental protection work throughout the country. The competent departments of environmental protection administration of the local people's governments at or above the county level shall conduct unified supervision and management of the environmental protection work within areas under their jurisdiction. The state administrative department of marine affairs, the harbor superintendency administration, the fisheries administration and fishing harbor superintendency agencies, the environmental protection department of the armed forces and the administrative departments of public security, transportation, railways and civil aviation at various levels shall, in accordance with the provisions of relevant laws, conduct supervision and management of the prevention and control of environmental pollution. The competent administrative departments of land, minerals, forestry, agriculture and water conservancy of the people's governments at or above the county level shall, in accordance with the provisions of relevant laws, conduct supervision and management of the protection of natural resources."

9 **Article 10** reads that "The competent department of environmental protection administration under the State Council shall, in accordance with the national standards for environment quality and the country's economic and technological conditions, establish the national standards for the discharge of pollutants. The people's governments of provinces, autonomous regions and municipalities directly under the Central Government may establish their local standards for the discharge of pollutants for items not specified in the national standards; with regard to items already specified in the national standards, they may set local standards which are more stringent than the national standards and report the same to the competent department of environmental protection administration under the State Council for the record. Units that discharge pollutants in areas where the local standards for the discharge of pollutants have been established shall observe such local standards."

10 **Article 12** reads that "The competent departments of environmental protection administration of the people's governments at or above the county level shall, in conjunction with relevant departments, make an investigation and an assessment of the environmental situation within areas under their jurisdiction, draw up plans for environmental protection which shall, subject to overall balancing by the department of planning, be submitted to the people's government at the same level for approval before implementation."

11 **Article 15** reads that "Work for the prevention and control of the environmental pollution and damage that involve various administrative areas shall be conducted by the relevant local people's governments through negotiation, or by decision of the people's government at a higher level through mediation."

12 **Article 16** reads that "The local people's governments at various levels shall be responsible for the environment quality of areas under their jurisdiction and take measures to improve the environment quality."

13 **Article 24** reads that "Units that cause environmental pollution and other public hazards shall incorporate the work of environmental protection into their plans and establish a responsibility system for environmental protection, and must adopt effective measures to prevent and control the

pollution and harms caused to the environment by waste gas, waste water, waste residues, dust, malodorous gases, radioactive substances, noise, vibration and electromagnetic radiation generated in the course of production, construction or other activities."

14 **Article 27** reads "Enterprises and institutions discharging pollutants must registered according to the regulation issued by the environmental protection administration under the State Council.

15 **Article 28** reads that "Enterprises and institutions discharging pollutants in excess of the prescribed national or local discharge standards shall pay a fee for excessive discharge according to state provisions and shall assume responsibility for eliminating and controlling the pollution. The provisions of the Law on Prevention and Control of Water Pollution shall be complied with where they are applicable. The income derived from the fee levied for the excessive discharge of pollutants must be used for the prevention and control of pollution and shall not be appropriated for other purposes. The specific measures thereof shall be prescribed by the State Council."

16 **Article 29** read that "If an enterprise or institution has caused severe environmental pollution, it shall be required to eliminate and control the pollution within a certain period of time. For enterprises and institutions directly under the jurisdiction of the Central Government or the people's government of a province, an autonomous region, or a municipality directly under the Central Government, the decision on a deadline for the elimination or control of pollution shall be made by the people's government of the province, autonomous region and the municipality directly under the Central Government. For enterprises and institutions under the jurisdiction of a people's government at or below the city or county level, such decision shall be made by the people's government of the city or county. Such enterprises and institutions shall accomplish the elimination or control of pollution within the specified period of time."

17 e. Other major laws concerning water environment protection include:

18 The ***Water Act*** (issued on January 21, 1988, revised on August 29th, 2002). The new *Water Act* has been enriched from the original 7 chapters, 53 articles to 8 chapters, 82 articles. The transjurisdictional water environment management represents an important revision. The revised law granted the title of monitoring and law enforcement to the watershed management authorities.

19 ***Water Pollution Control and Prevention Act*** (issued in 1984, revised on May 15th, 1996) is a law specialized in water pollution prevention and control. Its Article 10 addresses the planning and execution of transjurisdictional river pollution control and prevention. Article 18 clarifies the water quality monitoring of inter-provincial, key watersheds identified by the state. Article 26 identifies the dispute resolutions to transjurisdictional water pollution issues.

20 ***Water and Soil Retention Act*** (issued on June 29th, 1991). Article 31 address the transjurisdictional soil erosion prevention and control disputes.

21 ***Flood Prevention Act*** (issued on August 29th, 1997). Article 2 and 5 address the transjurisdictional flood prevention.

22 ***Fishery Law*** (issued in 1986, revised in October 2000). Article 7 in the new *Fishery Law* specifies the fishery and fishing quota management in transjurisdictional.

(3) Administrative statutes and regulatory policies

23 Administrative statutes are provisions, regulations, circulars, and decisions concerning the administration of the state issued by the State Council according to the Constitute and other laws.

24 a. ***Provisions on River Way Management*** (issued on June 3rd, 1988 by the State Council). Article 5, Item 2

25 b. ***Provisions on Flood Prevention*** (issued on July 2nd, 1991 by the State Council).

26 c. ***Implementive Provisions on Water Use Permitting System*** (August 1, 1993 issued by the State Council).

27 d. ***Interim Provisions on the HRB Water Pollution Control and Prevention*** (State Council Order No. 183 on August 8th, 1995) is China's first formal administrative statute on trans-watershed water pollution control and prevention.

28 e. ***Circular on Trial of the HRB Municipal WWT Fee*** (June 4th, 1997) specifies the collection, management, and use of the HRB municipal WWT fee.

29 f. ***Provisions on Interest Subsidy to Liao River Watershed Water Pollution Control and Prevention Projects Pollutants Discharge Fee*** (December 15th, 1997).

30 g. ***Reply on the 9th FYP and 2010 Plan of the HRB Water Pollution Control and Prevention by the State Council*** has issued unified comprehensive planning and management requirements.

31 h. ***Reply on the 9th FYP and 2010 Plan of the TLB Water Pollution Control and Prevention by the State Council*** (January 6th, 1998).

32 i. ***Circular on the Approval of the Huai and Hai Rivers Watershed Water Pollution Control and Prevention Plan by the Office of the State Council*** (March 11th, 1999).

33 j. ***Circular on the Approval of the 9th FYP and 2010 Plan of the Liao River Watershed Water Pollution Control and Prevention by the State Council,***

34 k. ***Implementive Provisions on Water Pollution Control and Prevention Act*** (March 24th, 2002) strengthens the management of transjurisdictional water pollution control and prevention.

(4) Administrative rules

35 Except the national laws and acts on water environment management and the State Council administrative statutes, agencies under the State Council also issue administrative rules on the water environment management. A number of such rules on transjurisdictional water environment management, on water pollution control and prevention, include:

36 a. ***Interim Provisions on Water Pollutants Discharge Permits Management***: Article 13

37 b. ***Pollution Prevention and Control Provisions of the Drinking Water Source Protection Zone***: Article 5

38 c. ***Procedural Specifications of Fishery Water System Polluting Incidents Investigation and***

Handling: Article 11

39 d. ***Management Provisions on Natural Protection Zone for Aquatic Animals and Plants***

40 e. ***Management Provisions on Ships and Coastal Solid Waste pollution Prevention in the Yangtze River Water System***

41 f. ***Trial Management Provisions on Huai River and the Tai Lake Key Water Pollutants Discharge Permits (2001)*** is the first administrative rule on watershed pollution prevention and control permits management.

42 g. ***Circular on Strengthen Environmental Monitoring and Management and Pollution Incidents Prevention during Low Water Seasons (2001)***

(5) Local legislations

43 Chapter 4 of the *Legislation Act* specifies that the People's Congress and its standing committee of provinces, autonomous regions, and municipalities may issue local laws and regulations according to the local conditions and needs, provided that the local legislations do not conflict with the Constitute, laws, and administrative rules. The People's Congresses at autonomous regions are entitled to issue autonomy regulations based on local political, economic and cultural needs. Ministries and committees under the State Council, People's Bank of China, Audit Commission and other direct administrative management subordinating agencies may issue regulations within their own authorities according to the laws and the administrative statutes, orders, and decisions of the State Council. Local governments issued transjurisdictional water environment management legislations. The table below is the water environment management regulations and policies in the HRB provinces.

Table 6.1-1 Provincial Policy and Regulations on Water Environmental Management in the HRB

Province	Policies and regulations
Henan	Decision on the river basin water pollution control and prevention (1989) Circular on treating the HRB water pollution control and prevention works in earnest (1994) Circular on the strengthening of provincial water pollution control and prevention works (1994) Circular on optimizing the industrial structure, strengthening environmental protection, prohibiting the development of high pollution and high consuming product (1995) Circular on the further strengthening of water pollution control and prevention works (1995) Henan Province economy and social development 9th FYP and 2010 objectives (environmental protection part) (1996) Henan Province management measures on the pollution sources control with time limit (1996) Circular on the implementation of the State Council decisions on environmental protection (1996) Circular on the expediting pulp industrial structure reform and improving pollution control (1997) Circular on the further expediting water pollution control and prevention steps (1997) Circular on the financial department support the water pollution control and prevention (1996) Circular on the punishment to the enterprises failed to timely finish pollution control (1997) Circular on control of the power supply to the enterprises that have serious pollution (1996) Circular on the implementation of the pollution control plan which made for the enterprises whose wastewater discharge higher than 100 ton per day (1997)

Province	Policies and regulations
Shandong	Shandong Province Nansihu watershed water pollution control and prevention regulation (1994) Shandong Province Xiaoqing River watershed water pollution control and prevention regulation (1995) Shandong Province environmental protection regulation (1996) Measures on the strengthening of water pollution control and prevention (1996) Shandong Province Xishu River watershed water pollution control and prevention measures (1996) Circular on the establishment of special capital for the pollution control of pulp mill and brewage industries (1996) Circular on the government official environmental protection performance evaluation measures (1996) Circular on the implementation of the State Council decisions on environmental protection (1997)
Anhui	Implementation measures on taking depreciation fund for the pollution control (1989) Anhui Province the HRB water pollution control and prevention regulation (1993) Circular on the charge of centralized WWTP construction and maintenance fee (1996) Implementation measures on keep the HRB. industrial wastewater discharge in compliance with standards (1997) Decision on the strengthening of environmental protection works (1997) Circular on the closing of the pulp facility that capacity is low than 5000 ton/year in Huai River, Chao Lake watershed (1996) Decision on the expediting the Huai River, Cao Lake watershed water pollution control and prevention works (1994) Circular on the authorization of environmental protection approval (1996) Huainan Huai River water system protection regulation (1997) Management measures for the lake and river watershed pollution control special fund
Jiangsu	Jiangsu Province environmental protection regulation (1993) Jiangsu Province water resource management regulation (1993) Jiangsu Province pollutants discharge TML control provisional regulation (1994) Circular on promoting of environmental protection works by using credit policy (1996) Jiangsu Province pollution control fund management measures (1996) Circular on the implementation of clean production audit (1996) Circular on the strengthening of environmental protection works (1996) Yangchenghu water resource protection regulation (1996) Policies and measures on the expediting the industrial pollution control and realizing discharge in compliance with standard (1997)

6.1.2 On China's Legislation on Transjurisdictional Water Environment Management

1 Although China's transjurisdictional water environment management policies and legislations experience fast growth and development, lack of standardization, inconsistency, and conflicts and gaps between the major laws (such as between the *Water Pollution Control and Prevention Act* and the *Water Act*) have troubled the transjurisdictional water environment management.

Table 6.1.2-1 Major Legislation and Policy Issues on China's Transjurisdictional Water Environment Management

Legislative Issue	Room for Improvement
1, Lack of delineation and definition of water usage rights between upper and downstream regions in water rights policies	The water usage rights of upper streams and downstreams for rivers cross jurisdictions are not clarified in policies or regulations.
2, Lack of effective	No articulated transjurisdictional water bodies quality assurance policy in the

Legislative Issue	Room for Improvement
water quality guarantee policy	legal system.
3, Lack of concrete policies on comprehensive exploitation	Although many laws have required coordinated planning and comprehensive development, but no concrete policies exist to direct the actions. The various regions within a watershed and the various sectors involved in water management usually select self-favored development policies to handle transjurisdictional water environment.
4, Lack of comprehensive decision-making and management policy	Transjurisdictional water environment management often relate to the decision-making on important issues and allocation of the management and monitoring authorities among multiple regions and sectors. Since China does not have a comprehensive decision-making and management mechanism on transjurisdictional water environment, the sectors and regions manage and make decisions basic on their own concerns. The uncoordinated decisions and management may appear beneficial locally, but may turn out harmful as a whole, and cause overlaps and conflicts. Therefore, the policy and a coordinated decision-making making mechanism is needed for transjurisdictional water environment management.
5, Lack of systematic and clearly defined disputes treatment policy	The current uncoordinated exploitation, development, and management often cause conflicts and incur disputes. Although the existing Chinese laws have already included provisions on transjurisdictional water environment disputes, systematic, finite, and concrete policies on dispute resolution is still lacking. The lack of designated dispute resolution organization and sound dispute process disfavors the early resolution of disputes. Some extreme cases have caused ship sinking.
6, To-be-perfected legal system	One could conclude from the above legal framework of transjurisdictional water environment management that the current legislation needs to be further perfected.
7, Lack of comprehensive water environment management laws for trans-jurisdictions	Provisions and regulations on transjurisdictional water environment management are dispersed among various laws. Systematic and comprehensive management can hardly be implemented with the fragmented legislation.
8, Lack of national individual legislation on the key watersheds	The State has selected the Yangtze, Yellow, Pearl, Huai, Hai, Liao, and Songhua rivers as key watersheds that need specialized statutes and regulations due to their particular natural geographic, economic and cultural characteristics. Nevertheless, such laws are still unavailable. This deviates from the regular international watershed management practices.
9, Lack of laws on the procedures	Most of the existing national transjurisdictional water environment management legislations provide only substantive rules but not the implementive rules. As a result, the substantive rules are not matched up with implementive rules, and the objectives of the substantive rules can hardly be achieved.
10, Lack of sound management institutions	China's water environment management legislation has defined many management institutions including transjurisdictional water environment management institutions, such as the planning, fee mechanism, and environmental impact assessment. Those institutions have facilitated the rational exploitation and protection of the water environment. However, the legislations still face the issue of incomplete and imperfect management institutions.
11, Lack of institutions necessary for trans-administrative water environment management	These mechanisms include: Economic compensation between upper and down-streams; Water use rights trading; Water information disclosure (including pollution information); Tort compensation through pollution affirmation and evaluation; Pollution damage insurance; Downstream's legal rights to require upper stream pollution control actions
12, Other burning	Insufficient coordination between MWR and SEPA during watershed planning;

Legislative Issue	Room for Improvement
issues	Lack of broad participation and implementation safeguard mechanism for watershed planning; Dependence on pollutants discharge fee collection and conflicts of interests of fee allocation among local EPBs; Lack of unified provisions on water quality monitoring, reporting, and administration conducts with clearly defined responsibilities at provincial boarders during polluting events; Mismatched management institutional set-up and needs. For example, the water & soil conservation bureaus, although only administratively mapped under the MWR, will need to report data to SEPA. The watershed committees do not have authorities for unified water resource management, as pollution management is out of their authorities; Lack of public monitoring toward law enforcement; Entities and individuals do not have legal standing to prosecute on public affairs to safeguard the public interests.

Table 6.1.2-2 Major Issues & Recommendations of Water Pollution Control and Prevention Act and Water Act

Current Issues	Recommended Revisions
Definitions are imprecise, or absent, or ambiguous.	Revise the *Water Pollution Control and Prevention Act* and the *Water Act*, and offer clear definitions
Inconsistent authority allocation between management agencies among the laws	Future revisions should incorporate coordinated definition of the duties of environmental protection authorities and WRBs among the legal provisions.
Compared to the western legal system, the legal provisions are short and abstractive, and lack of provisions on the procedures	Revise the *Water Pollution Control and Prevention Act* by adding implementive provisions concerning transjurisdictional water issues
The conflicts and overlaps between the *Water Pollution Control and Prevention Act* and *Water Act* have led to conflicts in the environmental protection	This is recommended to be discussed with the ministry-level joint commission issue.

Table 6.1.2-3 Major Issues on transjurisdictional water pollution management in the Water Pollution Control and Prevention Act

Major Issues	Recommended Revisions
General provisions not provide sufficiently concrete and finite interpretations. Lack of provisions directing local legislation and provisions on dispute resolutions through administrative mediation or litigation.	Add specific articles to the *Water Pollution Control and Prevention Act.*
Lack of provisions on transjurisdictional water pollution disputes. The *Water Pollution Control and Prevention Act* defines water pollution incidents as events that caused direct economic losses. However, water pollution incidents could cause not only economic losses but also human injury and ecological degradation. Moreover, certain economic losses will only become evident long after the actual event. The handling of the incidents tends to be untimely.	Add definitions of transjurisdictional water pollution to the *Water Pollution Control and Prevention Act* as the basis for administrative negotiation or judiciary interference. Establish provincial transjurisdictional water environment standards according to the defined procedures; Clearly define the dispute resolution procedure and the specific offense situation when violating the standards. Define the rights and responsibilities of each region when violating the transjurisdictional water environment standards according to the dispute resolution procedure.

Major Issues	Recommended Revisions
No assignment of water quality responsibilities between the upper and downstreams at boarders.	Clarify the upper stream' responsibilities for the potential losses of the downstream when boarder water quality violates the standards.
Lack of concrete dispute resolution procedure. Often water pollution disputes face problems such as lack of authorized dispute handling organization, prolonged and unfruitful process, or the government officials shirking responsibilities.	Two sets of procedures should be specified for environmental disputes handling: (1) Procedure for disputes between individuals and organizations, and (2) Procedure for disputes relating to government offices and transjurisdictional water environment pollution disputes; The legal status of the data used in the disputes and the requirements imposed to disputes handling.
Inadequate provisions on watershed planning, insufficient consistency and coordination in water resource planning. Provisions on clear procedure and responsibility assignment are needed for the SEPA and MWR to improve coordination when creating integrated watershed planning; Since SEPA does not have designated agency at the watershed, a coordinating committee will need to be established; WRBs and EPBs have partially overlapping and conflicting responsibilities.	Responsibilities need to be clarified and collaboration need to be strengthened when making comprehensive watershed planning; A watershed joint committee among SEPA, MWR, and representatives from each province can be established as the coordinating institution among the government agencies and provinces.
Lack of clear regulations on TMLL The existing regulations on TMLL provide no clear allocation of authorities and responsibilities between SEPA and MWR.	Provide clear provisions on the objectives, TML statistics, survey and monitoring, distribution, and the applicable procedures; Provide clear provisions on the monitoring responsibilities of SEPA and MWR, as well as the specific measures of mutual cooperation of the two ministries when enacting and implementing the TMLL measures.
Lack of provisions on data and information disclosure Currently no articles in the *Water Pollution Control and Prevention Act* refer to data and information disclosure.	Provide clear provision that the water environment information owned by the government and its environmental monitoring organizations should open to the public or justify the reasons why the information cannot be publicized; Prevent the randomness of government responses to the information disclosure requests from social entities and citizens; Increase transparency to the policy on data publicity, confidentiality, and the cost of information acquisition.
Unarticulated legal status and the quality control requirements of the water environment monitoring data.	Grant the water environment monitoring data universal legal effect across the jurisdictions to serve as the basis to start administrative or litigation procedures. The data effectiveness cannot be denied only because the data comes from the monitoring organization of another jurisdiction. Although the Metrology Law has provided provisions, the *Water Pollution Control and Prevention Act* should still require certain quality standards for the water environment monitoring data to be effective.
Inadequate execution of the responsibilities specified in the *Water Pollution Control and Prevention Act* by certain local officials.	It is important for the government officials in the jurisdictions to be responsible for the pollution caused in the zone. However, the current *Water Pollution Control and Prevention Act* cannot support investigation in the related responsibility.

6.2 Standard System

6.2.1 Overview of Standards

1 Environmental control standards that match the environmental legislations can be classified into 2 categories by functions-the environmental quality standards and pollutants discharge standards-or 4 categories by the scope of effectiveness-national comprehensive, national specialized, sectoral, and local standards.

2 Environmental control standards measure the effects of law enforcement. Environmental control standards can be classified to 2 categories by functions: environmental quality standards and pollutants discharge standards. According to the management rules of Chinese standards, for standards of the same subject, the local and sectoral standards should be stricter than the national standards; the standards set by the lower levels must be stricter than the standards by the upper level.

3 Moreover, to standardize environmental monitoring, the State has issued series of technical specifications, pollutants monitoring methods and standards for standard samples regarding environmental management and monitoring. Almost every pollutant has a corresponding code of monitoring. These codes and standards for standard samples, as part of the national standards, are compulsory.

6.2.2 Environmental Quality Standards

- In China, environmental quality standards are often issued by the central government according to the environmental quality control requirements. They are usually compiled by SEPA and co-issued with the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and SEPA
- China does not have watershed-wide or regional environmental quality standards presumably for 2 reasons. (1) The national environmental quality standards are already strict. The local governments generally will not issue local environmental quality standards that are stricter. (2) The pollutants migration in the watershed through rivers and lakes are generally transjurisdictional. Fully localized standards will not be necessary.
- The major environmental quality standards include:
    - Surface water environmental quality standard, GB3838-2002
    - Groundwater environmental quality standard, GB-T 14848-93
    - Farmland irrigation water quality standard, GB5084-92
    - Fishery water quality standard, GB11607-89
    - Drinking water sanitation standard, GB5749-85
    - Soil environmental quality standard, GB15618-1995
    - Seawater quality standard, GB3097-1997

1 China has a relatively complete water environment quality standard system with a relatively comprehensive coverage of the major areas. However, the current serious water environment pollution problems in the HRB have identified a number of shortcomings and revealed further

needs for the improvement in the water environment quality standard system:

2 Low number of control indicators in the standards. The diversity of pollutants discharged into the water bodies has significantly increased with the fast economic development in the region. The current level of development of the chemical, petroleum, steel, mining, pharmaceuticals, food processing and light industries in the HRB would discharge roughly the same complex pollutants composition as the developed and industrialized countries would. However, the *Surface Water Environment Quality Standard* has only 30 control indicators, *Groundwater Environment Quality Standard* 39, *Domestic Drinking Water Hygiene Standard* 35, and *Farmland Irrigation Water Quality Standard* 29-all under the average of the industrialized countries or the Drinking Water Control Indicators issued by WHO. This shortage will impede the comprehensive control of the water environment quality.

3 Lack of specifications on water body restoration. Parts of the HRB surface and groundwater bodies have been severely polluted. Pollution control could prevent further deterioration of the water qualities, but the polluted and degraded water bodies will require proper restoration to meet certain water body functions. The Water Environment Quality Standard needs to specify the threshold criteria as when the restored water bodies can be qualified to the pre-selected functions.

6.2.3 Pollutants Discharge Standards

1 Pollutants discharge standards, issued to control the discharge of pollutants, can be classified into 4 categories according their scope of effectiveness: national comprehensive standards, national specialized standards, sectoral standards, and local standards.

2 a. National comprehensive discharge standards are the standards developed for pollutants for particular environmental elements. They include:

- Integrated Wastewater Discharge Standard, GB8978-1996
- Integrated Air Pollutants Emission Standard, GB16297-1996

3 b. National specialized standards address the pollution or pollutants discharge control for certain sector, a particular purpose, or specified environmental elements. This set of standards includes the industrial sectoral environmental quality control standards.

- Control Standards for Urban Wastes for Agricultural Use, GB8172-87
- Discharge Standard of Pollutants for Municipal WWTP, GB18918-2002
- Odorous Pollutants Emission Standard, GB 14554-93
- Standard for Pollution Control on the Landfill Sites for Domestic Wastes, GB16889-1997
- Control Standards for Pollutants in Sludge for Agricultural Use, GB4284-84
- Discharge Standard of Pollutants for Livestock and Poultry Breeding, GB18596-2001
- Shipping Industry Pollutants Discharge Standard, GB 4286-84
- Pulp Mill Water Pollutants Discharge Standard, GB 3544-2001
- Textile, Dyeing and finishing Industry Water Pollutants Discharge Standard, GB 4287-92
- Iron and Steel Industry Water Pollutants Discharge Standard, GB 13456-92
- Effluent Standards for Oil-Bearing Wastewater from Offshore Petroleum Development

Industry, GB 4914-85

- Phosphor Fertilizer Industry Water Pollutants Discharge Standard, GB15580-95
- Discharge Standard for Wastes Containing PCBs, GB 13015-91
- Citric Acid Industry Pollutants Discharge Standard, GB19430-2004
- Meat Processing industry Water Pollutants Discharge Standard, GB13457-92
- Monosodium Glutamate Industry Pollutants Discharge Standard, GB19431-2004
- Types of Natural Resource Protection Zone and their Classification Criteria, GB-T 14529-93

4 c. Sectoral standards and technical specifications, issued by the state or government agencies, address the pollution control or environmental management in particular sectors. They usually have limited scope of effectiveness. Major sectoral standards include:

- Water quality standard for wastewater discharge into municipal sewer system, CJ 3082-1999
- Environmental monitoring technical standard for domestic waste landfill, CJ-T 3037-1995
- Municipal water supply standard, CJ T206-2005

Major technical specifications include:

- Environmental impact assessment technical guideline, HJ-T 2.1-2.4 1993-1995
- Environmental impact assessment technical guideline for surface water, HJ-T 2.3-1993
- Water resource assessment guideline, SL-T 238-1999
- Drinking water resource water quality monitoring assessment and publishing program, SEPA [2002]No.144
- Environmental impact assessment technical guideline for planning, HJ-T 130-2003
- Water pollutants total discharge amount monitoring technical guideline, HJ-T 92-2002
- Surface water and wastewater monitoring technical guideline, HJ-T 91-2002
- Ecological condition assessment technical guideline, HJ-T 192-2006
- Construction project soil conservation planning technical guideline, SL-T 204-98

5 d. Local standards vary with locality but are all stricter than the national standards. Local standards include administrative regional standards and watershed standards.

6 Administrative regional standards are pollutants discharge control standards issued by the local governments at various levels according to the local needs while abiding by the national or sectoral standards. The effectiveness of such standards is limited to particular jurisdictions. A partial list of such standards include: *Henan Province Pulp Mill Industrial Water Pollutants Discharge Standards, Shandong Province Pulp Industrial Water Pollutants Discharge Standards (DB37/336-2003), Shandong Province Livestock And Poultry Breeding Pollutants Discharge Standards,* Shandong *Province Domestic Waste Landfill Water Pollutants Discharge Standards (DB37/535-2005), Shandong Province Textile and Dyeing Industrial Water Pollutants Discharge Standards (DB37/533-2005), Shandong Province Amylum Processing Industrial Water Pollutants Discharge Standards (DB37/595-2006), Shandong Province SNWD Water Pollutants Integrated Discharge Standards (DB37/599-2006), Zhejiang Province Pulp Mill Wastewater Discharge Standards (DHJB1-2001), and Jiangsu Province Chemical Industry Water Pollutants Discharge*

Standards.

7 China has a relatively sophisticated and complete collection of standards on water environment protection and discharge control. However, the enforcement of the standards presents the following issues.

8 Lack of a comprehensive discharge standards system. The number of government offices and the variety of fields involved in the discharge standards setting have triggered an unsystematic collection of standards. It is advisable to fit all current and future possible standards into one consistent framework and clearly spell out the scope, targets, compulsiveness, and monitoring of the standards.

9 An example on the industrial wastewater discharged into the municipal sewage illustrates this problem. The EPBs as empowered by law monitor the discharge from the plants (including municipal WWTPs) with the Wastewater Comprehensive Discharge Standards. Municipal construction committees also monitor all wastewater that enters into the municipal network (regardless if it belongs to industrial discharge) with the Water Quality Standards for Wastewater Entering into Urban Sewage. By law, the municipal construction committee could disconnect the connection between the wastewater outlets and the sewage but not to penalize the plants who fail to comply with its standards. The same wastewater outlets are subject to 2 sets of standards enforced by 2 different government agencies, leading to management overlaps and inefficient resource use.

10 Lack of a standard system for the pollutants discharge TMLL. Pollutants discharge TMLL and pollutants discharge permits are closed related. In HRB, the pollutants discharge TMLL has been adopted according to the *Interim Statues on the HRB Water Pollution Control and Prevention.* Nevertheless, the discharge TMLL are chosen by SEPA and MWR rather than set according to a systematic TMLL standard.

6.3 Judicial System

6.3.1 Judicial Institutions and Dispute Resolution Mechanism

6.3.1.1 Overview

1 China's judicial system refers to the nature, mission, organizational system, principles of organization and activity, and the work institutions of the judiciary and other judicial institutions. China's judicial system is a set of punctilious judicial institutional system of the people. It includes investigation, prosecution, trial, prison, arbitration, judicial administration, mediation, attorney, notary, state compensation, and legal aid systems. The judiciary here refers to the public security (including state security), the procuratorial, judicial, and prison authorities in charge of investigation, prosecution, trial, and enforcement. The judicial organizations refer to the attorney, notary, and arbitration organizations. The people's courts at various levels nationwide and the People's Procuratorate conduct independent trial and legal monitoring abiding the *Organizational Law of the People's Courts*, the *Organizational Law of the People's Procuratorate.*

2 In China, water pollution disputes usually refer to the civil disputes between the victims and tortfeasors of the water pollution regarding the tortfeasors' damage compensation liability and the

amount of compensation. According to Article 41 of China's current *Environmental Protection Act*, the parties are entitled go to the people's courts and sue the accused tortfeasors. Therefore, when the victims raise civil procedure to the people's courts, the courts grant admission by the *Civil Procedural Law*. On the other hand, Article 338 and 408 of the current *Criminal Law* have spelled out that "severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health" will be convicted the crime of undermining protection of environmental resources and subject to crime punishments. Therefore, according to the *Organizational Law of the People's Procuratorate*, the People's Procuratorate will initiate the legal procedure starting with investigation when potential criminal conducts have been detected. At the end of the investigation, the People's Procuratorate will either prosecute the defendant or revoke the original case depending on the investigation results. Through this process, the court and the procuratorate execute their judicial authorities in the environmental pollution cases.

3 In China, the parties of the water pollution disputes have unequal positions. Unlike parties in other disputes, the victims of water pollution disputes often are the general public. Compared to the perpetrators the victims are often the disadvantaged group, while the perpetrators are often corporative groups with financial, technology, information, and human resources. When such corporations are of significant economic importance, the dispute could even be tied to the economic performances of the local governments.

4 Within the current Chinese legal institutions, the current Chinese environmental disputes resolution mechanism is consisted of non-litigation and litigation resolution mechanism.

6.3.1.2 Alternative Dispute Resolution (ADR)

1 The non-litigation resolution mechanism refers to the mechanism where the environmental disputes are resolved through non-litigation negotiation, mediation, arbitration, administrative ruling, et al. In the US, the non-litigation resolution mechanism is also called the ADR (Alternative Dispute Resolution). The ADR mechanism has become an important part of the environmental dispute resolution mechanism around the world. In China, the ADRs for environmental disputes mainly include:

(1) Negotiation

2 Article 51 in the *Civil Procedural Law* entitles the parties to choose negotiation. In terms of environmental disputes, usually the victims will demand the perpetrators stop polluting the environment and compensate for the losses incurred when realizing the environmental torts. When this happens, some perpetrators will agree to compensate for the environmental pollution and the victims often prefer negotiation to a prolonged law suit. Thus, the parties could resolve the environmental disputes through signing negotiation agreement. Therefore, negotiation is a relatively easy solution for both parties.

3 However, in the real life, perpetrators of environmental pollution usually will not admit their environmental liability, and negotiation is seldom practices in China. This approach has not played its role in China.

(2) Mediation

4 Mediation refers to the facilitated agreement between the disputes parties mediated by the third party by the laws and policies. By the current Chinese law, China's mediation institutions include the court mediation, people mediation and administrative mediation. Despite that the court mediation belongs to litigative mediation, the people mediation and administrative mediation belongs to non-litigation mediation.

5 The People mediation refers to the medication of civil disputes facilitated by the mediation committee by the laws, statutes, policies, and social norms. The people mediation is an important part of the current mediation institutions unique to China. The people mediation committee is a civil organization under the rural or urban residents committees. By the People Mediation Committee Organizational Regulations, the people mediation committee may act upon the request of the parties or initiate mediation by itself. The people mediation is mainly used to resolve the environmental disputes among individuals or between individuals and township, community, or individual enterprises.

6 The administrative mediation refers to the mediation of certain civil disputes and minor criminal cases by the government agencies within their authorities. The scope of the mediation encompasses civil, economic, and minor criminal disputes. Without specialized articles, the administrative mediation of environmental disputes will abide the general provisions on administrative mediation of all disputes. In general, administrative mediation of environmental disputes is often carried out by the EPBs or other related administrative authorities. For example, the fishery administrative authorities mediate fishery pollution disputes. In addition, according to Article 15 of the *Environmental Protection Act* that the local government is responsible for the negotiation, thus including mediation, of transjurisdictional environmental pollution prevention and control; government of higher level could assist in the resolution. Administrative mediation is one of China's primary approaches to resolve environmental disputes, especially cross-watershed disputes.

(3) Administrative Punishment

7 Article 41 of the *Environmental Protection Act* requires "the tortfeasors of environmental damages remove the harms and compensate the directly impacted entities or individuals. Disputes on the pollution liability and the amount of compensation can be handled by the environmental protection administrative authorities or other designated agencies upon the request of the parties involved. If either of the parties disagrees with the rules, the party is entitled to litigate at the people's courts. Either party is also entitled to litigate directly without administrative ruling." Therefore, the victims of environmental liabilities could resolve the dispute through either the environmental protection administrative authorities or other designed governmental agencies or litigation. The former resolution approach has been widely practiced, as it not only saves time and effort but also is well accustomed to the Chinese tradition of resorting to the government during disputes. The government agency usually will first try to mediate and only when mediation fails, provide rulings according to the *Environmental Protection Act*.

Zhao Guangshan of the Tai'an Apiology Research Institute vs. Dongping County Tool Shop Groundwater Pollution Case

Since Feb. 2001, Tai'an Apiology Research Institute appealed several times to the Shandong Provincial EPB on the wastewater and solid wastes discharged from Dongping County Tool Shop. The wastewater polluted groundwater, and lead to the death of bees of the institute. After several rounds of mediation by the local EPB, the two sides still could not reached an agreement.

In August, 2002, Shandong Province EPB registered this case on file. The survey results showed that the major causes of the groundwater pollution in Wangtai Village is the untreated wastewater discharged from the Dongping County Tool Shop since 1962, and also the solid wastes from electroplating landfilled in two large wells in the company, which leads to severe heavy metal pollution of the groundwater. In 1994, when the plaintiff, Zhao Guangshan used the water to feed bees, all the bees were killed.

Shandong Province EPB ruled that Dongping County Tool Shop had violated environmental protection laws, and issued a ruling on April 4th of 2003. First, the company should compensate Zhaoguangshan 6300 yuan for the well and water, and also 11200 yuan for the land. The company should also compensate Zhao Guangshan 82500 yuan for the 198 beehives. In addition, 20000 yuan for the land investment and agricultural products; 50000 yuan for the research institute. Second, the company should clean up the solid waste and prevent future pollution. According to Article 16 of the *Environmental Protection Law*, Dongping County Government should instruct Dongping County Toll Shop to take all available measures to clean up the illegally landfilled electroplating solid wastes and treat the solid wastes according to the relevant sold waste regulations to prevent further pollution.

8 However, the current administrative punishment mechanism of environmental disputes institutions presents a number of issues. First, Article 41 of the *Environmental Protection Act* does not impose the potency of enforcement of the rulings from the environmental protection administrative authorities, the parties could reject the rulings by litigation at the people's courts; thus the disputes resolution decisions by the environmental protection administrative authorities often will not be able to timely control the pollution and aid the victims. Second, because either party disagreeing with the decisions by the environmental protection administrative authorities could sue the authorities through administrative litigations, a few environmental legislation in the late 1990s tried to amend this problem but actually add more to the existing issue: Article 71 Item 2 of the *PRC Solid Waste Pollution Prevention & Control Act* issued on October 30th, 1995, Article 61 Item 2 of the *PRC Environmental Noise Pollution Prevention & Control Act* issued on October 29th, 1996; Article 62 Item 2 of the revised *PRC Air Pollution Prevention & Control Act* issued on April 29th, 2000 have defined the "administrative punishment" by the environmental protection administrative authorities or other designated agencies as "handling upon mediation," and therefore lowering the potency of "administrative punishment" to "mediation." Statistics suggests that about 70% of China's environmental disputes are resolved through medication or administrative punishment, a broad-sensed mediation. Further perfecting the mechanisms of mediation and administrative punishment has become a matter of urgency in China.

(4) Arbitration

9 The current Chinese *Arbitration Act* does not specify if environmental disputes (except for

marine pollutions) can be subject to arbitration. Thus two schools of thoughts current exist among the Chinese environmental law community. One school of thoughts disapproves the application of arbitration to environmental disputes because the arbitration subjects articulated in the *Arbitration Act* does not include environmental disputes. The other school, however, considers that eligible parties who opt arbitration for dispute resolution can apply for arbitration to the authorities. This existing debate indicates that the Chinese *Arbitration Act* should clarify the applicability of arbitration. Currently in China, the practices of arbitration to environmental disputes are rather limited.

6.3.1.3 Litigation

1 Victims of environmental pollution can opt for the litigation resolution mechanism beyond the ARDs. On the one hand, the victims can sue the polluters at the people's courts according to the *Civil Procedural Law*, other civil laws and statues, and the *Environmental Protection Act* for damage remedy and compensation. On the other hand, the People's Procuratorate could prosecute the infringer of the environment should the criminal provisions be applied. The civil and criminal litigation procedures have been the most potent and effective judicial solution of environmental pollution disputes in China.

(1) Criminal Liability Regime

2 In order to increase the punishment severity against environmental crimes, and protect the ecological environment through stricter legal measures, the 1997 revised *Criminal Law* lists acts of serious destruction of land, air, water, forests and other natural resources as criminal infractions. A separate section on "Crimes of destroying environmental resources" is included in Chapter Six, and stipulates different kinds of environmental crimes. This set up the criminal liability regime in China's environmental protection institutions. Article 338 of the *Criminal Law* specifies that severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health will be subject to up to 3 years of imprisonment or criminal detention and/or fine; particularly serious consequences will be subject to 3 to 7 years of imprisonment and fine. Therefore, in case of severe environmental pollution incidents, according to Article 3 of the *Criminal Litigation Act*, the public security authorities will take charge of the investigation, detention, arrest, and pre-trial; the procuratorate will take chare of the approve the arrest and prosecution; and the people's courts takes charge of the trial.

3 In Part II Specific Provisions of the Criminal Law, Chapter VI Section 6 "Crimes of Undermining Protection of Environmental Resources" clearly spells out environmental crimes of various types and the punishments for severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health.

4 According to the statistics from SEPA's China Environmental Yearbook, there were 5 in 2001, and 4 were crimes of serious environmental pollution accidents, while one was about negligence of supervision and administration of environmental protection; there were 2 crimes of serious

environmental pollution accidents and 2 crimes of negligence of supervision and administration of environmental protection in 2002; One serious environmental pollution crime took place in 2003.

5 In addition, Article 77 and 78 of *Criminal Procedure Law* stipulates that "If criminal acts of defendants cause property losses to victims, victims can bring collateral civil lawsuits during the criminal lawsuits process. If state or collective property is lost, People's Procuratorate can bring collateral civil lawsuits while pursuing public prosecution"; therefore, either victims or People's Procuratorate can bring collateral civil lawsuits, requiring defendants to assume compensation liability.

Case Study: Gaoyou Lake and Shaobo Lake Pollution Case[21]

On the afternoon of Jan. 29th, 2006, Qiao was instigating the plant when he discovered that the wastewater discharged from the cooling tower was of a dark yellow. Qiao, as a professional, knew that the wastewater contained aniline, volatile phenol, and other toxic chemicals. Nevertheless, Jiao did not try to stop the discharge. Instead, he instructed the workers to pump the wastewater into the Laozhuang River for more than 7 hours. The wastewater flowed downstream and caused severe pollution in Gaoyou Lake and Shaobo Lake. The aquaculture farms in Gaoyou Town Hubing Village and Jiangdu.Shaobo Town suffered severe damage. The direct loss in one single company amounted to hundreds of thousands Yuan.

Jiangsu Province Gaoyou City People's Court ruled that Qiao, as the manager of discharge unit, willfully neglected national environmental regulations, wantonly discharged hazardous wastewater, and caused severe environmental pollution accidents with grave consequences to public and private properties. Therefore, the Court ruled that he had committed the crime of causing severe environmental pollution accidents.

(2) Civil Liability Regime

6 According to Article 124 of the *General Rules on Civil Law* (of 1989) and Article 41 (1) of the *Environmental Protection Act* (of 1989), in regard to environmental pollution tort acts, China has established the tort liability system with non-fault responsibility as the basis. All organizations or individuals that pollute or damage the environment, as long as their acts cause damage to other organizations or individuals objectively, should assume civil liability, even if they have no subjective fault. Based on this, Article 55 (1) of the *Water Pollution Control and Prevention Act,* Article 62 of *Air Pollution Prevention & Control Act*, Article 71 of the *Solid Waste Pollution Prevention & Control Act*, Article 61 (1) of *Environmental Noise Pollution Prevention & Control Act*, and Article 90 of *Environmental Protection Act* have followed to provide detailed requirements on damage removal, risk reverse, and compensations. Therefore, if victims' physical well being or property is damaged due to environmental pollution tort acts, they can bring lawsuits to the People's Courts according to the provisions of Article 41 of the *Environmental Protection Law* and *Civil Procedural Law*, and request the polluters to assume liabilities for damage compensation or damage remediation.

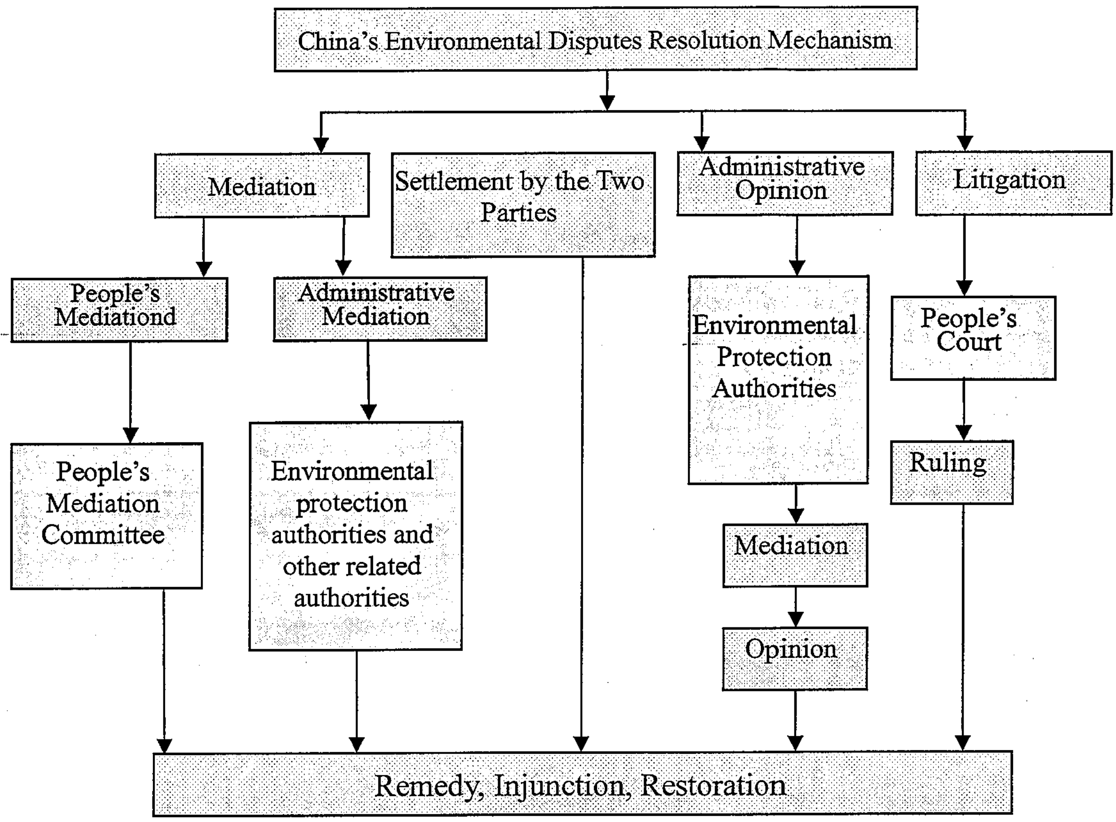
7 In addition, the *Interpretations on Several Issues of Law Application of Hearing Physical*

[21] http://news3.yztoday.com/news/1003/2006/02/22/2006-02-22_110849_1003.shtml

Damage Compensation Cases issued by the Supreme Court on December 26, 2003, further regulates clearly the law application issues related to physical damage compensation cases. It also becomes the legal basis, upon which pollution victims could request damage compensation remedies.

8 Figure 6.3.1.3-1 exhibits the disputes resolution mechanism.

Figure 6.3.1.3-1China's Environmental Disputes Resolution Mechanism



6.3.2 Causes for Transjurisdictional Disputes

1 Different from the usual disputes, transjurisdictional water pollution disputes are often related to the regional socioeconomic, geographical, and environmental features.

(1) Causes for the HRB Water Pollution

Table 6.3.2-1 Causes for the HRB Water Pollution

Causes for the HRB Water Pollution	Symptoms
1, Water resource shortage. High population density in the HRB – per capita water resource is only 1/5 of the national average.	Continuous urbanization and population growth aggravate the conflicts between people and water. Water pollution has led to the insufficient base flow of the Huai River ecological and the reduced self-purification capacity of the water bodies. Particularly, during the pre-flood season, the accumulated pollutants above the gates and

Causes for the HRB Water Pollution	Symptoms
	dams flush down and frequently trigger water pollution incidents.
2, Over-exploitation of the water resource. Overexploitation of water resource reduces the water self purification capacity, pre-flood management can easily trigger water pollution incidents.	The water resource of the HRB has been segmented by thousands of gates and dams. Water management capacity is extremely low: either no water or polluted water is released; currently the HRB has over 5300 medium and large-scaled reservoirs (gates and dams). Its natural ecological base flow is drastically inadequate.
3, Imbalance between economy and environment at local level. The relatively low economic and technological development level around the Huai River leads to the skewed emphasis on economic growth with GDP as the indicator in the background of rapid development across the country.	The current performance evaluation of local government officials is based on economic indicators. The environmental protection often gives way to economic development, and often the short-term economic interests. Some even sacrifice the long term environmental for short-run gains, or shield or condone violations of environmental regulations.
4, Lagged pollution control programs. About 3/4 of the total HRB COD and NH3-N discharge are from domestic sources. But the construction and operation of WWTPs have been lagged behind.	The construction of municipal WWTPs and collection networks is lagged without effective cost recovery regimes.
5, Polluting industrial structure. Industrial discharge from the heavily polluting industries in the HRB is one of the major pollution sources for the Huai River. SEPA monitoring data in April 2005 suggest that 151 of 533 (28%) of operating heavily polluting enterprises, have been over discharging, and over 80% of the non-compliance enterprises are the paper mills and chemical manufacturers.	Although environmental enforcement and monitoring has significantly improved compared to previous situations, the industrial discharge is still not fully effectively controlled; Many old and loss-making enterprises have had long history of environmental liabilities, and many highly polluting and resource concentrated small enterprises are still in operation.
6, Heavy non-point sources pollution. China is one of the most intensive fertilizer users in the world. The HRB as one of China's major crop production areas houses 1/6 of China's farmland. Large quantities of fertilizers and pesticides have been used in agricultural production in the watershed.	The excessive pesticides and fertilizers as well as the nutrients from livestock raising and husbandry and decomposed straws enter into the water body through soil erosion and farmland water withdraw, adding COD and TN, TP concentrations in the water bodies and have become an important factor impacting the water qualities.
7, Constrained environmental management institutions. The current administrative-zone-based management of environmental monitoring constrains the local EPBs (which are under the local governments rather than the SEPA).	A coordinated HRB water resource management mechanism is still lacking. Conflicts between different government sectors and regions still persist, leaving the pollution control measures and programs uncoordinated; No effective watershed-wide water rights, tariffs and market mechanism; Effective environmental monitoring, reward and punishment, and information disclosure mechanisms are still lacking; Inadequate pollutants discharge monitoring and enforcement.

(2) Forms of transjurisdictional water resource disputes

2 Frequently a large watershed will cross several counties, prefectures, or even provinces in its scope; therefore, water pollution disputes of an transjurisdictional watershed present a variety of forms.

Table 6.3.2-2 Major Forms of Transjurisdictional Water Disputes

Major forms of transjurisdictional water disputes	Descriptions
1, Disputes incurred due to ambiguous water resource titles.	Often triggered by the conflicts between the over exploitation in upper streams and the downstream water shortages.
2, Disputes caused by undefined environmental liabilities.	Such as disputes incurred by unclear water pollution liabilities or disputes in aquaculture.
3, Water pollution disputes triggered by water pollution or resource damaging incidents.	Including water resource disputes triggered by incidents in certain jurisdiction among individuals or entities of the same or different jurisdictions.
4, Water pollution disputes incurred by the regular business operation of certain entities.	For example, the water environment dispute between certain urban chemical plant and its neighbors regarding the pollutants discharge.
5, Water pollution disputes caused by regular pollution sources.	Disputes between upper and down-stream cities on the long-term, massive quantity pollutants discharge that deteriorate the downstream water quality.

(3) Major causes of transjurisdictional water resource disputes

- Characteristics of environmental pollution torts

3 Different from ordinary torts, certain characteristics of environmental pollution torts – its latency, indirectness, sustainability, inequality between parties, breadth, and concomitancy – makes it difficult to ascertain the damages, tortfeasor, and the causality of the torts. Such characteristics sometimes encourage the tortfeasors to make excuses and shift liabilities onto others and delay or impede the resolution of the transjurisdictional environmental disputes.

- Inadequate transjurisdictional environmental monitoring

4 Currently the environmental protection is spread to multiple government agencies at various levels. According to the *Environmental Protection Act*, currently China's environmental protection adopts the multi-level environmental supervisory, regulatory, and consultations settlement mechanism. Article 7 of the *Environmental Protection Act* further specifies that "SEPA under the State Council directs and supervises the nation-wide environmental protection. Local EPBs of county level or above direct and supervise the environmental protection of their jurisdictions. National oceanic, port monitoring, fishery management and monitoring, and military environmental protection authorities exercise environmental pollution prevention and control by the related environmental laws. The administrative authorities of land, mines, forestry, agricultural, and water resources of county-level or above exercise resource protection, monitoring, and management according to the related laws. Article 15 spells out that "environmental pollution prevention and control transjurisdictional should be resolved through consultation among the related local governments or by the government of higher levels." Therefore, transjurisdictional environmental pollution is subject to the administration and inter-consultation of the related local

governments or government of higher level. Such mechanism often gets caught among the various agencies and delays the process of environmental dispute resolution.

5 The first inter-provincial pollution civil lawsuit in the HRB, the Lianyungang Shiliang River reservoir pollution fish poisoning claim, is a typical case of such.

- Attentive to short-term economic return

6 One of the fundamental causes for the ineffective control of transjurisdictional water pollution is that some local governments attend to short-term economic return in the sacrifice of long-term environmental losses or even shielding or condone outlaw pollutants discharge.

- Local protectionism in resolving regional disputes

7 The local governments at different levels sometimes attend to their local interests when facing transjurisdictional environmental issues, which in turn impede the proper resolution of transjurisdictional environmental disputes.

- Lack of coordination in environmental pollution prevention and control

2 Although Article 15 of Chinese Environmental Protection Law, and Article 26 of Water Pollution Prevention Law have specified the settlement mechanism of Chinese transboundary environmental pollution and damage cases, in practice, because of the separation of management responsibilities in different jurisdictions and various agencies such as environmental protection, forestry, agricultural, fishery, and water resources, it is extremely difficult to reach consensus among all relevant agencies and governments. Even with the mediation of high level government, it is difficult to reach prompt settlements on transboundary environmental cases that meet every party's needs.

6.3.3 Measures to Settle Transboundary Environmental Cases

(1) Improve Transboundary Environmental Protection Inspection Mechanism

1 The current multi-level environmental inspection mechanism is not conducive to prompt and effective solution to environmental pollution disputes. Therefore, China should improve its transboundary environmental protection inspection mechanism, such as integrated transboundary watershed water quality inspection mechanisms. The central government should set up agencies with responsibilities to inspect, and manage transboundary watersheds, and to ensure the implementation of environmental protection works. Such agencies would also be more effective in the settlement of transboundary watershed environmental pollution disputes.

2 According to the news report of China News on July 31st, 2006, in order to strengthen the enforcement of environmental laws, SEPA has initiated the organization of 11 national environmental protection inspection and supervisory centers, including 5 environmental protection supervisory centers in Eastern China, Southern China, Northwestern China, Southwestern China and Northeastern China, and 6 nuclear and radioactive safety inspection center in Shanghai, Guangdong, Sichuan, Northern China, Northeastern China, and Northwestern China. Eastern China's inspection center is in charge of Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong. Therefore, the

environmental law enforcement inspection activities in Huai River, and the Tai Lake Basin are to be carried out under the Eastern China Inspection Center. The Northern China Inspection Center is still to be approved. More detailed responsibilities for the centers are showed in the following table. If these inspection centers can fully carry out their supervisory duties, it would be a significant boost to the nation's environmental protection effort.

Table 6.3.3-1 Administrative Responsibilities of the Five Environmental Protection Inspection Center (Eastern, Southern, Northwestern, Southwestern, and Northeastern China)

Responsibilities	Supervise local implementation of national environmental policies, statutes, and standards.
	Investigate severe environmental pollution and ecological damage cases
	Participate in the emergency response to severe environmental disasters and supervision of remedies
	Coordinate the mediation of transprovincial and transwatershed environmental conflicts
	Inspect the enforcement of environmental laws
	Inspect major sources of pollution
	Inspect state natural preservation zones and state major ecological protection zones
	Supervise transprovincial and transwatershed environmental pollution ecological damage petitioning cases and letters-and-visits reception.

Table 6.3.3-2 Administrative Responsibilities of the Six Nuclear and Radioactive Safety Inspection Center

Responsibilitie	Regular inspection of civil nuclear facility
	Regular inspection of nuclear facility directly supervised by SEPA
	Regular inspection of military nuclear facility radioactive environment
	Response to emergencies in nuclear facilities directly supervised by SEPA (including terrorist attacks)
	Onsite response to emergencies

(2) Implement Regional & Watershed Integrated Management

3 Because of the limitations in Chinese current environmental management system, as well as local protectionism, local governments often illegally interfere with the enforcement of environmental regulations, which results in obstacles in solving transboundary environmental problems. Therefore, China should establish regional & watershed integrated management system. Since the 11th Five Years Plan, China should incorporate watershed integrated management into the next comprehensive Five Years Plan of land management, environmental protection, ecological construction, and water resources management, and specific plans on environmental protection, and water resources management. China should enact comprehensive transboundary water environment management laws. Also, China should include watershed management laws in the national legislative plans, and revise current laws and regulations related to watershed management.

(3) Improve the Litigation System and Settlement Mechanism for Environmental Pollution and Damage Disputes

4 The current settlement mechanism for transboundary environmental pollution and damage disputes are usually based on the Article 15th of *Environmental Protection Law* and related regulations. Disputes are settled through negotiations between concerned governments or high level governments. In theory, this settlement mechanism should be able to help solve such

disputes, however, in practice, due to local protectionism and the separation of responsibilities between regulatory agencies, such disputes become extremely difficult to solve through the current settlement mechanism. Therefore, it is feasible and constructive to improve Chinese civil procedure, follow the nature of transboundary environmental disputes, and through the means of environmental public interest litigation and class litigation to achieve fair and swift solution of environment disputes.

6.3.4 Case Studies of the HRB Water Pollution Litigations

1 Although the current Chinese environmental torts system has positive effects in controlling environmental problems, it is obvious that traditionally China has focused on administrative penalties made by administrative agencies as the remedy, but has neglected the positive effects of civil remedies and criminal penalties. More specifically, as applied in the cases we discussed before, we discover that the following insufficiencies in the current environmental torts system.

(1) Setting up an Administrative Settlement Mechanism

2 According to the relevant provisions of environmental administrative procedure legislations, the administrative measures to handle environmental conflicts include: administrative penalties to the person who violates environmental protection regulations, fine the individuals and units that are directly responsible.

3 Although Article 41 of the Environmental Protection Law stipulates the damage remedy for the tortfeasors, the Article also reads that compensation responsibility and the amount of compensation may be set by the environmental protection administration or other legally designated environmental administrative bodies if requested by the victims. If the victims are not satisfied with the settlement, they may appeal in the court. Therefore, the Article is clear that the administrative settlements made by Chinese environmental protection administration are non-binding.

4 For example, in the case of Tai'an Apiology Research Institute Zhao Guangshan v. Dongping County Tool Shop Groundwater Pollution, after Shandong Province EPB issued a ruling on April 1st, 2003 after investigation, the plaintiff Zhao Guangshan sued the Shandong Prince EPB in the Shandong Province Ji'nan Tiaoqiao District Court. Tiaoqiao District Court dismissed the case on procedural ground. The plaintiff appealed again. The Shandong Province Intermediate Court again ruled that the compensation was adequate.

5 Therefore, the "settlement opinion" issued by the administrative body can not solve the environmental pollution damage compensation disputes. Moreover, it is an ineffective mechanism that wastes resources. To fill in this gap in Chinese environmental law, and to avoid the embarrassing situations when the victims appeal against the environmental administrative agency in administrative litigations, the following environmental laws in China, such as the Solid Waste Pollution Prevention Law issued on Oct. 30th, 1995, Environmental Noise Pollution Prevention Law in 1996, and Air Pollution Prevention Law in 2000 revised the "settlement" provision to "mediation & settlement." Therefore, it is clear that the "settlement opinions" issued by the environmental administrative agencies are non-binding mediation opinions.

6 This legislative approach shows that the major purpose for Chinese environmental protection administrations in solving environmental torts cases is to contain the conflicts between tortfeasors and victims and punish the polluters through administrative penalties. Remedies to the victims are usually neglected. And this is the major reason why Chinese current environmental administrative system is not effective in solving environmental pollution remedy disputes.

7 Under this situation, when environmental torts disputes happen, both the victims and the environmental administrative enforcers usually pay more attention to how to punish the polluters through administrative measures and stop the pollution. These measures are certainly meaningful in punishing, containing, or preventing pollution torts. However, these administrative penalties often replace compensations to the victims and civil liabilities, and the victims and administrative agencies often believe that disputes are solved when the tortfeasors are punished by the environmental administrative agencies. "Punishment but no compensation" becomes a prevalent mistake. Therefore, in most cases, the victims and even the judiciary often neglect the effects of the tortfeasors' civil liability in protecting the victims' rights. In some cases, even when the victims request compensations to environmental administrative agencies in environmental disputes, eventually the uncertainties and other obstacles in the administrative settlement procedure, method, compensation rules, and other relevant factors in calculating compensations would prevent the victims from obtaining their remedies. Under such legislations, even when there are hundreds of thousands environmental torts cases in China, only a few dozens received remedies through environmental administrative measures. Therefore, more importance should be attached to the administrative function of the government. Establishing a timely and efficient administrative settlement mechanism that can provide remedies to environmental torts plaintiffs is one of the most significant issues in Chinese environmental protection legislation. As a promising progress, the Property Law unequivocally protects prospecting right, mining right, water right, and the right to aquaculture and fishing of property owners. The Property Law also stipulates that "when these property rights are infringed, the property owners may request compensations and request the infringer to bear other liabilities." This provision is significant in protecting the property owners' water rights and their rights to aquaculture and fishing, and thus helps solve related disputes.

(2) The Lack of Criminal Liability in Practice

8 Although the *Criminal Law Code* revised in 1997 added a provision on the crime of "undermining environmental resources protection" to meet the needs of environmental protection under market economy, in reality, this provision of the Criminal Law Code has not been strictly enforced. The major reasons are: (1) this legislation needs to be refined. For example, the definition of "crime of severe environmental pollution accident" is still too abstract. Only those who actually caused the accidents are punished, and the punished targets are only limited to hazardous wastes cases. The summary legislation leads to inconsistencies in understanding among judges and academics. It is neither conducive to the strict enforcement of the provision, nor to achieve the legislative purpose of the provision as in the criminal code; (2) administrative liability replaces criminal liability. For a long period of time, China has overemphasized the effects of environmental administrative liability. Most of the "severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous

wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health" are only punished for those administrative liability. For examples, the published results of "Undermining Environmental & Resources Protection Crime" cases show that the sentences are usually relatively light. The longest sentence period is 5 years; the shortest is mere 6 months. Besides, the compensation is usually too low to fully compensate the aggrieved party. Article 408 of the *Criminal Law Code* also clearly stipulates "offense of misconduct in office of environmental management." However, in practice, the People's Court often delivers probative sentence to officers who committed offense of misconduct that leads to severe loss to public or private property, or death or injury to individuals. The sentence is light and often limited to one year. Therefore, it is safe to conclude that the good legislative purpose of "Undermining Environmental & Resources Protection Crime" has not been realized. Besides, offenses of general misconduct in office usually receive up to 3 years of imprisonment. Under particularly severe circumstances, the sentence can be up to seven years. In comparison, offenses of misconduct in office of environmental management, and especially when the serious pollution incidents with serious consequences of public or private properties and individual health receive up to three years of imprisonment. Such regulations are neither conducive to the punishment of the responsible officer, nor to the deterrence of future environmental pollution accidents.

(3) The Gaps in the Civil Liability of Environmental Torts System

1 Chinese current regulations on environmental torts remedies have not provided specified provisions based on the special situations of environmental torts. In practice, compensation for environmental torts follows the general provisions on civil torts liability in the Civil Law Code.

2 These cases are mainly solved through administrative procedures. Victims' request for civil compensation are usually dismissed or failed. Through analysis of the aforementioned cases, we discover several major gaps in Chinese environmental torts remedy system.

Lianyungang Shiliang River Reservoir Pollution Case[22]

For example, the first transboudary case happened in Huai River Basin is a typical case of civil liability. Shiliang River reservoir is the largest man-made reservoir in Jiangsu Province, which is located in Lianyungang City, Donghai and Ganyu Counties. Since 1998, fishermen in nearby villages invested heavily in aquaculture industries in the reservoir. From July 1999 to June 2000, upper stream wastewater pollution killed all fish in the reservoir. Direct economic loss amounted to over 5.6 million Yuan. The fishermen petitioned the local EPB and Fishing Agency with no result. Under such circumstances, the 97 fishermen who suffered huge loss started a lawsuit in Lianyungang Intermediate Court to request compensation from polluters. On Dec. 14th of the same year, the Intermediate Court ruled that the defendants Shandong Province Jingxinmen Paper Company and Lingmu County Chemical Company had caused the pollution accident and should compensate the 97 fishermen 5.604 million yuan for the fish and 48000Yuan for investigation. The defendants appealed to the Jiangsu Province Supreme Court. In April 2002, the Jiangsu Province Supreme Court affirmed the original

22 http://www.people.com.cn/GB/paper39/6537/641711.html July 15, 2002.

judgment. However, the enforcement was never completed because the two defendants were bankrupted. In the end, the 97 fishermen had to appeal to the government and the court. On Nov. 25th, 2003 and Dec. 5th, 2003, the Supreme Court twice sent investigation groups to Shandong and Jiangsu Provinces and reached settlement with the two provincial governments. Shandong Province would provide 3.6 million yuan and Jiangsu Province would provide 2 million yuan to compensate the victims.

9 First, there are several procedural requirements that are disadvantageous to the victims as in the following aspects:

10 a. difficulty in placing a case on file. According to the requirements in the *Civil Procedural Law,* those who seek remedies have the burden of proof. Therefore, the victims should present sufficient evidence of their injury. On the proof of injury, the Chinese court requires an appraisal of the injury caused by specific environmental pollutions from an official appraisal agency. Without an appraisal, the court would usually dismiss the case. However, such an appraisal is often very difficult to obtain given the financial and human resources limitations of the victims. Besides, the proof of causation in environmental torts is different from ordinary torts cases and difficult to verify. Normally, environmental pollution are generated through air, water, and other natural media, or accumulated and synergized by various causes. Environmental pollutions are characterized by their extensiveness, indirectness, and latency. In addition, the polluters often have the advantage of asymmetric information, and may refuse to provide the information to the public under the excuse of business secret. Therefore, it is extremely difficult to scientifically and closely prove the causation between hazardous substances and injury for an ordinary citizen. Furthermore, the proof of causation between the action and injury is influenced by the development of science and technology. The hazards of environmental pollution are not only generated with high-tech and high-hazardous industries; the development level of advanced technology also limits the proof of causation, especially when environmental torts caused unknown diseases in the aggrieved party. In some cases, with current science and technology, it is impossible to directly prove causations. Even when the hazardous substances can be identified, it is complicated to specify the pollution sources, the pollution routes, and the correlation between pollution and injury. Even though Chinese legislature has made some efforts to alleviate the burden of proof on causation in environmental torts cases, the situation is still disadvantageous to the aggrieved party.

11 b. The difficulty in determining liabilities of the defendants. Although the Chinese *General Rules of Civil Law* have stipulated some regulations on environmental torts civil liability, such regulations are not specific enough. It causes divergence of views on how to determine liabilities, and is not conducive to enforcement. In addition, although some judicial interpretations have stipulated that the burden of proof should shift to the defendant when proving the causation of environmental torts, in practice, the provision is still ill-defined.

12 Second, on the issue of remedy

13 Due to the influence of traditional civil law theory, the calculation of remedy for environmental torts in China includes the factors such as the plaintiffs and the defendants' economic situation; therefore, it tends to undercompensate the aggrieved party. Even when the

victims suffer grave loss, the compensations are often meager.

14 For example, in the aforementioned Lianyungang Shiliang River reservoir pollution case, though the trial court affirmed the economic loss of 5.6 million yuan to the plaintiffs, the remedy was just for the direct loss of the fishermen, but did not include the costs of environmental restoration. Therefore, the current Chinese system for calculating environmental tort damage compensation is still flawed, and disadvantageous to the aggrieved party and the damaged environment.

15 Third, on the calculation of remedy

16 In China, the remedy for environmental torts still includes direct loss and indirect loss according to the traditional method.

17 a. On property loss. China has long followed the traditional method in calculating environmental torts remedy, which includes property loss and other non-property losses. Property loss is further divided into direct loss and indirect loss. When determining the monetary value of remedy, the property loss is calculated through individual appraisal and accumulative calculation. On the other hand, other non-property losses are calculated through a combination of factors such as the fault of tortfeasors, the specific condition of the injury, the actual consequences of the injury, the profit of the tortfeasors, the economic situation of the tortfeasors, and other relevant regulations. However, such individual appraisal and accumulative calculation method and partial compensation is questionable in terms of its theoretical underpinning and practical effects. In addition, environmental torts are different from other torts. The traditional method of remedy calculation may be inappropriate in the case of environmental torts.

18 b. On the scope of personal injury.

19 China currently adopts the same method of calculating general torts cases in environmental torts with personal injuries. The method is specified in Article 119 of the General Rules of Civil Law and the legal interpretation on personal injury compensation issued by the Supreme People's Court on Dec. 26th of 2003

20 On the calculation of compensation to victims who are handicapped or dead, Chinese judiciary system adopts the theory of "lost parenting." The compensation is mainly for the dependents of the handicapped or the dead victims. Though the "lost parenting" theory is reasonable and widely adopted by England, United States and France, there are a few defects in the Chinese system when the "lost parenting" theory is applied to calculate the damage of the victims. First, the length of the dependants parenting period is too short. For example, according to the Provision 1 of Article 28 of the *Legal Interpretation on Personal Injury Compensation.* If the dependents are juveniles, the parenting period ends at age 18. If the dependents can not work and have no other legal guardian, the parenting period ends at age 20. Besides, for dependents older than 60, the period is subtracted for each year over 60. For dependents older than 75, the period is set at 5 years. This provision tends to undercompensate the victims. In addition, the definition for "dependants" is too narrow. According to the Provision 2 of Article 28 of the *Legal Interpretation on Personal Injury Compensation*, dependants are limited to the juveniles to whom the victim has legal responsibility and other adult relatives who can not work and with no other

legal guardian. When the dependants have other sources of income, the defendant only shoulders the portion legally required of the victim. Such a provision in fact rules out defendants who are willingly raised by the victims. Furthermore, according the Provision 2 of Article 28 of the *Legal Interpretation on Personal Injury Compensation,* "when there are several dependants, the annual compensation should not exceed the annual per capita consumption." Each dependant can not receive amounts exceeding the annual per capita consumption of the year before. The limitations on the amount that can be received by the dependants is inconsistent with the principle of full compensation and can not achieve the purpose of providing remedy to the victim.

21 Fourth, the Application of Injunctive Relief. Remedies for environmental torts are not limited to compensation, and should also include injunctive relieves. Since environmental torts often come with legal industrial production, the court often faces a dilemma in these cases. Whether the court should protect the victims' lives, health, protection and environmental rights, and stop the socially beneficial industrial production? Or should the court stands by the side of industrial production and sacrifice the local residents' lives, health, property and environmental rights?

22 Fifth, Obstacles in Enforcement. China has not established a mandatory insurance system for environmental torts. When the tortfeasor causes severe damage to the victims' property and health, the victims will not be properly compensated if the tortfeasor lacks a deep pocket to cover all the compensation.

23 For example, in the aforementioned Lianyungang Shiliang River reservoir pollution case, although the courts ruled that the defendants should compensate the 97 plaintiffs 5.6 million yuan and stop pollution promptly, the plaintiffs did not receive any compensation from the defendants because the defendants were unable to shoulder any civil liability. In the end, the defendants received compensation through the government. Therefore, to ensure that the victims would receive compensation through litigation, China should established a mandatory environmental insurance scheme through legislation to require all enterprises with high pollution risk to take out insurance policy on environmental liabilities.

7. Policies

7.1 Environmental Policies

1 In a broad sense, water environment policies refer to all decisions and actions by the state and local governments in water environment protection.

7.1.1 Major Environmental Policies

1 The HRB pollution control has received high attention from the State Council. In 1995 the State Council issued the *Interim Regulations on the HRB Water Pollution Control and Prevention.* The provinces in the HRB followed by issuing local policies and regulatory documents (Table 7.1.1-1).

Table 7.1.1-1 HRB Water Pollution Control Policies and Regulations

Level	Type	Policies
National	Environmental	PRC water pollution control and prevention law (1996)
		PRC administrative litigation law (1989)
		Environmental protection act of the PRC (1989)
		PRC administrative punishment law (1996)
		PRC administrative reconsideration law (1999)
		PRC clean production promotion law (2003)
		PRC EIA law (2003)
		PRC administrative license law, (2004)
	Environmental protection	Regulation on the construction project environmental protection management (1998)
		Implementation detailed rules of the PRC water pollution control and prevention law (2000)
		Management regulation on the collection of pollutants discharge tariff (2003)
		Investigation and clampdown measures on the non-license operation (2003)
		Regulation on the public suggestion management (2005)
		Regulation on the control and prevention of the water pollution from the watercraft (2006)
		the HRB water pollution control and prevention provisional regulation
	Department regulation	Measures on the management of water pollutants discharge permits (1988)
		Regulation on the management of pollutants discharge application and registration (1992)
		Code of the regulation and circular making for the environmental protection department (1999)
		Livestock and poultry breeding pollution control and prevention measures (2001)
		Management measures on the HRB and TLB water pollutants discharge permits (2001)
		Construction project completion environmental protection reception measures (2002)
		Classification and management of the construction project environmental protection (2003)
		Approval regulation of the construction project EIA report (2003)
		Management measures of the pollutants discharge tariff standard (2003)
		Management measures of the pollutants discharge tariff collection and use (2003)
		EIA report examination experts database management (2003)
		New chemicals environment management measures (2003)
		Regulation on the planning EIA report examination and approval (2003)
		Environmental protection field administrative punishment measures (1999)
		Environmental protection administrative license public hearing regulation (2004)
		Measures on the clean production audit (2004)
		Management measures on the license of environmental pollution control facility operation (2004)
		Management measures on the pollution sources automatic monitoring (2005)
		Punishment code on the illegal behavior in environmental protection field (2006)
Local	Jiang	Jiangsu Province environmental protection regulation
		Jiangsu ecological province construction plan

Level	Type	Policies
		Jiangsu Province circulation economic development plan
		Decision regarding strengthening of pollution control and boosting of the progress of ecological province construction
		Jiangsu Province lake protection regulation
		Jiangsu Province agricultural ecology environmental protection regulation
		Jiangsu Province urban water supply resource management regulation
		Jiangsu Province city environment and sanitation management regulation
		Circular on the authorization of EIA report approval
		Circular on the implementation of clean production audit
		Circular on the policies of expediting industrial pollution control and achieving discharge in compliance with standard - Jiangsu Province
		Circular on the scientific and sustainable development
		Circular on the strengthening of the construction of ecological province and environmental protection
		Circular on the strengthening of comprehensive decision regarding environment and development
		Circular on the strengthening of environmental protection works
		Circular on the decision of further strengthening of the environmental protection works
		Circular on the environmental protection priority and scientific development
		Circular on the policies regarding boosting environmental protection works
		Circular on the promoting sustainable development by price leverage
		Construction plan on the demonstration township of harmonizing development of environment and economy
		Fund management measures of the Jiangsu Province environmental protection science & technology development and standardized environmental monitoring station
		Management of Jiangsu Province on the surface water environment function classification
		Circular on the strengthening of the development of environmental protection industry
		Official assessment measures on the environmental protection works
		Circular on the strengthening of environmental protection works during the enterprise reform
		Circular on the strengthening of environmental protection works during the small scale township development
		Circular on the transfer to market for the environmental protection facility construction and operation
		Circular on the boosting the environmental protection industry development by credit loan
		Circular on the "environmental quality indicators" of the better-off life society and assessment measures
		Circular on the realizing of the all indicators of the better-off life in Jiangsu Province
		Circular on the stop using phosphor in whole province for environmental protection
		Jiangsu Province pollutants discharge outlet management measures
		Circular on putting the list of enterprises who has serious pollution to public
		Circular on the strengthening of supervision and realizing industrial pollutants discharge in compliance
		Circular on pilot program of water pollutants discharge right trade
		Circular on forbidding the use of phosphor containing detergent in whole province
		Circular on the strengthening of the environmental protection in the economic developing zone
		Circular on audit measures to the pollutants discharge tariff collection
		Management measures on the collection and usage of pollutants discharge tariff
		Provisional measures on the pollutants discharge tariff collection based on the water pollutants total discharge amount
		Circular on the management measures to the pollutants discharge automatic monitoring
		Circular on the strengthening of environmental protection works
		Implementation plan on the modernization of environmental monitoring
		Jiangsu Province construction project supervision provisional regulation

Level	Type	Policies
		Jiangsu Province main pollution sources pollutants discharge TML control monitoring report regulation
		Circular on the strengthening of environmental monitoring in the project construction
		Plan on the environmental monitoring modernization
	Anhui	Anhui Province urban domestic drinking water sources protection regulation
		Anhui Province agricultural ecological environmental protection regulation
		Hefei food and entertainment industry environmental protection management regulation
		Hefei implementation of water pollutants discharge permit management measures
		Usage measures of the pollution sources control fund
		Anhui Province the HRB industrial wastewater discharge in compliance confirmation methods
		Anhui Province the HRB water pollution control and prevention regulation (1993)
		Anhui Province implementation of Water Act measures (2004)
	Shandong	Shandong Province SNWD water pollution control and prevention regulation (2007)
		Shandong Province implementation of EIA Law measures (2006)
		Shandong Province implementation of PRC Administrative License Law measures (2004)
		Shandong Province pollutants discharge tariff collection standards calculation methods (1996)
		Measures on calling to account the administrative responsibility (2002)
		Shandong Province water pollution control and prevention regulation (2000)
		Shandong Province official environmental protection performance evaluation measures (1996)
		Shandong Province environmental pollution troubleshooting measures (1994)
		Shandong Province Yi-Shu River watershed water pollution control and prevention measures (1996)
		Shandong Province pollution control facility management and supervision measures (2000)
		Shandong Province environmental protection regulation (1996)
		Shandong Province Xiaoqing River watershed water pollution control and prevention regulation (1995)
		Shandong Province Nansuhu watershed water pollution control and prevention regulation (1994)
		Shandong Province agriculture environmental protection regulation (1994)
		Administrative punishment code on the illegal behavior in environmental protection field (1996)
		Circular on the further strengthening of the environmental protection works
		Circular on the special finance to the pulp mill and brewage industry pollution control (1996)
		Shandong Province implementation plan of the HRB water pollution control and prevention10th FYP
		Shandong Province environmental protection 10th FYP
	Henan	Henan Province construction project environmental protection regulation 1990, 2006, 2007)
		Henan Province pollutants discharge tariff collection and usage management measures (2003)
		Management measures of Henan Province water pollution sources control with time limit (1996)
		Henan Province municipal WWT tariff collection and usage management measures (2005)

2 The *Interim Regulations on HRB Water Pollution Control and Prevention* (August 8th, 1995) is China's first and currently only watershed-specific water pollution control and prevention regulation. It covers the watershed water pollution control and prevention objectives, watershed water resource protection organizational set-up, environmental accountability and liability, water pollution control and prevention planning and pollutants discharge TMLL targeting, compliance enforcement, pollutants discharge permits issuing, pollutants discharge fee collection and management, industrial restructuring, coordinated water quality and quantity management, environmental emergency response, and water pollution disputes.

3 Although touching all major aspects of water pollution control and prevention, the current policies have the following issues:

- "Principle" rather than concrete – there is no implementation guideline for the operation at various implementation level;
- Raising the "hopes" without telling "how";
- Lacking of specific result evaluation methods;
- Lack of service-oriented but highly professional implementation guidelines to fill the details of the policies and regulations with plain but accurate and professional language to support and serve the implementers of the policies at provincial, prefecture, and county levels.
- Possible conflicts of interest, inefficiency and ineffectiveness in the monitoring system lead to inefficiency, ineffectiveness, and weak enforcement.
- Inadequate preparation before launching the policies, which in turn leads to unsatisfactory policy implementation.

7.1.2 Implementation

1 The *Interim Regulations on HRB Water Pollution Control and Prevention* has required universal discharge compliance by Jan 1st, 1998 and the "clearing" of the Huai River water bodies by 2000.

2 Right before 00:00, Jan 1st, 1998, SEPA launched the CZZT. Later, SEPA announced at China Central Television nationwide the successful reduction of over 40% of the Huai River pollution. The water quality of the Huai River mainstream and tabulates have had visible improvements since.

3 However, the following problems occurred:

- On the whole, water quality has improved during the 10th FYP. The proportion of Class II-III water quality rose from 7.7% to 19.8%, and the proportion of worse than Class V sections declined from 75% to 32.6%. However, the majority of Huai River water quality still cannot meet the functional requirements. It's still far from the 9th FYP objective of clearing up the water.
- After the 'CZZT', industrial non-compliant discharge resurfaced. By 2005, nearly 1/3 of the enterprises exceeded the allowed discharge amount.
- By and large, the pollutants discharge TMLL objectives were not achieved. During both in the 9th and 10th FYPs, the actual discharge has far exceeded the objectives.
- In HRB, the pollutants discharge permitting system was carried out superficially.

4 The implementation results of the policies indicate the suitability of the policies. The results mentioned above reveal further issues in the policies and their implementation:

- The water policy-making does not adequately match or try to match the economic development level.
- Economic decisions do not fully incorporate the environmental issues. Although the central government has taken the environmental issues as an important factor during the decision-making, at the local and corporate levels the environment issues have not been put to a proper position in their decision making.
- Insufficient preparation of the long time span and complexity of river/lake water quality

restoration in the water pollution control policy-making, especially in meeting the targets.
- Insufficient financial and human resources in the EPBs to successfully enforce the environmental policies, laws, and regulations.
- Unsustainable execution of enforcement efforts: the often adopted "flare" style takes highly concentrated human resources and financial inputs and has been proved to have only short-lived results.
- Insufficient funding – although pollution control policies and plans require for matching budgets, the funding was always not in place, in time.

5 In relation to those issues, the future watershed pollution control policy implementation should watch for the following aspects:

- Early integration of environmental considerations in economic decisions.
- Elevated technological capacities.
- Decisions and management capacity enhancement of the EPBs.
- Increase in investment and funding.

7.2 Regional Development Policies

7.2.1 Building Ecological Provinces

1 Policies for building ecological provinces are carried out widely in provinces along the HRB, and are regarded as important development policies. According to SEPA's *Interim Construction Indicators of Ecological County, City, and Province*, the indicators include the following three categories: economic development, environmental protection and social advancement. The environmental protection indicators require that the water environment quality must meet the functional use standards. It also raises the required pollution control indices such as the COD discharge intensity, and centralized urban domestic WWT rate. The following are the result of implementation:

2 According to the *Provincial Environment Status Report 2005* issued by the HRB provinces, by 2005, the Jiangsu Province has implemented the *Jiangsu Ecological Province Planning Compendium*, held demonstrative units for both rural environment renovation and ecological city construction in 48 (22% of the national total) counties, cities, and districts, which became national ecological demonstration districts. Anhui Province has established 3 national ecological agricultural demonstration counties, 12 provincial-level ecological agricultural demonstration counties, and 60 provincial-level ecological agricultural demonstration districts. In Shandong Province, 17 cities carried out the *Construction Planning for Ecological City* authorized by regional governments. 60 of the total 140 counties, cities, and districts have established the plan for building ecological counties. Henan Province has established 18 national ecological demonstration districts and 1 provincial-level ecological demonstration district. The process of building rural well-to-do environmental protection and small-urban ecological cultural villages has unfolded widely.

3 According to the *Provincial Ecological Province Construction Planning Compendium*, building ecological province includes restructuring, optimized configuration of water resource,

pollution control and other important parts, dealing with water pollution control and prevention, adjustment and optimizing of industrial structure, industrial structural pollution control, clean production, and municipal WWT. Theoretically, building ecological province will benefit water pollution control and prevention, but current no data can refer to the concrete effects of the HRB pollution due to this policy.

7.2.2 SNWD East Line Pollution Control Project

1 The HRB would influence directly the SNWD and it water delivery in the east line.[23] In order to meet the quality required of the delivered water, the water quality objectives of 27 control sections have been prompted from class IV to III.

2 The SNWD east line project poses higher requirement for the pollution control. Water pollution control and prevention plan in the 10th FYP need to coordinate with the SNWD east line project, and the water quality requirement need to be improved. The State Council and the MWR, SEPA, MOC, and the provincial governments involved in the project have established the framework of "SNWD Pollution Control in East". The framework has pointed out that Shandong and Henan provinces, the areas of the highest pollutants discharges, should be emphasized in pollution control, since controlling the pollution in those 2 provinces means controlling of over 50% of the total watershed pollution. According the State Council's requests in the "Plan of SNWD East Line Pollution Control" framework, Shandong Province had advanced 27 sub-plans to control the pollution. In June and November, 2005, the NDRC has organized two inspections and approved those plans. Meanwhile, Jiangsu has also passed its plans in January 2005. Among their 14 control sections in the 10th FYP, 9 accorded with surface water environment standards Class III.

3 The elevated SNWD water pollution control objectives add pressure to pollution control. The industries spotting along the East Line are mostly heavily polluting industries as papermaking, brewing, or chemical plants. According to the East Line pollution control plan and the current wastewater discharge standards, most of plants will have difficulties to meet the water quality objective. Further elevating the discharge standards will further add on to the WWT cost and make the objectives more difficult to achieve. If the surface water quality standards Class III were to be adopted, most of the post-treatment wastewater cannot be released to the canal. Moreover, the shortage of funding will affect the implementation of the project.

4 In all, the pollution control in SNWD is better implemented than the entire watershed. It is clear that the government, especially the economic authorities, has provided great support to ensure the organization, fund, and inspection.

[23] According to the blue print of east part of SNWD project, towns along the Huai River which would have effort to the project are: Yangzhou, Suqian, Xuzhou, Taizhou city in Jiangsu province; Zaozhuang, Jining, Heze, Taian city and other 28 counties in Shandong province; Huainan, Bengbu, Huaibei, Suzhou city and other 8 counties in Anhui province.

7.3 Industrial Development Policies

1 Recent industrial development policies are mostly guiding environmental policies, which are listed as follows.

(1) Industrial distribution and structural regulation

2 A number of characteristics feature this policy: adjust the improper industry distribution based on the overall urban planning and the environmental protection planning; for the old industrial cities, relocate certain industries to alleviate the concentrated pressure from pollution; and replace heavily polluting industries with those of lighter pollution. In 1996, a policy favorable of moving polluting industry came out. This policy enabled economic compensation to the industries relocated, and therefore partially resolved the financial shortage in urban industrial pollution restructuring. The industrial restructuring would focus on restricting heavily polluting and energy consuming industries and regulating the technologies.

(2) Technological advancement and the cleaning production policy

3 This policy adds environmental protection requirements to the industrial technological advancements and imposes pollution reduction requirements for new technologies generally through two approaches: technological advancement which updates the originally heavily polluting techniques to lightly polluting or zero discharging ones and comprehensive utilization, which recycles the wastes back to production.

(3) The "Closing, Ceasing, Combination, and Conversion" Policy

4 The "Closing, Ceasing, Combination, and Conversion" Policy has been a strict environmental protection policy. It is generally implemented according to two scales: the situation of pollution and the industrial size. The former one targets at the heavily polluting industries unable to comply, and the latter forbids the existence of miniature enterprises in certain sectors. The 1996 *Decision on Several Issues in Environmental Protection* by the State Council required local governments to close off all miniature enterprises of 15 heavily polluting industries. The policy was enforced as administration order.

5 The structural pollution in the HRB has been severe. Papermaking, brewing, chemical industry, printing, and dying and some other water-consuming industries with heavy pollutions have not been sufficiently regulated. The case that one factory pollutes an entire river is still in existence. Companies with outdated techniques pay attention to expanding but not technological advancement. During pollution control, the discharging enterprises controls only the end-of-pipe discharges rather than striving for clean production. Stabilizing discharge level will be a remote goal. Repeated constructions of low technology plants are still prevalent, and outdated productions are pervasive.

6 To solve this problem, the 4 provinces along the Huai River announced in the *Huai River Water Pollution Control and Prevention Objectives and Responsibilities* that by the end of 2005, they would close off all the calcareous and chemical method product lines with production capacities under 30,000 tons/year, yellow board paper factories of under 20,000 tons/year, used paper factories of under 10,000 tons/year, alcohol factories of under 10,000 tons/year, and starch

factories of under 10,000 tons/year. Factories with excessive water pollution should be shut down or remodeled. For the factories with heavy pollution but still compliant to the standards, the pollutants discharge should be reduced. The pollution control projects, especially those adopting the clean production techniques to reduce the pollutants, would receive compensation from the government.

7 According to the *Evaluation Report of the HRB Water Pollution Control and Prevention Project in the 10^th^ FYP*, during the 10th FYP, each province along the Huai River had adopted multiple approaches for restructuring and spread the clean production plan and had exerted great effort to solve the structural pollution problem.

8 Shandong Province is a major agricultural province and also a major province of papermaking. The papermaking industry is an important part of the economy. In 2000, the production value from the papermaking industry was only 2.5% of the industrial total, while its COD discharge was 59.6%, ranking top among all the industries. To accelerate the industrial restructuring and assuring the water quality of the SNWD East Line project, during the10th FYP, the government of Shandong has taken certain measures: 1. All 61 papermaking factories with a production under 20,000 tons/year in 2001 were closed, and all alcohol production lines with capacity under 5,000 tons/year had been closed. Moreover, by the end of 2005, 28 papermaking, alcohol, and starch factories along the Huai River had been closed. 2. Accelerated the reconstruction of the papermaking industry structure by provide assistance to the 6 large papermaking factories and consolidating the industry. 3. Intensified policies and legislations to regulate the industries. Five pollutants discharge standards for the papermaking industry, dying industry, livestock rising and husbandry have been released gradually to tighten environmental protection step by step. Compared to 2000, the outputs, revenues, and taxes of the paper products industry increased by 110.5%, 835.6%, and 428.6% respectively, while the COD discharge declined by 46.5%, creating a win-win situation between the environment and development.

9 During the 10th FYP, Jiangsu Province also accelerated the industrial restructuring. By the end of 2005, 61 factories or product lines which caused severe pollutions below some standard had been closed; 156 "Small Fifteen" and "New Small Five" factories were also closed. The water pollution was efficiently reduced. Meanwhile, the clean production policy had been advocated to develop a circular economy and to improve pollution control. Up till now, along the Huai River, 537 factories have passed the examination of clean production, and over 40 factories have been ISO14000 certified. Also more than 30 factories have launched the circular economy demonstration, and over 70 factories have been further reducing their pollution discharge after achieving compliance.

10 In summary, the industrial restructuring policies have effectively reduced pollution in the HRB and brought favorable influence to the industrial development. The experience could possibly be borrowed by other large watersheds with severe pollution.

7.4 Investment and Financing Policies

1 The *9th HRB Water Pollution Control and Prevention FYP* and the *10th HRB Water Pollution Control and Prevention FYP* have required for efficient mechanisms for investment, operation, fee

collection, and pricing of water pollution control and prevention. The survey results show that the HRB provinces are starting to establish a multi-source investment and financing system, whose major funding comes from the government and is supplemented by funds from the civil society, private sector, and progressively foreign investment.

(1) Comprehensive watershed pollution control

1 According to the *9th HRB Water Pollution Control and Prevention FYP*, investment requirements for the HRB water pollution control and prevention was about 166×10^8 yuan during the 9th FYP. Planned loan from the State Planning Commission, the Economic and Trade Commission, and the Treasury was about 13.13×10^8 yuan (7.9%) of the total demand. The remaining part needed to be filled in by the local governments and the private sector. The *10th HRB Water Pollution Control and Prevention FYP* planned 488 projects on water pollution control and prevention with a total investment need of 255.9×10^8 yuan. 211 of these projects belonged to pollution control of the SNWD East Line, where the investment need amounted 108.3×10^8 yuan. The rest 147.6×10^8 yuan will be financed by the local governments; the central government only committed "providing certain support" in the plan.

2 Due to the variety of concerned entities in the private sector and among the government offices, the monitoring, management, statistics and reporting system within the current institution is too segregated to provide comprehensive data on water pollution control and prevention investment for the 9th and 10th FYPs. Only data on the HRB water pollution control and prevention project investment during the 10th FYP in the 4 provinces have been made available and are presented in Tables 7.4-1 through 7.4-4.

Table 7.4-1 HRB 10th FYP Water Pollution Control and Prevention Investment in Jiangsu Province

Program classification		Planned investment (x104yuan)	Actual investment (x104yuan)	Fulfilled investment (x104yuan)					
				Central government	Ratio (%)	Local government	Ratio (%)	Social financing	Ratio (%)
Completion	Comprehensive industrial pollution control	-	16650	-	-	14930	89.67	-	-
	Industrial structure reform	-	13500	-	-	11160	82.67	-	-
	Garbage disposal	-	7000	-	-	1.02	0.01	-	-
	Environmental supervision capacity building	-	950	-	-	793.19	83.49	-	-
	Agriculture non-point source control	-	10000	-	-	10000	100	-	-
	Drinking water	-	5200	-	-	5200	100	-	-
	Municipal WWTP	370000	258495	-	-	-	-	-	-
Under construction (until 2005)		269292	94476	31440	33.28	63036	66.72	-	-
Total		765000	406271	-	-	-	-	-	-

Source(s): The Jiangsu Province 10th FYP implementation evaluation report.

Table 7.4-2 HRB 10th FYP Water Pollution Control and Prevention Investment in Anhui Province

Program classification	Planned investment ($x10^4$ yuan)	Actual investment ($x10^4$ yuan)	Ratio of investment fulfilled to planned (%)
Municipal WWTP	312000	126237	40.5
Garbage disposal	41489	11889	28.7
Point source pollution enhancement	60690	60690	100
Industrial structure reform	94958	93307.31	98.3
Area comprehensive pollution control	101000	92460	91.5
Agriculture non-point source control	8800	7525	85.5
Drinking water	14000	14000	100
Capacity building and science research	14869	14869	100
Total	647806	420977.3	65.0

Source(s): Anhui Province 10th FYP implementation evaluation report.

Table 7.4-3 HRB 10th FYP Water Pollution Control and Prevention Investment in Henan Province

Program classification	Planned investment (x104yuan)	Actual investment (x104yuan)	Ratio of investment fulfilled to planned (%)	Fulfilled investment (x108yuan)					
				Central government	Ratio (%)	Local government	Ratio (%)	Social financing	Ratio (%)
Municipal WWTP	33.95	16.7	49.19	7.00	41.92	4.64	27.81	5.05	30.27
Industrial structure reform and clean production	16.06	4.23	26.34	0.00	0.00	3.23	76.36	1.00	23.64
Comprehensive industrial pollution control	5.33	1.48	27.77	0.45	30.31	0.64	42.76	0.40	26.93
Garbage disposal	2.31	0.38	16.45	0.09	23.74	0.29	76.26	0.00	0.00
Comprehensive watershed pollution control and ecological demonstration	7.30	5.34	73.15	0.00	0.00	5.34	100	0.00	0.00
Well-digging	0.91	2.00	219.78	0.00	0.00	2.00	100	0.00	0.00
Agriculture non-point source control	1.00	-	-	-	-	-	-	-	-
Capacity building	1.16	1.81	156.03	0.18	10.13	1.63	89.87		0.00
Total	68.03	31.95	46.96	7.72	24.18	17.77	55.62	6.45	20.19

Source(s): Henan Province10th FYP implementation evaluation report.

Table 7.4-4 HRB 10th FYP Water Pollution Control and Prevention Investment in Shandong Province

Program classification		Planned investment (x104 yuan)	Actual investment (x104 yuan)	Ratio of investment fulfilled to planned (%)	Fulfilled investment (x108 yuan)			
					Central govern-ment	Ratio (%)	Local govern-ment	Ratio (%)
Completed	Water pollution control and prevention (except WWTPs)	203210	66662	32.80	3100	4.65	63562	95.35
	WWTPs	-	207464	-	-	-	-	-
Under construction		173000	35360	20.44	8481	23.98	26879	76.02
Total		603800	309487	-	-	-	-	-

Source(s): Shandong Province10th FYP implementation evaluation report.

3 During the 10th FYP, none of the 4 HRB provinces met the target for water pollution control and prevention plan investment. Some provinces have shown a wide gap from the targets. Pollution control is mainly financed by the local governments with certain support from the state.

(2) WWTPs

4 The *10th HRB Water Pollution Control and Prevention FYP* requires the local governments of all levels to implement the WWT fee policy, strengthen the fee collection, promote the market-oriented operation of WWTPs, improve the financing ability of WWP projects, and attract non-governmental funding. For cities that do not charge WWT fees, their WWT projects will not be approved by the government. The objective of this policy is to diversify the funding sources and the operation models to a more pro-market approach.

5 Most of the HRB areas are economically underdeveloped with insufficient pollution control funding. Therefore, the HRB provinces have issued policies such as increasing the municipal WWT and water resource tariffs. For example, Jiangsu Province has issued the *Jiangsu Province WWT Fee Collection and Management Regulations for Self-Supplied Water User*. By now, almost all HRB provinces have increased the WWT tariff to above 0.8 yuan/ton to provide incentive to WWT investment. The BOT/TOT models have been promoted to stimulate private capital investment. Although the actual WWTPs construction did not meet the planned objective for both FYPs, the current WWTPs investment and operation policies have significantly facilitated WWTP construction and especially operation.

(3) Comprehensive industrial pollution control

6 According to the principle of the "polluters pay," the national policy requires the polluting enterprises finance their own WWT facilities through various means including the bank loans, civil society funding, and foreign investment with "proper state subsidy on the loan interests."

7 However, the survey suggests that the current industrial enterprises comprehensive prevention and control funds are mainly from local government's fiscal budget. For example, during the 10th FYP, for the constructed watershed water pollution control and prevention projects in Jiangsu Province, the total actual investment on industrial comprehensive prevention and control was 16650×10^4 yuan, where the local government contributed 90% (14930×10^4 yuan); actual industrial restructuring investment was 13500×10^4 yuan, 83% of which came from the local government (about 11160×10^4 yuan). Henan Province's total investment in industrial restructuring and clean production during the 10th FYP reached 42346×10^4 yuan, where the local government investment accounted for 76% (32336×10^4 yuan), and civil society financing accounted for the rest 24% (10010×10^4 yuan); among the industrial comprehensive pollution prevention and control projects, the central government financed 30% (4500×10^4 yuan), the local government financed 43% (6350×10^4 yuan), and the civil society financed 27% (3999×10^4 yuan).

8 The above analysis indicates that the advocated multi-sourced investment and financing mechanism for water pollution control is still to be established. In the current mechanism, pollution control mainly depends on direct government investment. The current policy is still incapable of channeling other capitals into the pollution control sector. As a result, the available financing methods remain narrow and monotone, and the financing abilities of some local county

(city) governments are still weak.

9 Pollution control capitals will be very limited, if it depends only on government fiscal budget, and the shortfall of the pollution control capital is the major factor to restrict the implement progress of the HRB water pollution control and prevention project. Although the current policy has tried to expand to social, enterprise and foreign capitals, the effect is still inadequate.

10 A multi-sourced investment and financing mechanism among the governments, banks, enterprises, and individual is an international common practice to absorb diffused capitals including fiscal capital, private capital, and other social capitals to environment protection projects. However, policies to enable profitable returns to the investment need to be nailed down to provide incentives for the private investments to come in.

7.5 Technical Policy

1 In November 1986, the State Council Environment Protection Committee published the *Regulations of Technical policies of Preventing Water Pollution*. The *Regulations* posed comprehensive requirements on controlling and preventing water pollution by technical policies of watershed, urban, industrial and mine enterprises and villages and township enterprises. It includes: watershed- or district-based technical policies of water pollution comprehensive prevention; urban WWT technical policy; water pollution control and prevention technical policies of industries, mines, and villages and township enterprises.

2 Since the 9th FYP, according to the needs of Chinese water pollution control, the state government has published technical policies of water pollution control, which include:

- Light industry resource comprehensive utilization technical policy (1997)
- Straw pulp industrial wastewater pollution control and prevention technical policy (1999-11-29)
- Municipal wastewater treatment and pollution control technical policy (2000-05-29)
- Domestic waste treatment and pollution control technical policy (2000-05-29)
- Dyeing industrial wastewater pollution control technical policy (2001-08-08)
- Lake and reservoir eutrophication control technical policy (2004-05-10)
- Tanning industry pollution control technical policy (2006-02-21)

3 Local government attaches great importance to the technical policies of water pollution control and prevention. The *Regulations of HRB water pollution control and prevention of Anhui Province*, passed on September 14, 1993, has formulated related technical policies and brought forward the requirements of spreading practical technology of water pollution control and prevention. In addition, targeting at the issues of the low management level of local tanning industry, dated production techniques, inadequate pollution control facilities, the Henan provincial EPB published the *Technical Standards of Water Pollution Control and Prevention of Tanning Industry*. In 1997, the National Planning Committee and the China Light Industry Chief Committee constituted the *Technical policy of Comprehensive utilization of Light Industry Resources*, where posed requirements on the minimum scale of food and ferment industries and improved the resource efficiency, saved energy, reduced consumption, and reduced pollution.

4 These technical policies, especially the sectoral technical policies, taking the advancement of clean production as its guidance, put forward a collective technical principal, solution, and measures of pollution control and prevention for the production processes. They also put forward the techniques that should be promoted or eliminated, which has played an important role in the water pollution control and prevention of HRB areas with serious structural pollution.

Box 7.5-1 Case of technical policy promoting clean production in enterprises

In 1992, the Anhui Gujing Group, Co. established a comprehensive cooling water utilization and treatment project of three circles, which circulated more than 80% of the water used in brewing and saved production costs as well as the costs of end-of-pipe pollution control.

The company invested 1200×10^4 yuan in establishing two WWT facilities successively, thus the effluent water would meet the second grade of National Discharge Standards. After that, the company expanded the WWT equipment to treat not only all the on-site wastewater but also thousands of tons of domestic wastewater from the Gujing Town.

In November 1997, the company became the first "advanced enterprise taking lead in passing discharging standards of the HRB industrial sources of pollution control in a limited term" among its peers of the entire province. In 2002, the company invested huge capital to install the first COD online monitoring system of Bozhou city in its main factory area.

The company has promoted "emphasizing on pollution control as much as product quality", environment protection should take from passively to initiatively, realize the objective of reducing pollution, increasing effect, saving energy and decreasing consumption.

In 2002, the company established leading group and working group on clean production and developed clean production plans with the guidance of auditing expert of clean production. By the end of the first round of clean production auditing at the end of the 2003, a total of 155 feasible projects were screened out, and over 30 no-waste or low-waste projects and 1 middle-waste project were carried out successively, leading to a total water use reduction of 30×10^4 ton, total COD reduction of 340 ton, and a saving from WWT cost of 26×10^4 yuan. Clean production continued in 2004, and by October, the company has further cut of water use by 20×10^4 ton and reduced the water use for unit vintage produced, thus cutting of the unit production cost of outputs.

Source: Anhui Daily, December 30th, 2004 "Gujing: benefiting from clean production"

5 China's environmental pollution control and prevention technical policies are the technical guidance formulated by the environmental protection authority according to the sectoral polluting patterns at certain economical development level. The technical policies place requirements on the technical principles, approaches, and measures of pollution control and prevention and have planed an important role in the HRB water pollution control and prevention. First, fundamental to environment protection it has formulated the environmental policies and avoided conflicts between the environment policies and the economic development; second, it has guided both the polluting and environmentally friendly enterprises to choose the best technologies in pollution control and prevention, avoid technical ineffectiveness and wrongful decisions, or economic loss; thirdly, it has provided technical baselines for formulating the environment standards and ensuring

the match-up of environment standards and economic development level.

6 Nevertheless, since the technical policies are voluntary, they have not been absorbed into the environmental control institutions by the local government as mandates.

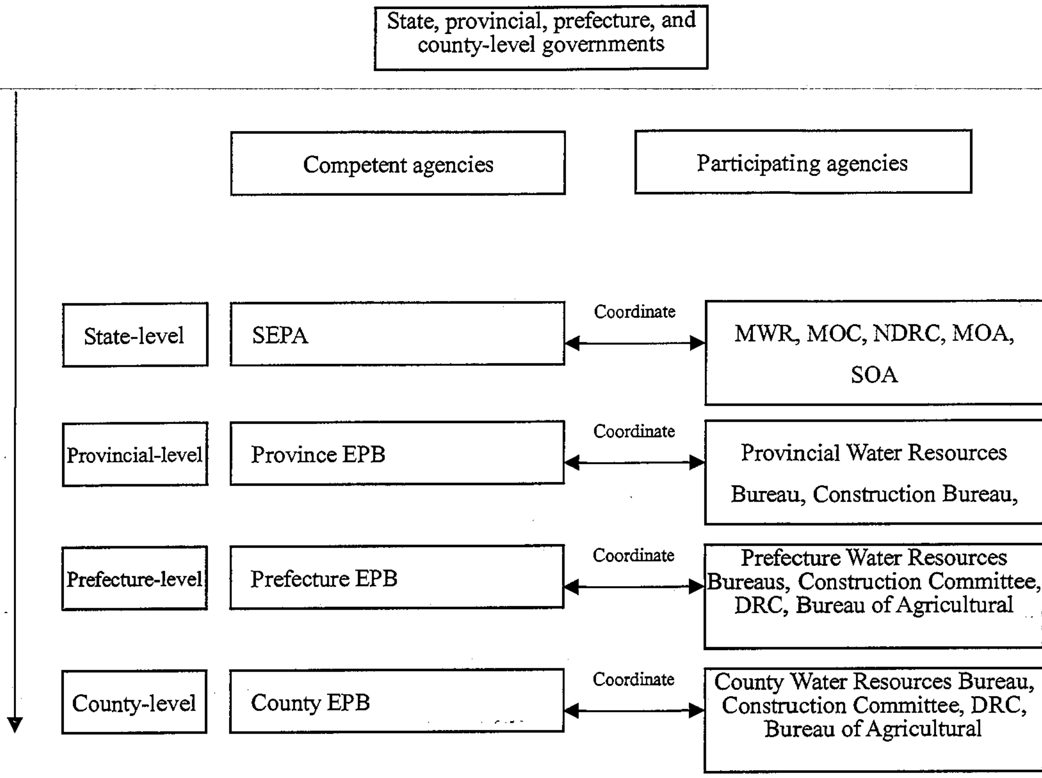
8. Institutions

8.1 Institutional Settings and Responsibilities

1 Water resource utilization and conservation encompass water supply, use, drainage and WWT. It naturally follows that the water environment management will have to incorporate all those aspects. However, those aspects of water environmental management are in the hands of various agencies according to the current administrative institutions.

2 The water environment management relates to: specialized agencies including MWR, SEPA, MOC, MOA, MLR, MOT, and SFA and their local bureaus; and comprehensive agencies including State Development Planning Commission (SDPC), MOF, State Economic and Trade Commission (related functions have been moved to NDRC) and their corresponding local agencies. By the authorization of the State Council, SEPA is responsible for the water pollution control and management; MWR is responsible for water resource planning, management and the construction of new projects; MOC is responsible for municipal wastewater network, water supply and sanitation and WWTP investment. MLR is responsible for management of national land and natural resources (water is resource); MOA is responsible for agricultural production, thus influences agricultural water use; MOT is responsible for transportation and impacts on water quality from river way shipping. Although the comprehensive agencies do not have direct impacts on water, but they still indirectly influence the water environment management. MOF is responsible for the investment and management of the state hydraulic engineering and pollution control projects, and participates in various fee policies and fee management relating to the water environment (water resources fee, over discharge fee and WWT fee); NDRC is responsible for state investment program planning and approval and participate in various policy-making in water environment; SDPC administers industrial enterprises, is responsible for the state industrial development policy-making, and has indirect impact on industrial pollution prevention and control (Table 8.1-1). The State Council and the local governments have exerted impacts on watershed environmental management, but they also can be the best coordinating body among various authorities. Table 8.1-1 tabulates responsibilities of different authorities.

Figure 8.1-1 Administrative Organization Chart



Brief introduction of responsibilities of the main agencies

(1) SEPA

The SEPA is the paramount management agency with administrative function in environmental protection. The work SEPA performs on watershed water pollution control and prevention include:

- watershed environmental monitoring
- supervising pollution source of each watershed zone
- collecting discharge fees, and
- preparing watershed water pollution control planning

(2) MWR

The MWR is the dominant/paramount management administration with administrative function in China's water resource protection. The work MWR performs in the watershed water resource protection and development include:

- making water conservation policy, preparing water saving plans, setting the standards, and organizing, supervising and monitoring water conservation
- preparing water resource protection plans according to the laws and statutes concerning state resource and environment protection, and
- partitioning water functional zones and regulating pollutants discharge to waters, monitoring water quality of rivers, lakes and reservoirs, setting pollutants carrying capacities of water bodies, and bringing forward TMLLs.

Table 8.1-1 Interrelated Responsibilities of Various Authorities for Water Environment Protection in the HRB

Ministry	Water resource protection			Water resource exploitation and development		
	Water resource and water environment management	WWT		Water extraction	Water supply	Water conservation
		Industrial	Domestic			
MWR	Unified water resource management, set water resource protection plans, monitor water quantities and quality in rivers and lakes, issue national water resource communiqué	Outlets to rivers, setting pollutants carrying capacities of water systems and the TMLL	Pollutants absorbing rivers and outlets to rivers, validate water system pollutants carrying capacity, advise TMLL	Implement water use permits institutions; establish water resource fee collection institutions, water distribution	Engineering water supply, organize and manage key hydraulic engineering	Water conservation policy, set water conservation plans and the relevant standards; organize, supervise and monitor water conservation projects.
SEPA	Water quality management; Pollution management	Monitor pollutants discharge outlets; manage; collect pollutants discharge fees	Issuing WWTPs fee policy			
MOC	Drinking water	Industrial wastewater entering into urban wastewater network	Urban WWPT planning, construction and operation	Water use permits	Urban water use and supply	Urban water conservation
MOA	Agricultural source water protection; Non-point sources pollution control	Wastewater discharge of agricultural products processing		Manage agricultural water supply and use	Agricultural water use	Conservation of agricultural water use
MLR	Water resource management					
SFA	Water conservation forests protection	Wastewater discharge from chemical industry				
Ministry of Transportation	Waterway shipping environmental management	Waterway shipping pollution				

Ministry	Water resource protection			Water resource exploitation and development		
	Water resource and water environment management	WWT		Water extraction	Water supply	Water conservation
		Industrial	Domestic			
SDPC		Sectoral policy		Management of industrial water supply and usage	Industrial water use	Industrial water conservation
MOF		Pollutants discharge fee policy and fund management	WWT fee policy	Participation in setting water resource fee standards	Water tariffs	
NDRC		Pollutants discharge fee policy	WWTP fee policy		Water tariffs	
People's Congress	Laws, regulations, and statutes; monitoring					
State Council	State Council statutes; coordination					

8.2 Water Environmental Managerial and Organizational Functions

1 The table below tabulates the allocation of responsibilities among various authorities and presents their differences.

Table 8.2-1 Responsibilities of Various Authorities

	Management responsibilities	Competent agencies	Remarks
Water resource use and management	Urban industrial and domestic water supply and use management	Local WRBs, construction committee, EPBs, and hygiene departments	With basically complete functional coverage and smooth operation, but the tariffs for water resource, water supply, and WWT are relatively too low
	Groundwater resource management	Local WRBs, construction committee, and EPBs	With complete functional coverage but the partial overlap responsibilities results in no bureaus to bear the responsibilities.
	Agricultural irrigation water use and supply management	Local WRBs, agricultural bureaus, and other local agricultural economic organizations	Management mechanism suited to the locale-specific, small scale production of agriculture but lacking strict water use permitting system. Low water tariff. The decentralization of the management rights of water use may cause the agricultural operations exceed the governmental water allocation.
	Rural domestic water use management	Local WRBs	Lacking of defined management responsibilities. Only management practice is to register a portion of the rural groundwater users. In general, the government management remains weak.

	Management responsibilities	Competent agencies	Remarks
	Management of functional water zones	EPBs and WRBs at various levels; also involving local urban construction, tourism, land resources, fishery, hygiene, agricultural agencies	The most important "functional zones of water quality" (by EPBs) and "functional zones of water resource" (by WRBs) overlap in contents and management responsibilities but both refer to water demands. The undefined responsibility allocation leads to management conflicts and increases management costs.
	Water resource management and dam construction	WRBs	With basically complete functional coverage and defined responsibilities. However, the water direction and dam construction by the WRBs often excludes ecological considerations and deteriorates water qualities. (WRBs disagree with this point.)
Water quality management and pollution control	Plantation and agriculture non-point sources pollution control	Agricultural bureaus and EPBs of various levels	The ecological agricultural extensions by the agricultural bureaus do not incorporate watershed (regional) water pollution control and prevention. The scope and progress of the extensions do not coordinate with the non-point sources pollution control of plantation.
	Livestock raising and husbandry pollution control	EPBs (for livestock raising and husbandry point sources pollution control); EPBs and agriculture bureaus (for non-point sources pollution control)	No clearly defined responsibilities of livestock raising and husbandry (especially small scaled family husbandry) non-point sources pollution control; agricultural bureaus do not incorporate the comprehensive utilization of the livestock excreta in the ecological agricultural extension.
water quality management and pollution control	Aquacultural non-point sources pollution control	Null	Responsibilities unassigned. The fishery bureaus only manage the production side of fishery. Fishery resource protection fee should be added and non-point sources pollution should be considered in aquacultural permits management.
	Urban and county surface runoff non-point sources pollution control	EPBs at various levels	The management offices do not have the even most basic control and management mechanism. The solution is to have the construction committees enhance management of municipal solid waste and incorporate urban uncontrolled surface runoff into the urban wastewater collection and treatment system.
	Solid waste landfill (dumps) wastewater leachate control	Construction committees and EPBs of various levels	Solid waste landfill site selection and construction is decided by the construction committee together with the EPBs; solid waste landfill is supervised by the construction committee; wastewater leachate control standard has been issued but no management authorities have been assigned. As solid waste treatment plants are mostly run by state enterprises under the government, pollution control by the EPBs remains weak.
	Industrial wastewater discharge and treatment	EPBs of various levels	With basically complete functional coverage and smooth operation, but the pollutants discharge fee and WWT tariff are relatively too low. The industrial WWT rate through municipal WWTPs should be increased.

	Management responsibilities	Competent agencies	Remarks
	Urban domestic wastewater discharge and treatment	Construction committees of various levels	Mis-allocated responsibilities. In WWTP construction, often the local interests overshadow the watershed-wide (or regional) planning.
	Ship pollution control	Local transportation bureaus	Relatively good short-term results, but the utilization rate of on-board pollution control facilities remains low, which is an inevitable result from unsound management institutions.
	Sediment pollution control	*De jure*: local EPBs; *de facto*: null	The sediment management responsibilities are with the constructors. The sediment pollution prevention and control have not been clearly assigned to particular departments.

2 The analysis above indicates that multiple administrative agencies are presiding over the water environmental management. Water resource management encompasses treatment, protection, and utilization of surface and groundwater. Water environmental management is in the hands of the water resources, electricity, communication, urban construction, land & mining, and agricultural authorities (Qi Jiayin, etc., 2000). Sometimes the agencies set single-facet policy conducive to their own work without considering the overall water environmental management. As a result, the "spill-over" from the single-facet policies and measures often harm watershed environmental management. Water environmental management requires comprehensive decision-making, but the existing decision-making mechanism cannot serve comprehensive water resource management, utilization and protection, even though certain coordinating mechanism – watershed management leading group and conference – has been working to improve the situation. This is caused by the absence of coordination and communication between management system by function and that by appanage, which leads to conflict of interests among various agencies.

8.3 Watershed Management Institutions

8.3.1 Introduction of Watershed Management Authorities

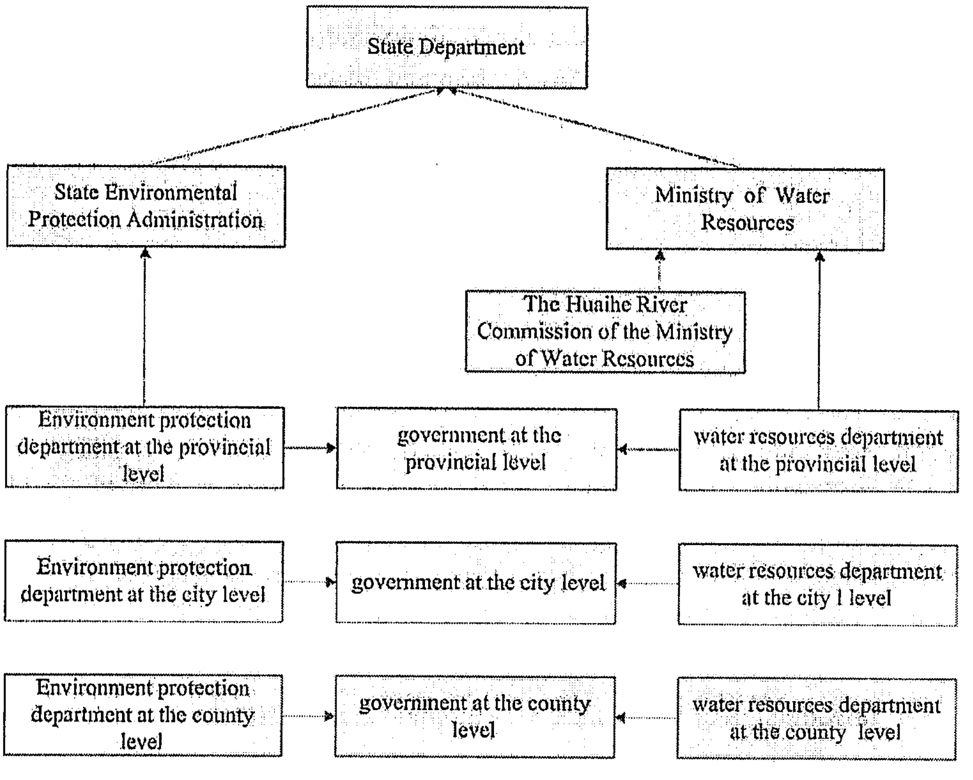
(1) Background

1 At the dawn of PRC, the Chinese Government established seven Watershed Management Committees, one of which had been the Management Committee of the HRB that was directly administered by the competent administrative authorities of water resources. However, at that time, fighting a flood, preventing water-logging, building water conservancy and managing water supply projects were their main responsibilities, and the management of water quality was not required. Afterwards water quality management also became an important function of watershed management. In 1975, the national hydrology working meeting put forward that the MWR need to manage not only water quantity, sand quantity, but also water equality due to the need of water resources development and protection. At the same year the State Council environmental protection leadership group explicated that the MWR is responsible for water quality protection, and watershed water resource protection organizations for the 7 major Chinese

water systems have been agreed by the State Council Environmental Protection Leading Group and approved by the Ministry of Hydraulic Power.

2 Owing to the inseparability of water quality protection and water pollution control, in order to strengthen national and water environment protection and management, in 1983, the Ministry of Urban and Rural Construction and Environmental Protection and MWR and Electric ruled six tasks of watershed water resource protection at publicity, planning, supervision, management, monitoring, and research, explicitly request all the EPBs and WRBs to strongly support the work of watershed management organization.

Figure 8.3.1-1 Environmental Protection and Water Resource Authorities of all Levels in the HRB



(2) Water Resource Bureaus in HRB

3 After establishing the SEPA, the Ministry of Hydraulic Power and SEPA jointly convened a meeting on water resources protection for watershed in 1987, and in October, they subscribed the *Notice on the Dual Leadership by MWR and MOC in watershed water Resources Protection* and explicated six responsibilities. In March 1991, MWR and SEPA jointly subscribed the *Notice on Renaming the Water Resource Protection Bureaus*. By then, the current management institution came into being. SEPA is the leader on water environment management of river basins and water pollution prevention and is charged with work expenses. The work the HRB water resource protection bureau takes on is as follows.

Box: Work Assignment of the HRB Water Resource Protection Bureaus

Since the watershed dual leadership, the seven watershed water resource protection committees are responsible for water resources and environmental protection under the two ministries:

1) Carrying out national laws, statutes and policies about water resource protection and water pollution control and prevention.
2) Constituting plans of watershed water resource protection, water pollution control and prevention and interrelated statute and standards.
3) Setting up watershed water quality monitoring network, collecting data of water quality, uniformly evaluating watershed water quality.
4) Investigating transjurisdictional water pollution accidents, bringing forward water pollution treatment recommendations.
5) Jointly controlling water pollution at low water seasons, abating water pollution disasters by endeavors of environmental protection and water resources department.
6) Carrying out the work of survey, evaluating and research of fundamental datum of water resource protection and water pollution control and prevention.

(3) HRB Water Resources Protection Leading Group

4 The HRB, as a transjurisdictional watershed, is difficult to manage. In order to coordinate water resources protection, easily jointly control pollution and solve inter-watershed pollution disputes, in 1989, the Leading Group of HRB Water Resources Protection came into existence in the 4 HRB provinces. At the beginning, the leading team was only a regional coordination organization without governmental function. In 1993, the State Council member Song Jian came to Huai River and presided over a Spot Conference. The Conference called for taming the Huai River by law, and decided to enact HRB management statute. In 1995, the first watershed management statute in China came into existence. Its Article 4 ordained that the leadership team had the duty to coordinate significant issues about water resources protection and pollution control in the HRB, to supervise water pollution control in HRB, and to exercise other functions. The office of the leading group was located in the HRB WRB. So the leading group of the HRB water resources protection formally became an official organization.

5 The main method of work of the leading group is through meetings. At the meetings, previous work on water resources protection and water pollution control is summarized, tasks for the future phases are assigned, and the objectives, tasks, and approaches of watershed management are debriefed, reviewed, and approved. Since 1990, the leading group has organized seven meetings. The meetings have convened the related leaders of watershed water resources protection and are favorable for coordination.

6 At the beginning, the HRB leading group is consisted of officials from SEPA, MWR and the Henan, Anhui, Shandong or Jiangsu provincial governments. Since the Spot Conference in 1994, leaders of the State Planning Commission, the State Economic and Trade Commission, MOC, MOA, National Council of Light Industry, People's Bank of China, and China Development Bank joined the leading group headed by the ministers of SEPA and MWR (China Environment Yearbook 1995:128).

7 However, the two leaders in leading group from different ministers may cause difficulty

in reaching consensus, making decisions, and coordinate with other ministries.

8.3.2 Particularities and Issues in the Management System

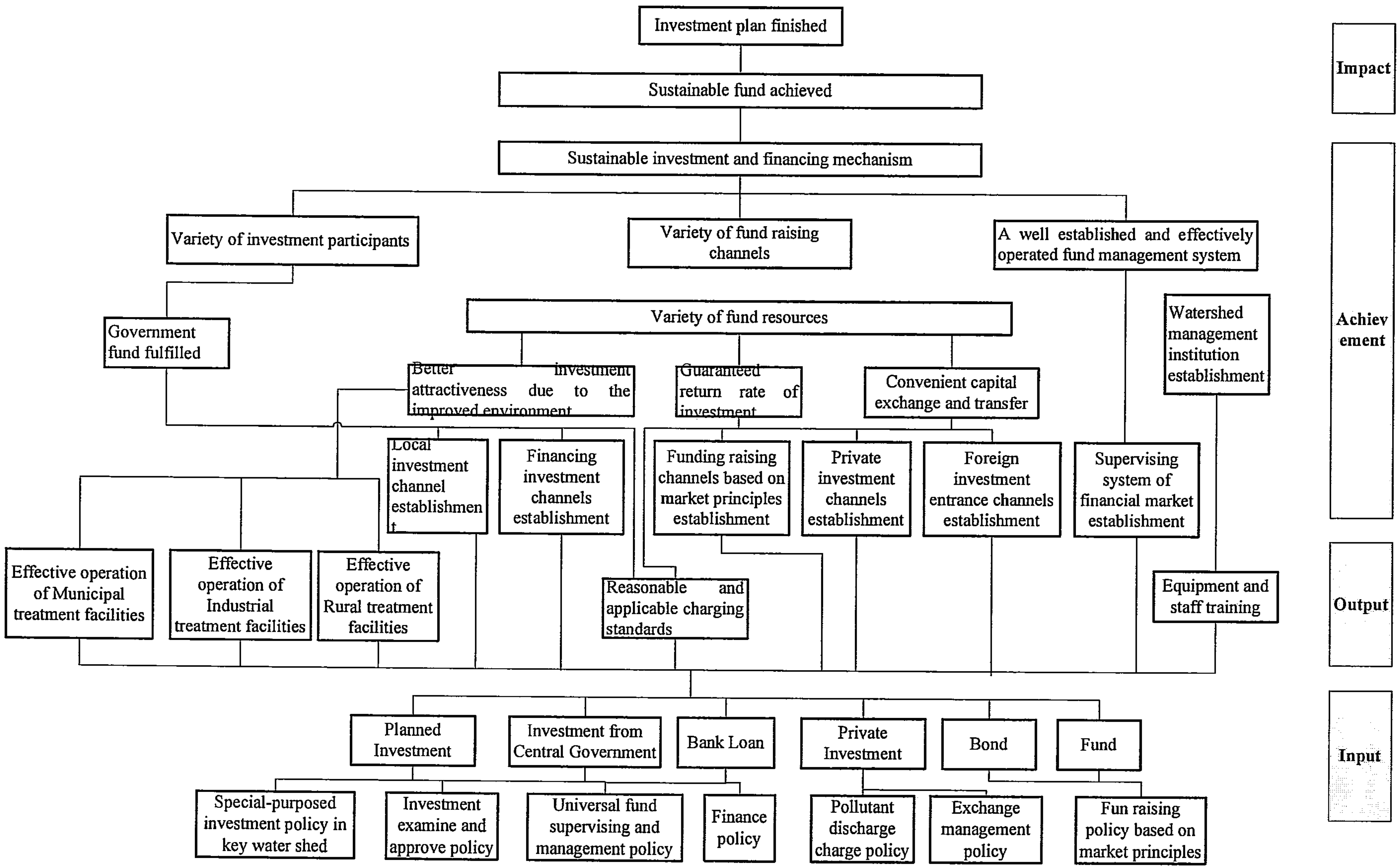
1 The current management system of HRB is a combined centralized and decentralized management at different levels and departments. Specifically, the management is centralized and coordinated at the watershed level, and supported by decentralized management at jurisdictions. However, in reality, this system has gradually evolved into a compartmentalized, manifold management between the state and the regions, the watershed and the jurisdictions, and the administrative governments and the specialized agencies (Wang Shuwen, 2000), which has been proved to hinder effective watershed management and the implementation of water pollution control policies.

2 The major causes for the compartmentalization include: (1) A combined management system of watershed management will eventually be torn apart by the divert interests of the local jurisdictions. (2) The manifold management will lead to decentralized decision-making, which further facilitates the management disintegration. (3) Although *de jure* the HRB management organization has the legal authority to implement HRB water management, its *de facto* authority is far from adequate to enforce its decisions.

9. Investment and Financing

9.1 Key Issues

1 Stable and sustained funding is necessary for the investment plans. Therefore, sustainable fund raising channels are needed. Based on the features of pollution control investment in HRB and TLB drainage area, the logic model is applied to analyze the logical relationship between the factors affecting the establishment of the investment and financing channels. An objective tree is also set up. The analysis found out that stable and reliable fund resources, proper fund utilization, and good fund utilization results are ultimately needed for a sustainable investment and financing channel. All these factors need the support from economic methods and policy, including special-purposed investment policy to the watershed, fund examine and approve policy, fund supervising and management policy, pollutants charging policy, finance policy, exchange management policy and policy of fund raising based on market principle. In this chapter, the fund resource, utilization and effect of HRB are analyzed and followed by an analysis on the economic methods and policies. Based on these analyses, an overall conclusion on the investment and financing in HRB is drawn, and the main problems identified.


Investment plan finished
Sustainable fund achieved
Sustainable investment and financing mechanism
Variety of investment participants
Variety of fund raising channels
A well established and effectively operated fund management system
Government fund fulfilled
Variety of fund resources
Watershed management institution establishment
Better investment attractiveness due to the improved environment
Guaranteed return rate of investment
Convenient capital exchange and transfer
Local investment channel establishment
Financing investment channels establishment
Funding raising channels based on market principles establishment
Private investment channels establishment
Foreign investment entrance channels establishment
Supervising system of financial market establishment
Effective operation of Municipal treatment facilities
Effective operation of Industrial treatment facilities
Effective operation of Rural treatment facilities
Reasonable and applicable charging standards
Equipment and staff training
Planned Investment
Investment from Central Government
Bank Loan
Private Investment
Bond
Fund
Special-purposed investment policy in key water shed
Investment examine and approve policy
Universal fund supervising and management policy
Finance policy
Pollutant discharge charge policy
Exchange management policy
Fun raising policy based on market principles
Impact
Achievement
Output
Input

9.2 Funding Sources

1 During the planned economy era[24], the funding for pollution control was not secured in the budget plans as infrastructure construction and industrial reconstruction were. Pollution control was considered less important than the economic development in state investment. Till the 10th FYP the power of market has been valued in policy-making. But, dictated by a narrow understanding of the "polluters pay" principle, the ideology that the funds for pollutants treatment should be 100% paid by the polluters persisted.

2 As a result, pollution control funds were considered of much lower priority than those for infrastructure construction and industrial reconstruction for either industrial and agricultural organizations or cities and towns. The discharged pollutants were not treated adequately. In later years during the market economy, the accumulated pollution problems from early years have proved too heavy a burden for the current funding to cover, and the reversed insensitive still persists, since the cost of non-compliance was much lower than the cost of compliance. In a word, the "Polluter Pay" policy was *de facto* not carried out, and the pollution control funds in the end were not all paid by the polluters.

3 In the last decade, a variety of fund channels for pollution control have been set up that include funds from the state government, local governments (through the local complementary funds), enterprises self-financed funding, bank loans, and foreign investment. Favorable conditions or guarantee from government was granted to promote bank loans and foreign investment.

9.2.1 During the 9th FYP

1 During the 9th FYP the HRB pollution control fund come mainly from the funds from central government, local government (i.e., the local complementary funds), enterprises self-financed funding, bank loans, and foreign investment. A case study on Anhui province by Cai, et al. indicates that during the 9th FYP the investment for pollution treatment for Huai River totaled 8.21×10^8 yuan, where 4.8×10^8 yuan (58.5%) came from local enterprises, 1.4×10^8 yuan (17%) came from domestic bank loans, 1.2×10^8 yuan(14.6%) came from governments, and 970×10^4 US$ (9.9%) came from foreign investors.

2 During the 9th FYP, cooperation among national and international financing organizations and other countries thrived. Information of various types of project approved by 1997 is listed in Table 9.2.1-1.

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24 The year 2002 can be used as a threshold, as in 2002 the National development and Planning Commission, originally renamed from the National Planning Commission in 1998, was renamed for a second time to the National Development and Reform Commission. Since then, the word "planning" has been eliminated.

Table 9.2.1-1 Project Financed by Foreign Capital in 1997

Project name	Capital (USD$)	Financing source
Huai River pollution demonstration (phase I)	0.5x108 (Loan)	WB
Huai River pollution demonstration (phase II)	$2.0x10^8$ (Loan)	WB
HRB industrial pollution prevention and control policy study	60×104 (Grant)	WB
Huai River project preparation technical assistance	400×104 (Grant)	Netherlands
Huai River water quality pollution emergency reaction system study	100×104 (Grant)	Canada

Source(s): China Environmental Yearbook 1995-1999

3 The fund resources of the newly built project (46 WWTPs) in 1988-1999 supported by the government financing plan are listed in Table 9.2.1-2.

Table 9.2.1-2 Financing of the Infrastructure during 1988-1999
(Unit: $\times 10^4$ yuan, %)

Item	Province	Total investment	Foreign capital	Bank loans	Local	Central government	Local government
Investment	Henan	169478	35233	22000	50745	23640	37860
	Anhui	95097	5800	17187	43260	16020	12830
	Shandong	88689	12883	0	51726	11760	12320
	Jiangsu	45020	4110	5500	16440	4850	14120
	Total	398284	58026	44687	162171	56270	77130
Ratio	Henan	100	20.8	13.0	29.9	13.9	22.3
	Anhui	100	6.1	18.1	45.5	16.8	13.5
	Shandong	100	14.5		58.3	13.3	13.9
	Jiangsu	100	9.1	12.2	36.5	10.8	31.4
	Total	100	14.6	11.2	40.7	14.1	19.4

Notes: The investment includes the accumulated total in 1998, planned investment in 1999 and the new state bonds.
Source(s): Ge Chazhong, Yang Jintian, Cao Dong, etc. China water pollution control and prevention policy innovation - Huai River case study. China Environmental Policies, No.12, Nov. 5, 2001

4 The complementary funds from the local governments are one of the most important resources for watershed pollution control, especially for municipal construction project such as centralized WWPTs. As shown in the table, most funds for centralized WWT facilities, some 60.1% of the total investment, came from the complementary funds and the local governmental budgets. Although the local governments have been trying to involve nongovernmental sources of funding into the water pollution prevention and treatment, especially the infrastructure construction and operation, statistical data of this channel is almost absent.

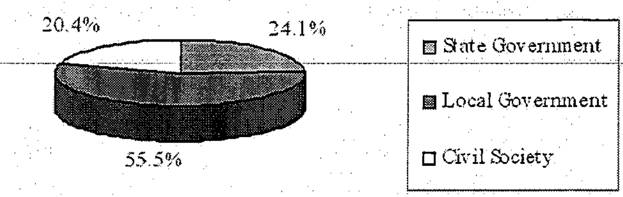
9.2.2 During the 10th FYP

1 Because a comprehensive statistics on the fund resources during 10th FYP for pollution control in HRB is unavailable, the analysis will focus on the fund resources of projects supported by the 10th FYP.

2 According to the *Progress Review and Evaluation Report of HRB Water Pollution*

Control during 10th FYP, Henan Province conducted a simple statistic on the variety of fund resources. The proportion of different sources is shown in Figure 9.2.2-1.

Figure 9.2.2-1 Composition of Actual Investment during the 10th FYP in Henan Province



Source: Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP in Henan Province

3 As for Henan province, the state investment accounted for less than 30% of the total investment, and the main part came from local investment. For Henan, the proportion of investment from the civil societies exceeded 20% of the total investment.

4 According to the Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP of Jiangsu Province, the actual investment on constructed water pollution prevention and treatment projects (excluding WWTPs and solid waste treatment sites) in the key watershed in Jiangsu reached 5.33×10^8 yuan, of which 4.21×10^8 yuan came from local government, and statistical data of other funding resources was unavailable. Among the actual investment in water pollution prevention and treatment project under construction in key watershed, 3.14×10^8 yuan came from the state government, 6.30×10^8 yuan (over 2/3) came from the local governments. Statistical data of investment on the completed WWTPs and solid waste treatment sites is unavailable.

5 Statistical data of funding sources of various types of projects in Anhui Province in the 10th FYP is unavailable.

6 According to the *Progress Review and Evaluation Report of the 10th FYP of Shandong Province*, only the funding sources of investment on completed projects (excluding WWTPs) and construction projects have been counted, of which 70% came from the local investments, and the rest came from the state government.

- Construction of WWT System

7 The TA "Transboundary Water Environment Management (sub-project B), TA No. 3588-PRC" Project of ADB has found that SEPA does not have plans to provide financial support for cities that should construct municipal WWT systems or improve the current WWT systems to carry out the required feasibility study or EIA or to provide construction fund for WWTP construction or upgrade. If a city's WWT system cannot effectively collect urban domestic wastewater into the WWTPs, it will be impossible to control the urban pollutant discharge.

8 The WWTPs financing during the 10th FYP can be summarized as follows: (1) financing and construction of WWTPs: In more developed areas funds for new WWTPs are generally raised through BOT (Build-Operation-Transfer), BT (Build-Transfer) and other models which involve private capital under the regulation of government. The investment will

be repaid through collected WWT fee. (2) Financing and construction of collection network and other auxiliary facilities for WWTPs: Generally the network and other auxiliary facilities for WWTPs are invested by the government. The total investment for such facilities are generally equal to or greater than the investment in the WWTP itself and no tangible financial benefit will be achieved during the construction and operational period. Hence it is difficult to raise funds for the collection networks. Due to the lack of financial funds and infeasibility of applying commercial bank loans, the local governments have no other applicable funding channels other than applying for state bonds. The fund deficiency for such facilities is of considerable size.

9 The features of the different funding sources in the 2 FYPs are summarized below:

(1) Financial support from the central government

10 Although the current circumstances suggest the governmental channels such as the fiscal budgets and state bonds are playing a major role, the funding from these channels remain insufficient.

(2) Complementary funds from the local governments

11 Funds from the local governments mainly rely on the urban construction and maintenance fee, collected wastewater fees and pollutant discharge fees from non-compliant enterprises, of which wastewater tariff is generally too low. The pollutant discharge fee is usually distributed at the provincial level universally, thus will not be able to distinguish the local differences in financial need.

(3) Self-raised funds by enterprises

12 Effective supervision is an important prerequisite to guarantee the enterprise to fuse the funds for pollution control and equipment update.

(4) Bank Loans

13 It is rare for pollution control projects to receive commercial bank loans due to the large investment volume, long return period, and high risks of such project.

(5) Foreign investment

14 Foreign investment is found difficult to be actually used due to its long preparation and approval period, comparatively complex procedure and unfamiliarity on loan application for local project management staffs. In some region foreign investment has even been considered not a major funding source for pollution control projects.

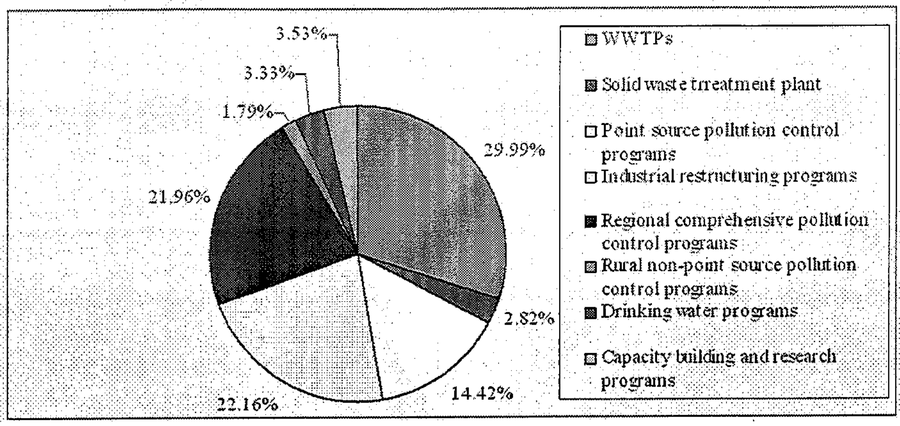
15 In general it is difficult to obtain reliable and comprehensive information of the scale and composition of funding from different sources due to the lack of statistics for HRB pollution control investment. According to currently acquired information, the framework of multiple funding sources pollution control has been established. But financial support from the local governments is still the most important funding sources for planned projects. A diversified, stable, and sustainable investment structure is far from being established.

9.3 Fund Utilization

1 Analysis of fund utilization of the projects in HRB during the 9th FYP is not included due to the unavailability of comprehensive and reliable data.

2 Fund utilization of projects in Anhui Province during the 10th FYP is shown in the figure below.

Figure 9.3-1 Fund Utilization of Projects in Anhui Province during the 10th FYP

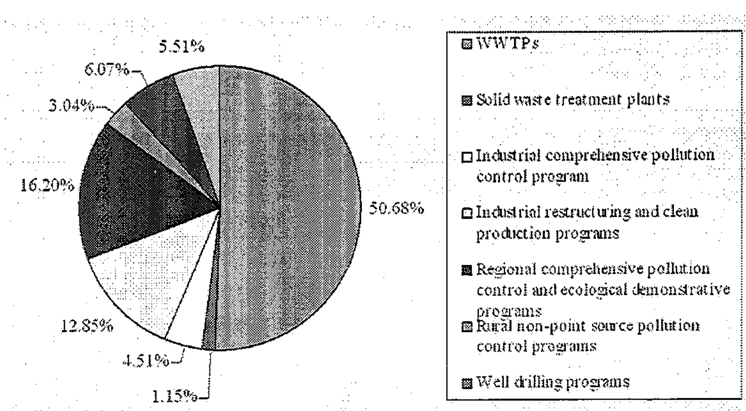


Source: Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP in Anhui Province

16 As shown in the figure above, funding for watershed pollution control in Anhui Province were mainly channeled into WWTPs construction, industrial restructuring and integrated regional pollution control projects. Such projects have been favored by the funding due to their quick and noticeable pollution reduction results. Rural from non-point source pollution control projects, nevertheless, received only 1.79% of the total investment due to the large investment volume and the comparatively long time span requirement before real effects can show.

17 Fund utilization of projects in Henan Province during the 10th FYP is shown in Figure 9.3-2.

Figure 9.3-2 Fund Utilization of Projects in Henan Province during the 10th FYP

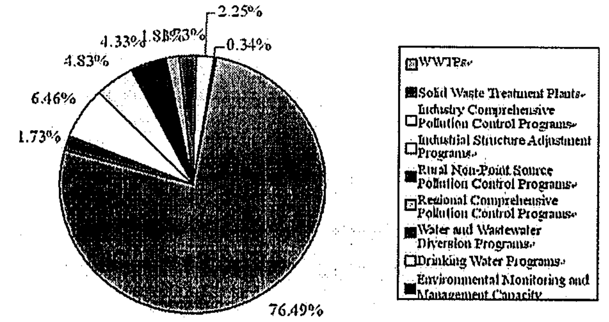


Source: Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP in Henan Province

18 As shown in the figure above, fund utilization in Henan Province is similar to that in Anhui Province. The difference between those 2 provinces is that the fund for integrated pollution control projects for industries in Henan accounted for only 4.51% of the total investment. This is because a dominant number of small-scale enterprises listed in the pollution control plan of Henan experience difficulty to fulfill the required investment and almost a half of the listed enterprises have stopped production or bankrupted, and those projects were withdrawn.

19 Fund utilization of projects in Jiangsu Province during the 10th FYP is shown in Figure 9.3-3.

Figure 9.3-3 Fund Utilization of Projects in Jiangsu Province during the 10th FYP

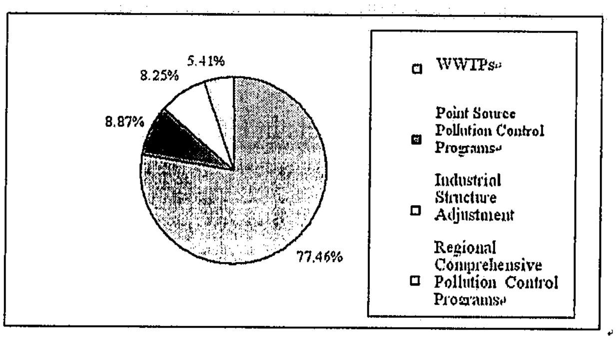


Source: Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP in Jiangsu Province

20 As shown in figure above, investment in WWTPs construction accounted for 76.49% of the total investment in the 10th FYP, and the investment in any of the other types of projects accounted for less than 7%.

21 Fund utilization of projects in Shandong Province during the 10th FYP is shown in Figure 9.3-4.

Figure 9.3-4 Fund Utilization of Projects in Shandong Province during the 10th FYP



Source: Progress Review and Evaluation Report of HRB Water Pollution Control during 10th FYP in Shandong Province.

22 The situation in Shandong Province is relatively unique. The water and wastewater diversion projects were launched and funds for pollution control and capacity building project for rural non-point sources were excluded from the statistical data. Based on the analysis on the fund utilization for the WWTPs, point sources control, industrial restructuring and integrated regional pollution control projects, funds for WWTPs accounted for 77.46% of the

total investment and the other 3 type each accounted for less 10%.

23 As indicated by analysis above, currently most of the investment has been used for wastewater treatment and a very small proportion has been used on other types of project. Such utilization of funds is on one hand in compliance with the requirement of the 10^{th} FYP and on the other hand meets the key issues for pollution control in HRB. It indicates that the investment has been used properly. However according to the analysis on industrial policy and cleaner production policy, a comparatively higher reduction of pollutant discharge can be acquired from a comparatively low investment in the industrial restructuring and cleaner production, which also indicate that the proportion of funds used for industrial structure update and cleaner production should be enlarged in the future.

9.4 Investment Benefit

1 Investment requires returns. Returns, or in a general sense, the benefits from pollution control investment, include socio-economic and environmental benefits.

2 Direct economic benefit comes from urban WWTPs, recycling or reuse of "pollutants" after WWT. To enterprises or organizations, indirect economic benefits include reduction of production costs by reducing pollutants discharge fees, obtaining green reputation, fulfilling enterprises' social responsibility after satisfying environment standards. However, under the current circumstance, enterprises obtain little economic benefit through reducing pollutants discharge or penalty, as the cost of compliance is universally is higher than the cost of non-compliance, and in the current China social responsibility is not an important factor for elevating profitability. Therefore, the indirect economic benefits are very limited.

In Focus: Non-Compliance Discharge by the Lotus MSG Group

Henan Province Lotus MSG Group, Inc. (hereafter Lotus Group) is located in Xiangcheng City, Henan Province and is to the north of the Shaying River of the upper stream Huai River. On April 30, 2003, SEPA announced that the Henan Lotus Group, a large state-owned enterprise, has deceptively discharged a large quantity of significantly over-the-standard wastewater into the Shaying River through hidden outlets. Henan Provincial EPB issued punishment decisions such as shutdown of the factory, fines for polluting, pollutants discharge fee, and disconnecting hidden discharge outlets to the Lotus Group.

In 2003, the Lotus Group had already been fined more than 1200×10^4 yuan for illegal discharge through hidden outlets. Why a fine of such large amount still cannot stop Lotus Group's discharge? Someone familiar with this problem reveals that the Lotus Group can save nearly 10×10^4 yuan each day for pollutants discharge through hidden outlets. Obviously, discharge through hidden outlets can save much more than the compliant operational expenses.

If the enterprise complies, it is not only the WWT facilities must operate normally, but they have to pay for the daily operating costs. Then the enterprise will necessarily increase operational cost. On the contrary, non-compliant enterprise does not need to invest in pollution control facilities or to operate it. The cost of non-compliance is far below the cost of compliance. If an enterprise could save 2×10^8 yuan from illegal discharge, it will be imposed with the EPB's maximum penalty, only 1×10^6 yuan. Therefore, as long as the non-compliant enterprises could manage to illegally discharge for 1

minute, the cost of environmental penalty will be covered. For the Lotus Group, its pollutants discharge at a concentration 40 times only exceeding the standard receives only 1×10^4 yuan fine from Xiangcheng City EPB.

Source: Qie Jianrong, Controlling and protecting the Huai River need responsibility and measures in place. China Environment Press, September 2, 2004.

3 Due to the absence of statistics, the effectiveness and direct economic benefit of urban WWTPs will be illustrated through a typical case.

4 Bengbu City No.1 WWTPs project is of the first HRB water pollution control projects among the 4 HRB provinces using foreign government loans and the state bonds. Its total design daily treatment capacity is 2×10^5 ton, covering about 171.307 mu. The entire project will be built through 2 phases. From July 1998 to 2002, the first phrase was completed. At the same time, Tushan section, Wuwan section, Hongqi II section and 2.9 km matching collection network outside of the factory were finished. Through careful operation and strict control, at the end of June 2003, water quality after treatment can all meet design requirements. Currently, constructed first phrase project daily design capacity is 10×10^4 ton. Total investment is 18467×10^4 yuan (including the collection network), where the state bonds accounted for 30%, Spanish loan accounted for 20%, and local funds accounted for 50%. The Phase II construction has been completed in September 2005 with a daily design capacity of 10×10^4 ton and a total investment of $9,700\times10^4$ yuan (including the collection network), where the state bonds accounted for 30% and rest came from local funds.

5 The current actual daily treatment quantity of the project is 15 ton using A_2O oxidation ditch treatment process. The pre-treatment water quality is COD$<$450mg/l, BOD$<$230 mg/l, SS$<$250 mg/l, and NH3-N$<$30 mg/l; and the post-treatment water quality is COD$<$60 mg/l, BOD$<$20 mg/l, SS$<$20 mg/l, and NH3-N$<$8 mg/l.

6 Domestic and industrial wastewater each takes up 50% of the total wastewater to the plant. Without considering the financial costs, the operational cost is at 0.3 yuan/ton; concerning the financial costs, the operational cost is 0.7 yuan/ton.

7 The major revenue is the WWT fee. The WWT tariff are: residential domestic wastewater at 0.6 yuan/ton, non-profit users at 0.7 yuan/ton, business and special industrial users at 1.0 yuan/ton.

8 The costs and revenues of the Bengbu No. 1 WWTP is exhibited in Table 9.4-1.

Table 9.4-1 Costs and Revenues of Bengbu No. 1 WWTP

Item	Details	Total (yuan/ton)
Cost	Repay the loan	0.40
	Cost of O&M	0.30
	Total	0.70
Revenue	Resident WWT tariff (50%)	0.60
	Enterprise WWT tariff (25%)	0.70
	Company and special consumer (25%)	1.00
	Total	0.73

9 The WWPT has managed to recover its operational costs and obtain certain profits.

10 However, data suggests that the 51 major WWTPs in 2004 have a total asset value of 40×10^8 yuan, but their total profit was only 3900×10^4 yuan, and 16 of the 51 showed a net loss. A rough estimation indicated the asset profit rate was only 0.9%[25]. It will be reasonable to conclude that the direct economic return for the urban WWTPs is relatively poor.

11 The environmental and social benefits can be reflected in a number of ways. In this study, they are evaluated through evaluating the effects of the major pollutants discharge on the environment.

Table 9.4-2 COD and NH_3-N Discharge by the End of 10th FYP and Investment during 10th FYP

Item	COD Discharge (ton/year)	NH3-N Discharge (ton/year)	Investment in10th FYP ($x10^8$ yuan)
Target	642700	112753	262.7606
Actual	945678	126153	146.4956
Difference (%)	47.14	11.88	-44.25

12 According to the table above, during the 10th FYP, the actual investment showed a 44.25% gap from the planned level, and the COD and NH_3-N discharges have exceeded the planned levels by 47.17% and 11.88% respectively. These results seem to indicate that the realized investments have been effective.

13 The most direct benefit of the investments can be reflected through the reduction of total annual COD and NH_3-N discharge from 2000 to 2005. So investment effectiveness can be reflected through the gap between the expected discharge reduction per unit investment and that of actual unit investment.

Table 9.4-3 Pollutants Reduction per Unit Investment in 10th FYP

Item		2000 ($x10^4$ ton)	2005 ($x10^4$ ton)	Reduction ($x10^4$ ton)	Total investment ($x10^8$ yuan)	Pollutant reduction per unit investment (ton/10^4 yuan)
Objectives in the plan	COD	105.9	64.3	41.6	262.7606	0.1583
	NH3-N	15.2	11.3	3.9		0.0148
Actual value	COD	105.9	94.5678	11.33	146.4956	0.0774
	NH3-N	15.2	12.6153	2.56		0.0176

Notes: The investment refers to the value in the year happened, the minor price changes in the 5 years are not taken into consideration.

14 The above analysis indicates that the actual COD reduction per unit investment is only half of the expected level, and actual NH_3-N reduction per unit investment is close to the expected. Assuming proper design, it can be argued that the actual investment effect is not satisfactory for the reduction of the main pollutants in of HRB.

15 The above discussion indicates that the newly launched urban WWT market provides

[25] Shanghai Security Press, September 8, 2006.

little information on whether its economic effect is satisfactory. But international experiences and cases of the HRB suggest that the prospect of urban WWT is bright. If the market experiences in urban WWT can be introduced to other water pollution control fields such as the industrial WWT and agricultural non-point sources by introducing profitability to the industrial WWT and agricultural non-point sources control projects through policy innovations, one could expect satisfactory economic return.

16 Indirect economic benefits of pollution control investment remain minor in China. Innovating in policy instruments will be necessarily to increase indirect economic benefits of pollution control investors.

17 Environment and social benefits of pollution control investment are obvious. But neither the water quality objectives nor the reduction effectiveness per unit investment have not met the design requirements. It is necessary to further study the pollution control investment effectiveness.

9.5 Economic Measures

9.5.1 Preferential Policy

1 Preferential policies are an incentive measure to promote investment. To promote the HRB pollution control, the Chinese government has launched a number of preferential policies including the tax exemption of fixed assets investment in pollution control projects and expedited depreciation for enterprise pollution treatment facilities.

2 In 1998, Shandong provincial government introduced 8 preferential policies in its *Circular of Further Implementing Preferential Policies to Ensure the HRB Industrial Sources Pollution Control Meeting the Standards on Schedule.*

3 Jiangsu province promulgated the *Policy Measures to Facilitate Industrial Pollution Control Discharge Compliance* and supported the enterprises through tax breaks, prices, electricity supply and funds.

4 In 1994, Henan Province granted tax breaks and improved access to the financial sector to enterprises with better pollution control in its *Circular on Achieving the HRB Water Pollution Control and Prevention in Our Province.* Later, in its *Circular on Further Enhancing Water Pollution Control and Prevention,* the Henan provincial government waved the water and electricity capacity enhancement fee, matching fee and other surcharges for investment in environmental protection projects

5 In 1998, Anhui province government introduced 7 tax exemption or relief policies for the HRB municipal WWTPs.

6 The above-mentioned preferential policies have to some extent encouraged enterprises to control pollution and the private capitals' entry to pollution control. But the high incidence of unlawful discharge through hidden tunnels, the slow progress of WWTPs construction, and problems during WWTPs operation suggest that incentives provided by these preferential policies are limited.

9.5.2 Pollutants Discharge Fee

1 The MOF, State Planning Commission, MOC and SEPA jointly issued the *Testing on the HRB Municipal WWT Tariff and its Collection* (Financial Comprehensive [1997] No.111). Any facility, organization and person who discharge wastewater to municipal WWTPs must pay municipal WWT fee. After paying the municipal WWT fee, the organization discharging wastewater to municipal WWTPs need not pay fee for using discharge facilities; but if the pollutants concentration exceeds the national standards, paying for over-standard pollutants discharge is required.

2 From 2003, the basis of pollutants discharge fee calculation has been changed from the combined consideration of concentration and total amount to the total discharge only. State Development and Reform Commission issued the *Circular on the Issues in WWT Tariff in the 4 Provinces of HRB* (2004), requiring the 4 provinces increase WWT tariff to operational cost recovery or profitable level as quickly as possible, expanding the range of tariff levy from enterprise and institution organization to every household. Increasing WWT tariff is a major change in pollutants discharge levy, which aims at realizing "polluters pay" and opening the urban WWTPs to the market. Currently, among the 8 HRB cities, most counties have adjusted WWT tariff to above 0.8 yuan/ton, activating WWTP construction and operation market through price mechanism and attracting social investment.

3 For example, Jiangsu province has increased its WWT tariff, created the mechanism of fee-ed nature resource use, and pioneered the market-base municipal WWTPs operating nationwide. On April 23, 2003, Henan provincial government issued the *Enhancing Municipal WWT Tariff Levy, Promoting Municipal WWT Industrialization* and increased its WWT tariff to 0.70 yuan/m^3 on average. Another example is the HRB area of Shandong province, where is mainly undeveloped and lack of pollution control fund. In light of this situation, Shandong province introduced policies in succession such as increasing municipal WWT tariff, levying water resource fees, establishing water supply quota system, stepped over-the-quota tariff structure.

4 The policy legitamating profitable WWTPs by increasing pollutants discharge fee produced a number of urban WWTPs which are constructed, operated and managed based on the market mechanism. This has provided references for existing WWTPs. Currently, there are a number of well-run WWTPs with the increased pollutants discharge tariff.

Xuzhou : WWT is profitable

"Construction is affordable; operation is not" has been a common problem in many municipal WWTPs. This phenomenon in Xuzhou has been changed. Currently, 3 WWTPs have all signed a contract with related city government departments. The contracts confirmed that the city government will pay 0.8 yuan monthly to the enterprise for every ton of wastewater that meets the discharge standards. From 2003, payments for the operational cost "in arrears" have not happened in Xuzhou.

Where does the money of city government come from? According to the policy of Jiangsu province, from March 1, 2003, Xuzhou has increased WWT tariff for residents, enterprises, and other service providers to 0.71-0.96 yuan per ton, which will cover the 0.8 yuan per ton WWT operation fee. By 2005, the HRB WWT fee was increased to 1.1-1.2 yuan per ton.

In order to increase profit, the operating enterprises also put forward many good ideas. Xuzhou

Yuanquan Environmental Protection Corporation considered operation cost during the design and construction stage in its Sanbahe WWTP. At the same time, one expert capable of many fields and one position of multi function obviously reduced staff costs. Thus, all kinds of operation costs of WWT are controlled under 0.6 yuan per ton. Under the circumstance of little profit, the enterprise expanded its daily treatment capacity from 3×10^4 ton to 4×10^4 ton, getting profit every month, and handing in 48×10^4 yuan taxes every year.

To ensuring discharge stably meeting standards, Xuzhou Public Utilities Board and the operating companies signed the operating and management contract, providing detailed rules in wastewater amount calculation, water quality monitoring, operation and evaluation. Both parties agreed, the company must monitor water sample before treatment and after treatment every day, and kept staff working in WWTPs to supervising and inspecting water quality. In order to assess conveniently, both parties invested and established COD on-line monitoring instrument and flowmeter. Public Utilities Board assessed WWT results every day, if one index can not meet standard, Public Utilities Board will only pay 70% of WWT fee; if two index can not meet standards, Public Utilities Board will only pay 50% of WWT fee; if more than two index can not meet standards, except detaining the payment of treatment fee at that day, Public Utilities Board will impose another 20% WWT fee as penalty.

Sources: "People's Daily" (2006-04-20 version 16)

24 But the policy is still facing problems. The first is that levying WWT tariff is difficult; the second is that in some areas elevated pollutants discharge tariff still cannot recover the WWTP operational costs. These two problems actually reflect a socio-economic paradox. As economic development is always uneven across areas, to ensure WWTP profitability in the entire watershed may prove a long journey. In addition, there are some problems in implementing the policy. For example, 77 counties in Shandong province have introduced the levy policy, but among them 23 have not put it in operation. In addition, after collecting WWT tariff to local finance, many cities still treat it as the extra budgetary funds and use it in other fields, which struck the local WWT development seriously.

9.6 Sustainability Evaluation

1 According to the "user pays" principle, any individuals, groups and departments who used environmental resources should pay for them; in another word, the users should become the subjects for protection and pollution control investment.

2 Currently, the HRB pollution control is operated under the watershed pollution control FYPs made by our country. The main idea is to analyze watershed current water environment quality, to make water quality and pollutants discharge object according to national watershed economic development level and environmental function orientation and to achieve the established objects through implementing some planned projects.

3 According to plan, local government at all levels should take charge of projects funds implement and state will give certain support, at the same time, encouraging strengthening local water pollution control financing attracting ability oriented for water pollution control projects. According to "who pollution who governance" principle, industrial enterprises control funds should be collected by themselves, state will grant loans at discount interest to some proper projects, while making efforts to broaden financing collecting channels, actively seeking bank loans, social and foreign funds, ensuring financing implementation.

4 As watershed pollution control is a long-term and arduous task, only by establishing

sustainable financing mechanism can stable and sustainable funds be ensured. But sustainable financing mechanism has not been established. Taking municipal WWTPs as an example, constructing WWTPs needs lots of funds, but planned economic system investment means is still in use. Government responds for collecting funds for, constructing and managing WWTPs. Besides high infrastructure funds, local government has to bear WWTPs annual operating costs too, which bring a heavy financial burden to government.

5 After 1998, the state implemented stimulating domestic demand policy, so granting energetic support for WWTPs in all areas. But following the increasing WWTPs construction speed, all kinds of pipeline network and pre-treatment facilities do not keep up, leading to incomplete wastewater collection system and treatment facilities. Regardless of the new pipeline network construction or rain sewage diversion transformation requires huge capital support, as 2-4 times as WWTPs construction funds. As the wastewater network is public facility, private investment refuses to intervene, while the state began a new round of macro-control, tightening bank loans. The government can not apply for loan as sponsor, which making wastewater network construction a serious lag. Normally, WWTPs has been built, wastewater network construction or transform has just been considered into plan.

6 In the course of research process, the HRB WWTPs construction funds mainly come from state bonds, corporate fund-raising, loans, government discount, and foreign investment for few WWTPs construction. Despite all areas are positively struggling for WWTPs public facilities operated in market mechanism like BOT or TOT modes, in actual operation, application of these models is not very mature. The main problem is though many areas running according to market mechanism, the major income source WWT fee is still colleted through administrative means, which contradicts with each other. In addition, some residents WWT fee standards are lower than industrial enterprises WWT fee standards, considering from economic benefit, some domestic WWTPs also accept industrial wastewater, through wastewater discharging into network agreements running WWT. For example, domestic wastewater and industrial wastewater separately occupy 50% in Bengbu first WWTPs treatment. For Bengbu enterprises normally run using self-owned water source, their pollutants discharge amount is difficult to control. So Bengbu first WWTPs demand even if water quality can meet standards, enterprises discharging wastewater into network must hand in pollutants discharge fee and WWT fee.

7 In sum, obstacles in the HRB sustainable investment and financing channels construction include:

8 a. Various investment and financing policy and security measures are imperfect, lack of clear rules to foreign, private and department funds entering water pollution control field, easy leading to problems, especially high risk in investment return ratio. For example, in the implementation process of BOT projects, due to the lack of corresponding laws and regulations and mismatching between projects approval institutions and BOT projects implementation, problems as BOT projects can not run on schedule occurred. Especially, regulations and policies among various government function departments are mismatching which worried successful bidders for BOT projects. For instance, t successful bidders with foreign background needs getting the creation approval by foreign trade authorities, while

4 The table above suggests that rate of practice of the Environmental Impact Assessment has been relatively high and reached 99.2%, 96.9%, 99.7%, and 99.5% for Jiangsu, Anhui, Shandong, and Henan provinces respectively in 2004. Shandong and Henan have been above the national average, while Anhui Province is relatively low. However, implementation of the "Three Synchronousness" has been quite lagged compared to the EIA. Except Shandong Province, other 3 provinces have been below the national average; Jiangsu Province, in particular, has the lowest rate of 86.6%.

5 EIA and 3S during the project feasibility study phase have been important mechanisms to implement "head-of-the-pipe" prevention.

10.1.2 Permitting System

1 China has 3 types of permits in the water resource and water environment management: water use permits, wastewater discharge permits, and pollutants discharge permits. The water use permits are adopted to adjust the aggregated water use by projects and organizations and are administered and issued by the WRBs. Wastewater discharge permits adjust the total wastewater discharged to the municipal drainage system and are administered by the city construction committees. Pollutants discharge permits control the total wastewater and pollutants discharge to the natural environment and are administered by the environmental protection bureaus.

2 All three types of permits cannot be issued to individuals. The discharge by the urban and rural residents is regulated through the economic incentives by water tariffs and wastewater discharge fee.

(1) Water Use Permits

3 Water use permits were first adopted at the early 1990s following the State Council's *Implementation Guidelines of Water Use Permitting institutions*. Guided by the State Council Guideline, MWR issued the *Specifications on Approval Procedure of Water Use Permitting* (1994), *Guideline on Water Use Permitting Monitoring* (1996), *Guidelines on Water Quality of Water Use Permitting* (1997), *Circular on Water Use Permitting Pre-Applications of Construction Projects* (1997), *Circular on Issues on State Council's Approving Water Use Permits of Large Construction Projects* (1995), and *Circular on Water Use Permitting Management Boundaries of International Transboundary or Boarder Rivers and Transprovincial/Transjurisdictional Inland Rivers* (1996).

4 The water use permits usually apply to the urban organizations and projects that draw water from the natural water bodies. The water use permits have not been applied to rural domestic and agricultural water use. In each watershed, MWR delegates the administration of water use permits to the watershed hydraulic committee; at local level, the local WRBs directly administer. The MWR directly oversee the water use permitting of state key projects.

5 The water use permits have suppressed the untamed water "demand" and emphasized water conservation. Through the water use permits system, the limited water resources could be allocated more reasonably and used more efficiently.

(2) Wastewater Discharge Permits

6 The wastewater discharge permits were also launched in the 1990s according to the administrative statutes by the MOC. The wastewater discharge permits apply to all enterprises and commercial organizations that discharge to the municipal wastewater network. Institutes such as the government offices and schools are not included. The wastewater discharge permits impose the *Water Quality Standards for Wastewater Discharged to Urban Sewage* on the wastewater and no limits to the quantity of wastewater discharged.

7 The purpose of the wastewater discharge permits is to avoid the negative impacts to the WWT processes from the inlet wastewater qualities to ensure the proper operation of the municipal WWTPs. Although the wastewater discharge permits system has been implemented over a decade, its applications is largely confined in large or median scale cities. Many small cities still do not have established wastewater network or even a WWTP.

(3) Pollutants Discharge Permits

8 The pollutants discharge permits were first experimented in 1987 and gradually promoted starting 1990. To control the discharge of key water pollutants in the Haul River and the Tai Lake and enhance the monitoring and management of water pollution control and prevention, according to the *Water Pollution Control and Prevention Act,* the *Implementation Guideline on Water Pollution Control and Prevention Act*, and the *Interim Regulations on the HRB Water Pollution Control and Prevention*, SEPA enacted the *(Interim) Management Provisions on the Haul River and Tai Lake Key Water Pollutants Discharge Permits* on October 1, 2001. This is the most comprehensive statute in China on the water pollutants discharge permits system.

9 The *HRB Water Pollution Control and Prevention Objective Statement* of the HRB provinces have laid out the implementation plan of pollutants discharge permits system: by the end of 2004 complete issuing pollutants discharge permits to the key pollutants discharge enterprises and operating urban domestic WWTPs with daily wastewater discharge over 100 ton or COD discharge over 30 kg or NH_3-N over 20 kg; by the end of 2005 complete issuing permits to all pollutants discharge entities; by the end of 2006, complete installing online monitoring equipment, which are connected to the environmental protection authorities, at designated locations of the key pollutants discharge enterprises and urban domestic WWTPs; beginning from 2006, all pollutants discharge entities could only discharge with the pollutants discharge permits.

10 In order to regulate the management of pollutants discharge permits, the HRB provinces have issued a number of regulations and management methods on the management of pollutants discharge permits. For example, in Jiangsu Province, the *Jiangsu Province Environmental Protection Regulations, Acceptance Methods of Water Pollutants Discharge Permits System of Jiangsu Province, Work Plan of Implementing Pollutants Discharge Permits System during the 10th FYP in Jiangsu Province,* and *Assessment Methods of Implementing Pollutants Discharge Permits of Jiangsu Province (Draft)* have provided regulatory basis for the implementation of the pollutants discharge permits locally. Bengbu of Anhui Province forecasted, approved and controlled the regional total discharge of COD

according to the 1999 HRB Bengbu City Water Pollutants TMLL Target and Implementation Plan. Starting from the 2nd half of 2001, Bengbu allocated the water pollutants discharge quota and checked the pollutants discharge from the key discharging entities, and issued the pollutants discharge permits by the requirements of the provincial EPB and city government. Currently a total of 72 key discharging entities have been allocated the water pollutants discharge permits to bring the total pollutants discharge under control. Likewise, Shandong Province began issuing pollutants discharge permits in its key watersheds in 2004. Based on the environmental capacity, the pollutants discharge permits are the key method in the market-based pollutants discharge TMLL mechanism. Enterprises are obliged to comply with the quantity and quality of the allowance of the discharge permits. Non-complaint discharge will be subject to administrative punishment or mandatory shut-down, and administrative or criminal liabilities if applicable. By 2005, Henan Province has issued pollutants discharge permits to 926 entities.

11 The survey results indicate that the pollutants discharge permits have helped improve industrial pollution control, reduce total pollutants discharge, and elevate enterprises' environmental awareness. But the implementation is of mixed results.

12 The positive side indicates that the pollutants discharge permits have: (1) achieved significant results in areas with advanced environmental concepts, established monitoring capacity, good basis for industrial environmental protection, (2) improved local environmental management and facilitated the improvement of local environmental quality, and (3) improved the enterprises' environmental awareness.

13 The negative side indicates the following inadequacy in the implementation of the pollutants discharge permits: (1) slow issuance of the permits, (2) inadequate enforcement and non-compliance punishment leading to low compliance, and (3) except for certain areas, no obvious improvements in the environmental quality have been found.

(4) Improve Permits Management

14 A prerequisite for the permits system is the sound and comprehensive management of water environment and water resources. Water quantity and quality management are closely interlinked. The water quantity and its hydraulic conditions are crucial to the water environment capacity, and the water environment capacity determines the pollutants TMLL.

15 Therefore, coordination between the water usage and overall water resource management that incorporate both socio-economic and ecological water demands and comprehensive management of water environment and water resource, as well as coordination between water use permitting and pollutants discharge permitting will be necessary to ensure the sustainable utilization of the water resources.

16 The comprehensive management of water environment and water resource and the coordinated management of permits at the national, watershed, and provincial levels need improvement and enhancement. This is particularly important to watershed management.

17 The survey results show that the current water resource, water supply, WWT, and pollutants discharge tariffs cannot fully reflect their costs of production and values. This leads

to the wasteful use of scare water resources and untamed pollution. The market- and incentive-based mechanisms, such as stepped water tariffs, water quota, should be employed to promote conservation in water extraction from the natural water bodies, recycling of water uses, and optimization of water resource allocation. The water resources should be considered as one of the strategic assets in social and economic development. Those market-based mechanisms will be able to facilitate the balanced renewal and withdrawal of water resources and the pollution discharge and clean-up.

18 Based on watershed management, the watershed management authority should plan the water extraction allowance and ecological water use of each river sections and the pollutants discharge TMLL targets, coordinate the water use, wastewater and pollutants discharge permits according to the watershed water resource and environment conditions, and issue the water use permits based on the exploitable water amount and water conservation requirements. The water use permits can be traded to promote water conservation and improve industrial water efficiency. The authorities should also issue the maximum pollution load of each water environmental function zone and the maximum allowed pollutants discharge into the rivers and issue discharge permits accordingly. The pollutants discharge permits can also be traded to improve industrial pollution control and to achieve watershed-wide water quality management and pollution control objectives.

19 The sub-watersheds within the parent watershed should practice small watershed management based on the allocated quota and the parent watershed environmental requirements. Meanwhile, the watershed water quality and pollution control authority should revise the quota allocation, indicators, and the management requirements, should the sub-watershed practice reveal such needs.

10.1.3 Other Management Institutions

(1) Environmental Accountability Mechanism

1 These four provincial governments shoulder the main responsible for the pollution control, according to the working objectives responsible file of the HRB water pollution control and prevention, the four provincial governments should play the leading role in controlling the pollution of Haul River. The first leadership takes all the responsibility of this work, the objective, duty and manager should be noticed to the public. The four governments should sign the responsible files of water pollution control with lower governments, and bring these into the evaluation system of leaderships' achievements. The beginning of every year, the lower governments will be evaluated about their implementation of the plan of water pollution control and prevention last year. The result will be announced to the public and the same level of communist party organization, it also be an important reference for the leaderships' promotion and punishment.

2 Now, the four provinces have effectively implemented the responsible mechanisms of environment protection, and every provinces have established the mechanism of the first leadership who is responsible for environmental protection and finished drawing the executive plan of the HRB water pollution control and prevention. Every Provincial governments open the meeting of the HRB water pollution control and prevention annually,

discussing the work of pollution control. And through signing the responsible agreements, they disassemble responsibilities to every urban government and related provincial bureaus. Their performance will also be evaluated.

3 Jiangsu provincial government and every city in the HRB have established the leading grouping responsible for water pollution control and prevention. The provincial government holds the HRB water pollution control and prevention working meeting every year, discussing the work of pollution control, finishing drawing Jiangsu Province the HRB water pollution control and prevention the 10th FYP executive plan, and at the beginning of every year, they distribute the working plan to every city government and related province bureaus, making sure the responsibility of pollution control. In December 2003, Liangbaohua, the leadership of Jiangsu province, signed the fourth round responsible agreement of environmental protection objectives with eight urban governments of the HRB, this agreement has listed the HRB water pollution control and prevention as the evaluation scope. In September 2004, the government leaderships signed the responsible agreements of the HRB and the east line of SNWD pollution control and prevention with eight urban separately. The agreements have disassembled the national demand of every task to related responsible people. The province government has carried out inspections many times to monitor the implementation of pollution control, and the province government office has initiated inspection paper to notice every bureau about the result.

4 Shandong province has establish the mechanism of the first leadership of communist party organization, government taking the responsibility of environmental protection, signs the agreement of building ecological province from high level to local and the responsible file of four pollution control objectives, including the activity of clear water of two lakes and one river, initiating the evaluation method of party and political leaderships' working achievements of Shandong province, strengthening every level government's environmental protection responsibility, announcing social the water quality of important rivers across administration boundary, perfecting the institution of environmental protection federal meeting, establishing the working mechanism of polluting control, under which unit responsible for the pollution is main body, the leadership of party council, the governments take their responsibilities, environmental protection supervise public participation. Through hard work, the pollution control work of important watersheds are shifting from micro management of point sources to macro management of the regional area, shifting from simple pollution control to environmental comprehensive control emphasizing control and prevention, shifting from the act of mainly using administrative command to the comprehensive act of more assort to law market technology, and so on.

5 In addition, on 2005, Anhui province signed the responsible file (2005-2010) of working objectives of water pollution control and prevention, bringing environmental protection work into the evaluation system of the working objectives of every level government annually. At the beginning of 2005, Henan province government signed the responsible file of environmental protection objectives with eighteen local governments. At the end of that year, the province government established federal inspection group, and the inspection results showed that eighteen governments had all finished their responsible objectives of

environmental protection, Zhengzhou Xuchang Sanmenxia Hebi Jiyuan have been evaluated the excellent units for their accomplishments of environmental protection objectives, other thirteen local governments are evaluated the advanced units.

(2) Quantity evaluation of urban environmental comprehensive control

6 The quantity evaluation of urban environmental comprehensive control is an important part of the implementation of governments' environmental protection objectives responsible regulation. Through this work, the urban government leaderships have strengthened urban environmental comprehensive control, enhancing urban environmental management level, improving urban environmental quality, and accelerating the coordinate development of urban economy, society environmental protection. Under the leadership of governments, through relative bureaus' active cooperation, most of the urban environmental protection infrastructures have been greatly improved, so does the capability of pollution control and the level of environmental management. The capability of environmental monitor is continuously strengthening, urban environmental quality is improving step by step, for example, in the quantity evaluation of national environmental comprehensive control, Rizhao, Weihai, Dongying, and Tsingdao of Shandong province have been on the top of the national environmental protection model cities.

7 At the same time, some local governments take economic development as their only priorities, not paying enough attention to protect the urban environment and improve urban environmental quality. The financial support doesn't satisfy the demand of urban environmental protection, and the way of environmental management is very simple, the environmental monitoring method also gets behind. The capability of polluting control doesn't satisfy the demand of economic and social development. In order to implement the state council's decision of implementation scientific development and strengthening environmental protection and further strengthen urban environmental protection, based on the experience of the 10th FYP urban environmental comprehensive quantity evaluation, SEPA adjust and amend the 11th FYP urban environmental comprehensive quantity evaluation indicator system.

Table 10.1.3-1 Enforcement of Environmental Management Requirement in the HRB Provinces (2004)

Province		Jiangsu	Anhui	Shandong	Henan	Total	Nationwide
Total discharge fee (x10^{4}yuan)		87222	21840	69632	47055	225749	941846
Rate of increase (2003 to 2004)		11.1	36.9	26.4	41.5	23.5	32.8
Pollution control projects with time limits	# of projects	1277	121	1258	1104	3760	22649
	Investment (x10^4 yuan)	67548	19539	110850	51293	249230	1464070
# of enterprises enforced CSCM[1]		562	90	694	1537	2883	13348

Source(s): China Environmental Statistic Annals 2004

CSCM – To close the enterprise, stop the operation of enterprise, change the production of enterprise or move the plant to other place because of the pollution of the enterprise.

8 From this table, the four provinces' pollutants discharge fee and Mandatory pollution control within a given time limit have made some progresses. The amount of pollutants discharge fee also grows to some extent. The amount of pollutants discharge fee of 2004 has

increased 23.5% than that of 2003. The amount of Mandatory pollution control projects within a given time limit is 3760, accounted for 16.6% of all state. The amount of investment is 24.9×10^8 yuan, accounted for 17.0% of all state. The amount of closed, transferred companies is 2883, accounted for 21.6% of all state.

9 Generally, there are still some problems. In the process of executing pollutants discharge fee institutions, it does play an active role in motivating company's environmental protection activities, raising necessary fund of environmental protection. But during the survey, local departments also reflect several common problems: firstly, the discharge fee standard is far lower than basic treatments fee, and it also doesn't take into account of the rising price. The fee discharging standards keep unchanged many years, the effect of motivating pollutants discharge companies is greatly falling, some companies is even willing to pay pollutants discharge fee, not increasing environmental protection investment. In order to enhance the executive effect of pollutants discharge fee, the standards of pollutants discharge fee should be appropriately adjusted according to the price and economic development level, and strengthened pollutants discharge fee.

10 Mandatory pollution control within a given time limit is a environmental management institution based on special Chinese condition, which is that the environmental protection fund is very limit, environmental pollution is a common phenomenon, and we can only assemble limit fund to resolve urgent environmental problem. But there are some personal factors. The judgment of the pollution degree is different for people, location, and time, because of lacking impersonal standards, t will intrigue some unfair phenomena. So with the growing strengthen, the objectives of mandatory pollution control within a given time should be suitable for not only heavily polluted company, but also every company.

10.2 Monitoring System

10.2.1 Monitoring System of Water Environment

(1) Monitoring of the water pollution sources

1 By the *National Environmental Monitoring Guideline* (1983), the national environmental monitoring system has been established to include the 4 levels of environmental monitoring stations:

- Headquarter Station: China National Environmental Monitoring Center (CNEMC).
- Level-One Station: provincial-level central environmental monitoring stations at the provinces, autonomous regions, and municipalities.
- Level-Two Station: city environmental monitoring station (or central stations) at the prefecture-level cities.
- Level-Three Station: environmental monitoring stations at counties, county-level cities and the districts in large metropolis

2 The environmental monitoring stations at all levels are subordinate to the EPBs of the

same level administratively and supervised professionally by the environmental monitoring station of the higher level. As state-owned institutions and public service organizations, the environmental monitoring stations conduct environmental monitoring and inspection within the authorities given. The budgets of the environmental monitoring stations are covered in the local fiscal spending of the same level.

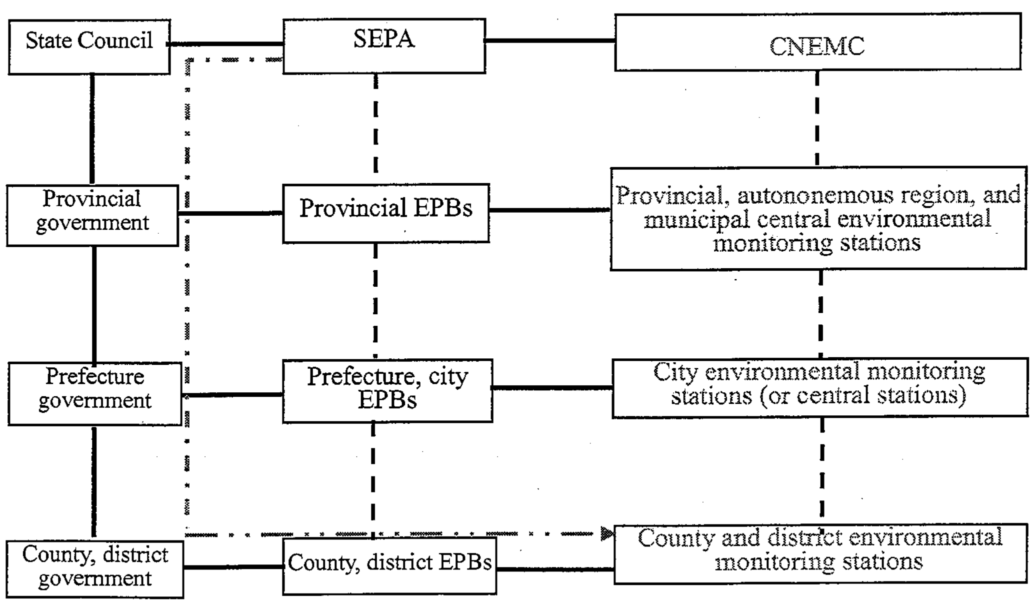
3 According to the SEPA's method of pollution source monitoring and management, in the process of monitoring pollution sources, environmental protection bureaus below provincial level are responsible for supervising monitoring the condition of pollution sources discharge and establishing pollution sources monitoring net in their administrative boundary, leading the work of pollution sources monitoring.

4 In terms of the frequency of monitoring, for the key sources of pollution, the monitoring is conducted 1-2 times per quarter; for usual sources, the monitoring is conducted once per 6 months.

5 The water pollution source monitoring has established a system from the central to local government, which is summarized in Figure 10.2.1-1.

6 This system has shaped such a situation that environmental monitoring is managed by every level of local governments, SEPA and environmental monitoring general station only draw institutions and make technological instructions. Technologically, for the sake of environmental management, if SEPA want to carry out environmental monitoring in some counties, firstly, they should report to the state council, and only when the command is sent to the local EPB, the monitoring activities can go ahead.

Figure 10.2.1-1 Structure of Environmental Monitoring System at SEPA



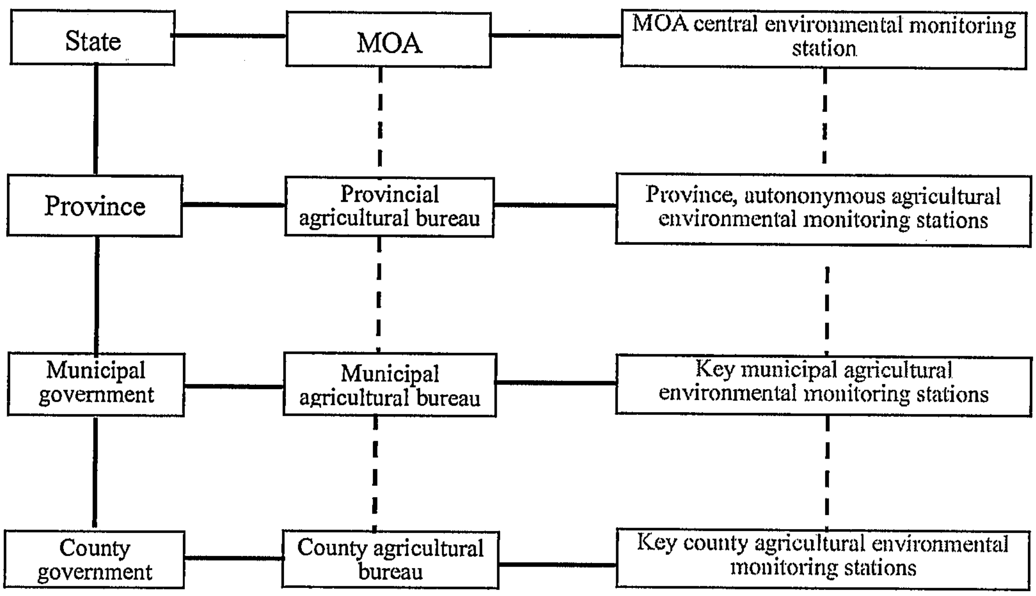
1, Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

2, The red, arrowed dash lines indicate the administrative path from SEPA to county-level environmental monitoring stations.

7 An important attribute of environmental monitoring is its independence or neutrality. The environmental monitoring station of this system is under the leadership of local governments, when monitoring the pollution sources of economic organization which is closely connected to local government's political achievements, the independent of this monitoring will be doubted.

8 This system should includes urban and agricultural none point pollution monitoring, but now, most of the pollution sources monitoring of this system is mainly aimed at industrial pollution sources, the monitoring of agricultural none point pollution has not been carried out. In 1984, the MOA initiated the working regulation of natural agricultural environment monitoring, and established an agricultural environment monitoring system based on it, which is responsible for continuously monitoring the pollution entering into agricultural environment, including soil, irrigating water, underground water, agricultural none point sources pollution, agricultural ecology, and so on. Except Zhejiang and Jiangsu provinces, the monitoring of agricultural none point sources pollution hasn't been carried out. The figure of 10.2.1-2 shows the agricultural environment monitoring system structure of agricultural department. The monitoring system is resemble to that of environmental protection bureau, but monitoring stations of the level of urban and county aren't comprehensive, only several important urban and county establish monitoring station.

Figure 10.2.1-2 Structure of Environmental Monitoring System in MOA



Notes: Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

9 The above review and analysis reveal further problems in the water pollution monitoring system.

10 From the environmental management perspective, the 23-year-old *Management Regulations on Environmental Monitoring* can no longer guide the current environmental monitoring and management in the current-day China, which has undergone significant development and changes in the government structures, the economic level and the society.

11 From the perspective of professional government agencies, pollution monitoring of water resource is managed by the two ministries, SEPA and MOA, separately. MOA takes charge of agricultural pollution sources, and the SEPA takes charge of other pollution sources. SEPA does not manage the monitoring of pollution sources by the environmental protection laws. When the agricultural none point sources pollution become the main pollution sources of water pollution, its management and monitoring become more important but the loopholes in the legislation and practice still persist.

12 From the perspective of SEPA's admnistration, except the CNEMC, SEPA has no actual administrative authority over other environmental monitoring stations. In fact, the local governments directly manage environmental monitoring. According to the *Environmental Protection Act*, the local governments carry out environmental protection management of their jurisdictions. This weak vertical leadership between the environmental protection offices impedes the independence of environmental monitoring.

13 In terms of monitoring frequency, in the past ten years, the frequency of monitoring is so low that it cannot reflect the actual condition of pollution sources nor to sufficiently supervise and manage the pollution sources.

(2) Water Body Environment Monitoring

14 According to environment's definition given by the *Environment Protection Act*, the monitoring system of environmental protection bureau should carry out monitoring water quality, but because of other laws' different provisions, environmental protection bureau, ministry of water resource and resource department actually jointly take part in monitoring water quality.

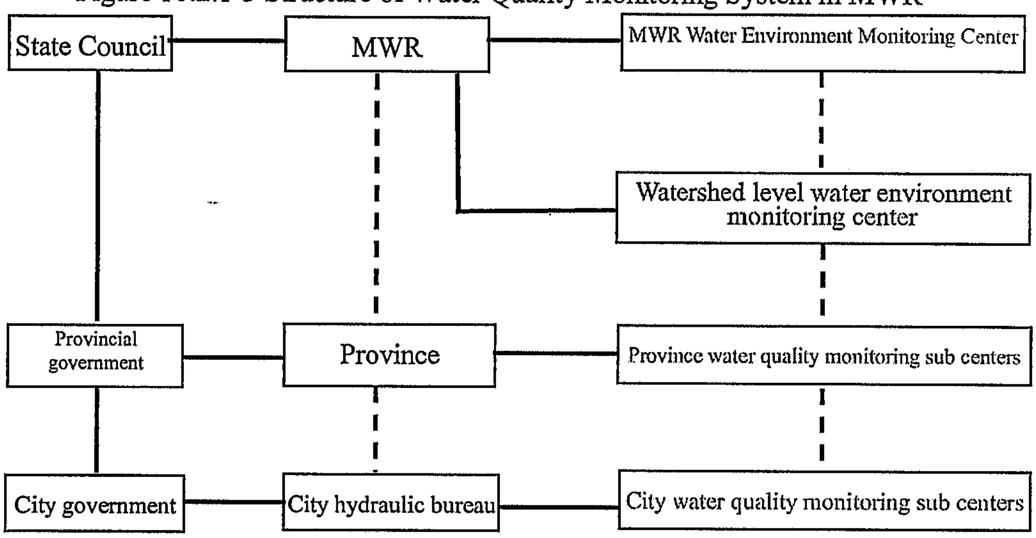
15 Water body quality monitoring of environmental protection system includes ground water monitoring net set by environmental protection general bureau and every local province and urban these monitoring nets basically cover main water quality control sections of the Tai Lake and the HRB. From 1999, SEPA began to construct automatic monitoring system of water body sections, thirteen automatic water quality monitoring stations have established in the Tai Lake, and seven automatic water quality monitoring stations have established in the HRB, these help to understand the condition of water quality in time. But the water quality monitoring nets of environmental protection system don't include the monitoring the underground water quality. The groundwater monitoring net of national land resource department is responsible for monitoring underground water quality monitoring. But according to Chinese environmental quality announcement, this net is divided into units based on big region, the two regions of east and south China include not only Haul River and the Tai Lake, but also the watershed of the Yangtze River, the Pearl River, and so on. In addition, environmental monitoring system of MOA also monitory water quality of rural wells.

16 According to *Water Pollution Control and Prevention Act*, the water resource protection working organizations of Haul River and the Tai lake are responsible for monitoring the water quality of the watershed within their own provincial boundary, and report the monitoring result to SEPA and MWR. And according to the *Water Act*, WRBs of Haul River and the Tai lake are responsible for monitoring water quality, so WRBs established the water quality

monitoring system, at the same time, they also monitor the water quality and quantity of all pollution discharge outlets that enter into water bodies. In order to regulate supervising and managing the discharge outlets, the MWR initiated the *Management Method of Pollutants Discharge Outlets Entering River*, which became effective on January1, 2005. This Act makes certain that the WRBs are responsible for supervising and managing the pollutions discharge outlets.

17 In the 1980s, MWR has carried out water environmental monitoring by adding water quality monitoring institution. In 1984, water quality Experiment and Research Center of MWR has been established, and the water quality monitoring standards have been issued. After twenty years' development, MWR has established a four-level water quality monitoring system.

Figure 10.2.1-3 Structure of Water Quality Monitoring System in MWR



Notes: Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

18 The monitoring of water quality of MWR emphasizes on the service to the water resources development and management. The setting of the monitoring stations considers watershed as whole, and has combined with the WRB stations. The design of the monitoring items, considers the nature chemical characteristic of the river and its pollution. However the the setting of the monitoring station can not fully and comprehensively reflect the water supply, pollutants discharge control and water body function characteristic and not so suitable for the water pollution control.

19 The organizations under MWR responsible for the HRB water environment monitoring are the HRB Water Environment Monitoring Center and WRBs of four provinces of the HRB. They carry out the water quality monitoring for the water body function zones and the provincial boundary sections.

20 The MWR is responsible for water body monitoring, and SEPA is responsible for the water monitoring on land. But in fact, SEPA has conducted the water quality monitoring of

water bodies, and the MWR has monitored the water pollution sources "ashore". This shows in a special way that it is necessary to connect the pollution source monitoring and water quality monitoring of water bodies.

21 In addition, the MOC system also carries out water quality monitoring which focus on the drinking water resources.

22 The above review and analysis reveals a number of issues in the water environmental monitoring institutions:

23 a. The SEPA/EPBs and MWR/WRBs have overlap responsibilities in the water environment monitoring, which has led to the waste of the limited, if not insufficient, monitoring resources. The segregated institutional arrangement has led to the lack of coordinated, synchronized, and unified arrangements in the set-up of the monitoring systems, selection of the monitoring indicators, locations, time, and frequency. No single agency is designated to summarize, collate, and use the monitoring data from various sources. Actually, under such segregated environmental monitoring system, even if the data were available from those agencies, they tend to be inconsistent and prove difficult to use.

24 b. Coordination between the *Environmental Protection Act*, the *Water Pollution Prevention Act*, and the *Water Act* in water quality monitoring is still lacking. The standards, management, and institutions in water quality monitoring remain ambiguous.

25 c. The lack of a watershed-based groundwater monitoring network leads to the lack of understanding of the watershed groundwater conditions.

Difference between the Water Quality Monitoring Systems of SEPA and MRW

According to the Weekly Water Quality Automatical Monitoring News Press of Key Sections of Major Watersheds Nationwide by the SEPA, starting from January 1, 2004, the weekly updates of the water quality automatic monitoring results of the 73 (later increased to 82 since June 5, 2004) authomatic monitoring sections will be publicized to the public.

According to the report by the minister of the MWR on December 27, 2004 at the 13th Meeting by the Standing Committee of the 10th National People's Congress, the national water environment quality monitoring network is consisted of a total of over 760 monitoring sections and 117 water quality automatic monitoring stations, which have enabled the dynamic monitoring.

10.2.2 Reporting System of the Water Environment Monitoring Data

1 The mechanism of water environment monitoring determines the data reporting system. The structure figures 10.2.1-1, 10.2.1-2, 10.2.1-3 show the water environment monitoring system of environmental protection, hydraulic and agricultural department, they also reflect the water environmental data reporting process. The environmental monitoring station of Environmental protection, hydraulic, agricultural department separately report data to their own higher department, these professional departments report to the same level governments, or to higher governmental professional departments. Environmental monitoring station may

directly report to higher level environmental monitoring station.

2 The main problem of the data reporting system of water environment monitoring is that none of departments summarize all monitoring data, and carry out instructing and using these. In fact, under the separate environment monitoring mechanism, even though some departments summarize all the data, because the data of different departments lack unification it's still hard to make use of them.

Difference of the water environment monitoring results between MWR and SEPA

Monitoring results of Huai River water quality in 2005

Water quality classification	Environmental Annals 2005 from SEPA		Water Quality Report 2005 from MWR	
	86 national control sections	32 sections between provinces	50 control sections	46 sections between 0rovinces
I/II	3	1	4	
III	12	3	15	12
IV	33	13	10	11
V	11	5	5	4
Worse than V	27	10	16	18

The monitoring results of COD discharge to the rivers in 2000
SEPA: 812000 ton (Huai River Pollution Control 10^{th} FYP)
MWR: 943300 ton (Visit Huai River Surreptitiously, Eou Zhengtao, Xinhua Publication, Beijing January 2005)

10.2.3 Installation of the Monitoring System

1 The construction of automatic monitoring net is an important part of these two FYPs. But according to the 2005 Implementation Evaluation of the TOR of the HRB Water Pollution Control and Prevention, the results of online monitoring device installation have proved uneven across the HRB provinces. The rates of installation of online monitoring devices of Anhui, Jiangsu, Henan and Shandong are 82%, 70%, 63% and 13% respectively; none of the installed facilities have been in operation so far.

10.3 Small Watershed Pollution Control Plan

1 The integrated pollution control in small watershed should integrate the water quality, total water quantity, projects and investment for every watershed and consolidate the treatment of water pollution, wastewater reuse, ecological restoration and watershed protection through a combined means of economical, legal, technical and administrative. The intergarted small watershed management will also pull in the forces of social groups, market mechanism, public monitoring, and macroscopic management to facilitate the industry restructuring, environment facilities construction, clean production, and pollution control.

2 Integrated small watershed pollution control requires adjustments in government environmental management characterized by the following transfers: from microscopic

management on pollution sources to macroscopic management to river section, from pollutants concentration management to combined management of concentration and total pollutant discharge amount control, from pollution treatment to a combined measures of pollution treatment, wastewater reuse, and ecology protection, from the dominant use of administrative measures to the comprehensive usage of economical, legal, technical and administrative measures, and from the championship by the environmental protection administration to the universal participation of all related government sectors and social groups.

3 In terms of the effects of small watershed pollution control operation, Shandong Province has accumulated generally successful experiences. Base on the experiment in some cities, the experience and measures in Binzhou, Linyi, Zaozhuang, and Weifang for integrated pollution treatment ware introduced to the provincial scale in the Small Watershed Pollution Control Conference on 23rd, Oct., 2002. On 26th, Nov., 2002, Regulation on the provincial small watershed pollution was announced by EPB, Economy and trade commission, financial Bureau Construction Bureau, hydraulic bureau and forestry bureau together, approved by the province government.

Practices and Experiences of Small Watershed Pollution Control in Shandong Province

Firstly, reinforcing leadership of the administrative authorities and improving watershed inclusive treatment. According to watershed pollution control scheme of paying equal attention to target, total amount, project and investment, strategies were carried into execution to control watershed environmental pollution including pollution treatment, wastewater recycles and watershed ecological rehabilitation & protection. Various measures have been taken to enhance watershed comprehensive treatment including measures of economy, law, technology and administration.

Secondly, establishing management administrations, then making clear and fulfilling their responsibilities. Comprehensive pollution treatment of small watershed became part of environmental protection target liabilities from 2003 to 2005, with assessment content of constitution of watershed pollution treatment leading group and compilation of comprehensive treatment planning. Besides, staggered target of watershed pollution control were broached and measures were taken to achieve the target anticipated that making clear the controlling target as well as assigning particular departments responsible for it.

Thirdly, compiling the planning of water pollution treatment for small watershed and advancing the process of execution. According to compilation requirements of comprehensive pollution treatment planning for small watershed issued by provincial EPA， 17 cities were summoned to compile comprehensive pollution treatment with small watershed as the controlling unit. Now, all of the CSWPTP in 17 cities are completed, and 16 of them passed the professional demonstration organized by provincial government. With the consideration of paying equal attention to pollution control, wastewater recycling and ecological rehabilitation & protection, governments of Shandong province issued the indication for further strengthening water pollution treatment of Xiaoqinghe watershed. The provincial government of Shandong province compiled successively two comprehensive pollution treatments planning including "overall planning of water pollution treatment for Shandong reach of south-to-north water transfer" as well as "planning of comprehensive pollution treatment for Xiao Qinghe watershed". In the end of the year of 2003, pollution planning for 27 controlling units in Shandong reaches along water transfer line was

completed to instruct water pollution control along the water transfer line.

Fourthly, adjusting measures to local conditions and paying attention to actual effect. Planning of comprehensive pollution treatment for Linmuniutui ditch was completed according to the comprehensive pollution treatment for small watershed, and 65 million yuan will be appropriated to comprehensive treatment projects including further advancing point pollution control, WWTS building, wastewater recycling and ecological rehabilitation. The projects at first phase were accomplished with the investment of 20 million Yuan. Based on the centralized treatment of urban wastewater, more than 10milion yuan was invested into construction of check gate overflow dam and irrigation area in Zechengsha River for the purpose of realization of wastewater recycling and improve water quality of low reaches of the river.

4 Integrated small watershed management represents the successful international planning and developing model that combines economy, urban construction, industrial production, water conservancy, pollution controlling and ecological conservation of a small watershed. As a small river watershed usually does not involve big jurisdictions, its management could be accommodated within the authorities of local governments at the county (city) level, and the watershed comprehensive plan can be easily connected to local plans. Hence a better result can be acquired in the HRB. Although no specific monitoring data can be cited to quantify the contribution of integrated small watershed pollution control on the water quality improvement, past international experiences has proved it an effective measure to improve environment quality with little investment.

5 Based on the conditions in each province, the provinces can work out general plans on water environmental pollution control in small watersheds and bring them into the local plans for national economic and social development to ensure the objectives of water environmental pollution control achieved.

11. Public Participation

1 China has a relatively found legal foundation for environmental protection public participation. The *Constitute* of PRC clearly specifies that "The people are entitled by law to manage the state, economic, cultural, and social affairs by various channels." This is the constitutional basis for any Chinese citizen to participate in environmental management. Article 6 in the *Environmental Protection Act* further specifies that "all entities and individuals are obliged to protect the environment and are entitled to reveal to the higher authority or prosecute any entity and individual who pollutes the environment." The state has already confirmed the rights and duties of public participation for environmental protection in statutes, which has served as the legal foundation of the public participation. However, the statutes remain in principle and abstract. The lack of practicality and concrete implementation rules prohibits the further deepening of public participation in China.

11.1 Forms of Public Participation

1 In recent years, some provinces and cities have pioneered in public participation and established certain institutional arrangements. For example, *Fuyang, Hangzhou* and *Dongyang* of Zhejiang Province have started public hearings for public participation in environmental management, monitoring and Environmental Impact Assessment. Jiangsu Province has experimented public participation of comprehensive environmental and development decision-making and the environmental management and enterprise environmental information disclosure (in *Zhenjiang* City). However, in general, the current forms of public participation are still largely limited to:

(1) Raise Environmental Proposals through the People's Congress, CPPCC, and the democratic parties

2 The public could raise congressional proposal on the environment to the government during the legislative period of the People's Congress raise environmental legislative issues through deputies to the People's Congress at various levels. Meanwhile, deputies to the People's Congress can monitor the government's environmental actions through inquiries to the government, debrief government environmental reports, and inspect environmental law enforcement.

3 The *Constitute* specifies the CPPCC's (National Committee of the Chinese People's Political Consultative Conference) function as participation in state administration. The government is required to earnestly listen to its views and provide responses upon careful study. Members of various levels of CPPCC often pay high attention to the environmental protection and proactively organize environmental studies and provide valuable recommendations and advices.

4 Members at the democratic parties generally have advanced educational backgrounds and have access the central government through channels such as the CPPCC and influence the decision-making by providing influential reports and recommendations.

(2) Monitoring through Media

5 The media can help publicize environmental conditions and the evaluation results of the urban comprehensive pollution control programs. The media can establish columns or featured programs for the public opinions on environmental protection. The public participate in China's environmental management through appraising the organizations and individuals contributing to environmental protection and exposing and criticizing polluting and environmental destructing activities. The *China Century Environment Protection Campaign*, a nation-wide environmental protection public education program, is one of the examples.

(3) Environmental Petition Complaint

6 The public can pursuit environmental law suits through the EPBs to safeguard their own interests and benefits. Most of the EPBs in China have opened the environmental protection hotline and the petition office. In order to standardize petition responses, the government at different levels has issued procedures and guidelines. For example, SEPA has issued the *Environmental Protection Petition Management Guidelines*. Those efforts have to a certain degree facilitated public participation.

(4) Through Environmental Protection Public Education Activities Organized by Government, Civil Societies, and Other Organizations

7 The government promotes the public participation in environmental protection through organizing various specialized pollution control activities, the *China Century Environment Protection Campaign*, and various environmental protection memory day activities. Other environmental protection civil society organizations such as the Friends of Nature and the Global Village also promote the public participation in environmental protection.

(5) Environmental Impact Assessment

8 The *Environmental Impact Assessment Act* has specified that "the state encourages the proper participation in the environmental impact assessment by the related organizations, experts and public." Typical environmental impact assessment process will involve surveys, expert panel discussions, and public hearings. However, due to the lack of compulsory implementation guideline and monitoring, the current public participation often remains a mere formality.

(6) Expert Opinion

9 The government usually consults the opinions from the related institutes and experts during policy- and decision-making, and the experts usually conduct surveys at the place of study/interest when preparing the study reports. This process represents one of the forms of the public participation in China.

11.2 Effects and Issues of Public Participation

1 Although in the past 10 more years public awareness of environmental protection has been significantly improved, the public participation is just been started. Forms of public participation are limited; sound institutional support is yet to be built. The public participation at the current level is still mainly "end-of-the-pipe" and passive. NGO development, an important proxy of public participation is still lagged.

2 Our survey results indicate that: The sound public participation mechanism is still to come. Existing environmental protection regulations concerning public participation in China are still to be perfected and have already impeded the effects and development of public participation. A number of key concerns have been noted below:

(1) Lack of sound information disclosure institutions and the missing public environmental right to know.

3 The public cannot participate without knowing. Currently it is the government sectors and enterprises that have the environmental information. This has determined that the government and enterprises are the obliged to disclose the information in public participation for environmental protection. Whether the public will be informed thus depends on whether the obligor will proactively disclose the environmental information they have. To a certain degree, the issue of public's environmental right to know is the issue of environmental information disclosure. Sound environmental information disclosure institutions thus become the key to public environmental right to know.

4 Although in recent years the government environmental information disclosure has been improved, the contents of disclosed information and the methods of disclosure are still limited. Untimely and education-oriented have been the features of most disclosed information. The use of the Internet is rather low. Using the HRB as an example, only when information such as the environmental monitoring data, pollutants discharge data, government inspection data, government law enforcement results have all been disclosed, will true public participation become possible. Particularly, information regarding the enterprises' behavior concerning the environment is not disclosed, leaving public participation and enterprises' environmental behavior monitoring on paper.

5 The fundamental cause for those issues is the lack of a set of sound institutions to clarify the subjects, methods, procedures, and contents of information disclosure.

(2) "End-of-pipe" and passive public participation

6 Using the public participation in Environmental Impact Assessment as an example, "public participation" takes place as the distribution of survey tables to the public by the constructers of development projects and collection of the responses afterwards. The public usually do not have much knowledge of the construction project prior to the survey; their knowledge will likely remain limited even during the survey. The effects of the public participation will almost for certain be limited as well. The public participation in real life tends to be the post participation posterior to the environmental pollution and ecological destruction. The public are often called to participate in the environmental affairs after the pollution and ecological damages have occurred, and the public interests have been infringed. The participation in the environmental legislation, policy-making, planning, and program preparation is almost absent.

(3) Lack of practicality of public participation principles

7 Specifications on public participation in China's environmental protection laws and regulations often have a flavor of advocacy. The principles do not specify the procedures,

methods, time, rights and obligations of public participation, leaving its implementation to the mercy of the real life. The impractical legislations forms little binding force and provides little guiding to the public participation in practice. Till this moment, the state has not issued authoritative, detailed, and practical complementary technical specifications on public participation.

8 Within the entire Chinese legal system, articles regarding public participation could hardly be found. The mechanism for public participation in democratic decision-making and state administration is still lacking. The laws also have not clearly defined the legal status of the citizen and civil societies, nor the incentive mechanism of broad public participation or the legislative aid system for intrusion to the right to participate.

(4) Public lack of awareness and concept of public participation

9 This TA project would like to reflect the public opinion in the study results. The project team has designed questionnaires on the environmental economics and investment, institutions and policy, legal cases, and comprehensive watershed water pollution control and prevention policies and investment for the HRB and TLB. The questionnaires have been distributed to the stakeholders during on-site surveys. However, the project team discovered that a NIMBY (Not In My BackYard) attitude has dominated among the concerned organizations and individuals: This is not my business; I am not obliged to respond. The questionnaires have experienced an extremely low response rate (Table 11.2-1). The extremely low response rate indicates a number of problems:

Table 11.2-1 Questionnaire Survey of Water Pollution Control Environmental Policies and Investment Evaluation in the HRB and TLB

Questionnaire	# of distributed	Reply collected	Rate of reply (%)
Comprehensive questionnaire for evaluation of environmental policy and investment for water pollution control in the HRB and TLB	80	7	9
Investment and operation of the WWTPs	10	1	10
Enterprise pollution control survey questionnaire	7	1	14
Policy and institution survey questionnaire	65	32	49
Administrative effectiveness of the water pollution dispute	40	0	0
Judicial effectiveness of the resolving of the civil pollution cases judged by people's court	10	0	0
Judicial validity of the resolving of the environmental resource destroy cases transacted by people's court and procuratorate	10	0	0
Total	222	41	18

10 Most of the public have taken public participation as participation by individuals. In fact, public participation – in theory and in practice – involves the participation by all stakeholders. The stakeholders could be individuals, civil societies, enterprises, institutes, and even local governments. Before the law, all stakeholder groups are equal. Provided that the participant has certain stakes – interests and benefits – related to the discussed matter, the participant is a stakeholder, and to protect his/her/its own rights and interests and express his/her/its opinions the stakeholder can and should voice his/her/its opinion.

11 The public awareness of participation is low. Often the public considers the questionnaire

filling as a "pro-bono" service provided to the favor of the project team, which is not obliged or useful for the surveyed. This lukewarm attitude toward public participation, nevertheless, is a tragic consequence of lukewarm tradition of public participation in China. The infrequent public participation incidents whose fate seldom escapes "a case of mere formality" have disseminated the public confidence level in participation.

12 On the other hand, the low public environmental protection awareness topped with the lack of environmental knowledge is another important cause of low public participation.

13 In general, the following causes have led to the issues with the public participation in the HRB: (1) The "tradition" of economic development tends to under-evaluate environmental protection. In particular, the GDP-oriented cadre performance evaluation system creates incentives for the government officials to skew toward economic development and downplay environmental protection. (2) Practical legislative support for public participation is still missing. (3) High costs persist for information acquisition and participation. To resolve those issues, not only the environmental legislation need to be perfected, but also a sound supporting base has to be established from China's legal system. The true question is not that if the public could participate, but rather if the public could participate effectively, and how the procedures and methods of public participation could be improved.

Volume III

REVIEW AND EVALUATION OF THE TAI LAKE BASIN

Table of Contents

1. TLB Natural and Social Background 1
 1.1 Natural Conditions 1
  1.1.1 Climate 1
  1.1.2 Vegetation 2
 1.2 Socio-Economic Background 2
  1.2.1 Industries 4
  1.2.2 Agriculture 4
  1.2.3 Urbanization 4
2. TLB Overall Evaluation during the 9th and the 10th FYPs 5
 2.1 Water Quality Objectives 5
  2.1.1 Water Quality Review against 9th FYP Objectives 5
  2.1.2 Water Quality Review against 10th FYP Objectives 6
  2.1.3 9th and 10th FYPs TLB Water Quality Changes 7
  2.1.4 Pollutants Distribution 9
 2.2 TML Control and its Reduction Objectives 10
  2.2.1 During the 9th FYP 10
  2.2.2 During the 10th FYP 10
 2.3 Investment in Pollution Control Programs 12
  2.3.1 During the 9th FYP 12
  2.3.2 During the 10th FYP 13
3. Indicator System 16
 3.1 Of the 9th FYP 16
  3.1.1 9th FYP Indicator System 16
  3.1.2 Analysis of the 9th FYP Indicators 16
 3.2 Of the 10th FYP 16
  3.2.1 10th FYP Indicators 16
  3.2.2 Analysis of the 10th FYP Indicators 16
4. Sources of and Factors Impacting Pollutants Discharge 18
 4.1 Sources of Pollutants Discharge 18
  4.1.1 Industrial Point Sources 18
   4.1.1.1 During the 9th FYP 18
   4.1.1.2 During the 10th FYP 18
  4.1.2 Urban Domestic Wastewater Discharge 19
   4.1.2.1 During the 9th FYP 19
   4.1.2.2 During the 10th FYP 19

4.1.3 Agricultural Non-Point Sources 20
4.1.3.1 Non-Point Sources and Pollution Pathways in the TLB 20
4.1.3.2 Production of Non-Point Source Pollution and Amounts Discharged into the Environment 21
4.1.3.3 Non-Point Source Contribution to the HRB Water Pollution 27
4.2 Factors Impacting Sources of Pollution 27
4.2.1 Development Level 27
4.2.2 Economic Growth 28
4.2.2.1 Growth during the 9th FYP 28
4.2.2.2 Growth during the 10th FYP 29
4.2.3 Factors Impacting Industrial Point Source Discharge 30
4.2.3.1 Discharge (Non-)Compliance 30
4.2.3.2 WWTPs of Enterprises 31
4.2.4 Factors Impacting Urban Domestic Wastewater Discharge 33
4.2.4.1 Municipal WWTP Construction 33
4.2.4.2 Rapid Urban Population Growth and Urbanization 34
4.2.4.3 Improper Operation of WWTPs 36
4.2.4.4 Capacity, Effectiveness and Efficiency of Municipal WWTPs 39
4.2.5 Factors Impacting Non-Point Source Discharge 40
5. Water Resource Review and Evaluation 44
5.1 Water Resource and its Impact on Water Environment 44
5.1.1 Change of the Water Resources 44
5.1.2 Watershed Water Usage Variations 45
5.1.3 Impact from Water Quantity Change on Water Quality 46
5.2 Impact of Hydraulic Facilities on Water Environment 48
5.2.1 Hydraulic Facilities 48
5.2.2 Features of Hydraulic Facilities 49
5.2.3 Impacts from Hydraulic Operations 50
6. Legal Review and Evaluation 54
6.1 Laws 54
6.1.1 Basic Legislative Framework of China's Transjurisdictional Water Environment Management and Disputes Resolution 54
6.1.2 On China's Legislation on Transjurisdictional Water Environment Management 60
6.2 Standard System 64
6.2.1 Overview of Standards 64
6.2.2 Environmental Quality Standards 65
6.2.3 Pollutants Discharge Standards 66
6.3 Judicial System 68
6.3.1 Judicial Institutions and Dispute Resolution Mechanism 68
6.3.1.1 Overview 68
6.3.1.2 Alternative Dispute Resolution (ADR) 69
6.3.1.3 Litigation 73
6.3.2 Causes for Transjurisdictional Disputes 77

6.3.3 Measures to Settle Transboundary Environmental Cases 79
6.3.4 Case Studies of the TLB Water Pollution Litigations 81
7. Policy Review and Evaluation 87
7.1 Environmental Policies 87
7.1.2 Implementation 89
7.2 Regional Development Policy 91
7.3 Industrial Development Policy 92
7.4 Finance Policy 94
7.5 Technical Policy 97
8. Institutional Review and Evaluation 99
8.1 Institutional Settings and Responsibilities 99
8.2 Water Environmental Managerial and Organizational Functions 102
8.3 Watershed Management Institutions 104
9. Investment and Financing 106
9.1 Key Issues 106
9.2 Funding Sources 106
9.3 Fund utilization 107
9.4 Investment Benefit 108
9.5 Economic Measures 111
9.5.1 Preferential Policy 111
9.5.2 Pollutants Discharge Fee 112
9.6 Sustainability Evaluation 112
10. Management Review and Evaluation 115
10.1 Environmental Management Settings 115
10.1.1 Environmental Impact Assessment and the "Three Synchronousness" 115
10. Management Review and Evaluation 115
10.1 Environmental Management Settings 115
10.1.1 Environmental Impact Assessment and the "Three Synchronousness" 115
10.1.2 TMLL 116
10.1.3 Permitting System 117
10.1.4 Other Management Systems 117
10.2 Monitoring System 119
10.2.1 Monitoring System of Water Environment 119
10.2.2 Reporting System of the Water Environment Monitoring Data 124
10.2.3 Installation of the Monitoring System 125
10.3 Small Watershed Pollution Control Plan 125
11. Public Participation 127
11.1 Forms of Public Participation 127
11.2 Effects and Issues of Public Participation 128

1. TLB Natural and Social Background

1.1 Natural Conditions

Figure 1.1-1 Administrative Map of TLB

1 A total of 36900 km^2, the TLB is separated into plain and hilly and mountainous areas roughly by the Danyang–Liyang–Yixing–Huzhou–Hangzhou line. To the east of the line lies the Tai Lake Plains, the major part of the basin that accounts for 80% of the total area. Within the Tai Lake Plains, Shanghai occupies 12% in terms of area, Jiangsu 44%, and Zhejiang 24%. To the west of the line are hills and mountains, which take up the rest 20% of the TLB. Among the 20%, Zhejiang occupies 13%, and Jiangsu takes up 7%.

1.1.1 Climate

1 The TLB is subject to subtropical monsoon climate that is made of cold, dry winters characterized by continental cold masses and prevailing north winds and hot, humid summers dominated by marine air masses and prevailing southeast wind. With distinctive seasons, plenty precipitation and warmth, the annual average temperature is the area ranges from 14.9-16.2℃ with a gradual increase from north to south.

2 Danyang in the far north records the minimum 14.9℃, while Hangzhou in the south has the maximum 16.2℃. In the basin, the yearly average hours of sunshine are 1870-2225 hours, the northeast enjoying more than the southwest. For example, Baoshan of Shanghai by the

mouth of Yangtze River enjoys 2225 hours of sunshine; in contrast, Deqing (1774 hours) and Changxing (1870 hours) in the southwest have the least hours of sunshine.

1.1.2 Vegetation

1 TLB extends across the northern subtropical and mid-subtropical belts, and has a long history of agricultural development. The vast plains are dominated by cultivated vegetation. Most of the existing natural vegetation on hills and mountains is secondary, although there is still a clear strip of distribution patterns.

2 Natural vegetation: from north to south, the temperature in the TLB gets higher, precipitation increases, and the vegetation composition becomes complex. Typically deciduous and evergreen broad-leaved mixed forest dominates the north subtropical strip at the north of *Yijian* and *Liyang*. South of this line lies the ever-green broad-leaved forest in the mid-subtropical strip.

3 Due to the dominance of secondary vegetation and vertical distribution of the plant communities, cross-strip distribution with deciduous broad-leaved forest, deciduous and evergreen broad-leaved mixed forest is common.

4 Cultivated Vegetation:

- Crops: Grain is the major crop. Economic crops like cotton and oil plants follow. Cotton is relatively concentrated in the area along rivers and sea; oil plants are mainly the widely distributed cole. A variety of vegetables have been mostly cultivated on the city outskirts. Two harvests per year of wheat (cole) and rice take up a considerable proportion on the high-lying *Danyang* and *Jintan* Plains. *Shazhou*, *Changshu*, the area along the River in *Taicang*, area around the Hangzhou Bay, and parts of the costal area of Tai Lake practice two harvests per year of wheat (cole or horsebean) and dry crops (cotton). Other parts of the vast plain practice two harvests per year of wheat (cole) or rice, as well as three harvests (of various crops). There is also a rotation of rice and cotton in Songjiang, Qingpu and Jinshan.

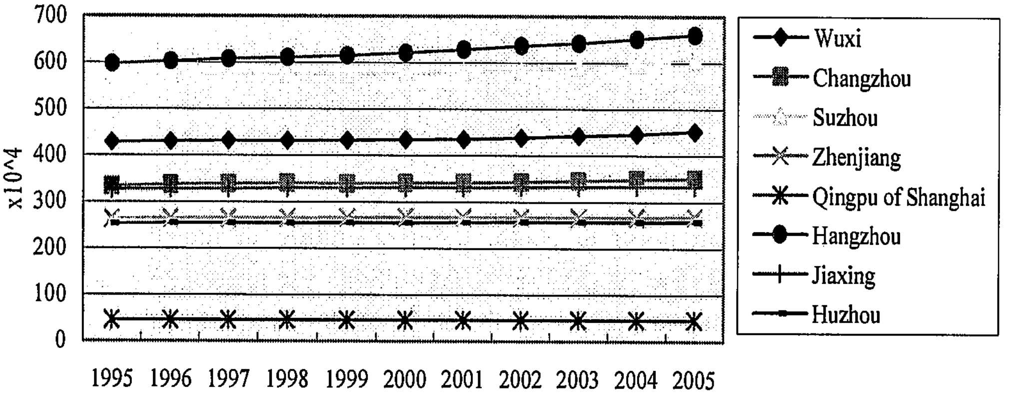
- Non-timber products forests: Orchards with subtropical evergreen fruit trees such as oranges, loquats and waxberries have spotted the lakeside hills of Tai Lake and parts of the *Tianmu* Mountainous area with favorable climate. Peach and pear orchards have distributed widely. Chinese chestnuts can be found in *Yixing, Liyang, Changxing* and *Anji*.

1.2 Socio-Economic Background

1 The TLB encompasses the Jiangsu, Zhejiang, Anhui provinces and Shanghai municipality. It is one of the most economically dynamic and populous areas in China. With its high population density and relative advanced economic development, its rate of industrialization and urbanization is among the highest in China. In 2005, the TLB population reached 2977.27×10^4. Although the TLB counts only 0.4% of China's total landmass, but its 2005 GDP counts 7.7% of the national total.

2 During the 9th and 10th FYPs, population and GDP changes in the TLB are exhibited in Figure 1.2-1and 1.2-2.

Figure 1.2-1 Population Change in TLB (1995-2005)

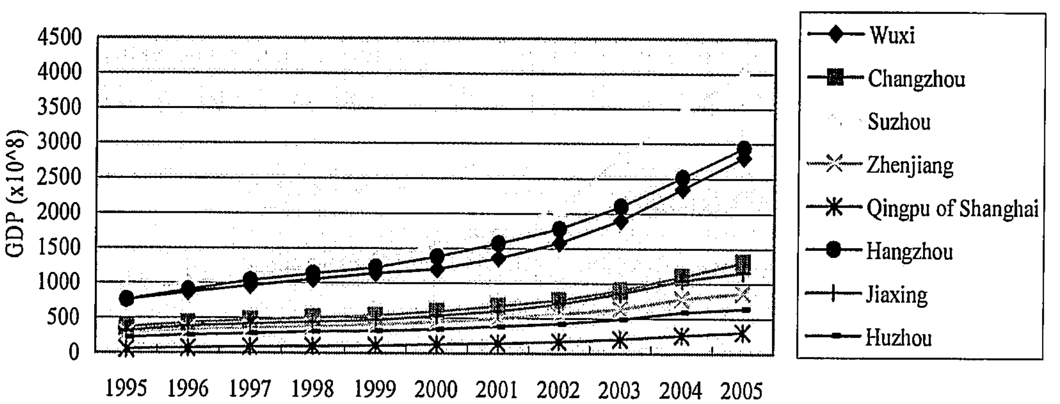


Data Source(s): Wuxi Statistics Yearbook 1996-2006, Changzhou Statistics Yearbook 1996-2006, Suzhou Statistics Yearbook 1996-2006, Zhenjiang Statistics Yearbook 1996-2006, Shanghai Statistics Yearbook 1996-2006, Qingpu District of Shanghai Statistics Yearbook 1996-2006, Hangzhou Statistics Yearbook 1996-2006, Jiaxing Statistics Yearbook 1996-2006, Huzhou Statistics Yearbook 1996-2006

Table 1.2-1 Population of the TLB during1995-2005
Unit: ×10^4 person

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Wuxi	429.19	430.82	432.29	432.21	433.4	434.61	435.9	438.58	442.54	447.19	452.84
Changzhou	333.65	337.54	339.23	340.75	339.71	341.48	341.52	343.24	346.22	348.96	351.63
Suzhou	572.91	574.12	574.99	575.35	576.23	578.17	580.53	583.86	590.97	598.85	607.31
Zhenjiang	263.27	264.8	265.41	265.64	266.17	266.67	266.58	267.13	267.19	267.21	267.61
Shanghai Qingpu	45.78	45.69	45.62	45.55	45.49	45.89	45.68	45.95	45.83	45.57	45.52
Hangzhou	597.96	603.22	607.96	611.64	616.05	621.58	629.14	636.81	642.78	651.68	660.45
Jiaxing	326.39	328.06	329.29	329.91	330.19	331.26	331.93	332.38	332.96	333.94	334.33
Huzhou	252.63	254.56	254.58	254.81	255.07	255.79	256.49	257.05	256.78	257.21	257.58

Figure 1.2-2 GDP Change in TLB (1995-2005)



Data Source(s): Wuxi Statistics Yearbook 1996-2006, Changzhou Statistics Yearbook 1996-2006, Suzhou Statistics Yearbook 1996-2006, Zhenjiang Statistics Yearbook 1996-2006, Shanghai Statistics Yearbook 1996-2006, Qingpu District of Shanghai Statistics Yearbook 1996-2006, Hangzhou Statistics Yearbook 1996-2006, Jiaxing Statistics Yearbook 1996-2006, Huzhou Statistics Yearbook 1996-2006

Table 1.2-2 GDP in the TLB during 1995-2005

Unit: 10^8 yuan

Region	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Wuxi	761.1	870.0	960.0	1052.0	1138.0	1200.2	1360.1	1580.7	1901.2	2350.0	2804.7
Changzhou	369.7	431.2	470.1	504.6	538.7	600.7	672.9	760.6	901.4	1100.6	1303.4
Suzhou	903.1	1002.1	1132.6	1250.0	1358.4	1540.7	1760.3	2080.4	2801.6	3450.0	4026.5
Zhenjiang	285.9	335.1	360.5	390.6	416.5	452.0	502.7	560.9	641.1	781.2	871.7
Shanghai Qingpu	55.0	72.5	90.3	96.6	109.3	125.4	144.3	168.7	207.1	258.9	306.2
Hangzhou	762.0	906.6	1036.3	1134.9	1225.3	1382.6	1568.0	1781.8	2099.8	2515.0	2942.7
Jiaxing	315.3	381.7	419.8	443.5	472.2	538.4	604.3	706.4	858.0	1050.6	1159.7
Huzhou	221.3	257.7	281.9	305.4	315.3	343.4	385.0	422.5	490.8	590.7	644.3

1.2.1 Industries

1 The TLB, as one of China's largest comprehensive industrial bases, has a solid foundation for industrial production, technology and equipment. Various economic development zones and high-tech development zones, through industrializing and transforming advanced technologies, absorb foreign investments and acquire introduced advanced technologies. Now the TLB has already established its own industrial product development and design capacity and market adaptability.

2 Economic development levels vary within the watershed. In 2005 the industrial production of Suzhou, Wuxi and Hangzhou have reached 9908.58×10^8 yuan, 5718.00×10^8 yuan, and 5441.13×10^8 yuan respectively. In terms of industrial sectors, the electronics, machinery, chemical, metallurgies, textile and food processing have become the six major sectors in the TLB.

1.2.2 Agriculture

1 The TLB presents plenty of water, sunlight, and thermal resources, favorable natural conditions for agriculture, forestry, husbandry, and fishery development. Its major crops include rice, wheat and other economic crops. The entire watershed houses 2266×10^4 mu farmland, 1.8% of the national total, among which 1856×10^4 mu are paddy field, and the rest 410×10^4 mu are dry fields. Its cropping index reaches 200%, much higher than the national average. Agricultural productivity per ha is more than double of the national average. Its crop harvest is 37% higher than the national average.

1.2.3 Urbanization

1 The TLB encompasses part of the metropolis of Shanghai, 4 prefecture-level cities of Jiangsu Province (Suzhou, Wuxi, Changzhou, and Zhenjiang), 3 prefecture-level cities of Zhejiang Province (Hangzhou, Jiaxing, and Huzhou), and 30 county-level cities. The TLB thus encompasses one mega-city of population above 500×10^4, one super-city of population between $100\text{-}500\times10^4$, 3 large cities of population between $50\text{-}100\times10^4$, and 9 cities of population between $20\text{-}50\times10^4$. Together with the urbanization, the population continuously migrate from rural or urban areas with an ever accelerating pace in the TLB.

2. TLB Overall Evaluation during the 9th and the 10th FYPs

2.1 Water Quality Objectives

2.1.1 Water Quality Review against 9th FYP Objectives

1 The 9th FYP has set clear and concrete Tai Lake water quality objectives. The 2000 Tai Lake water quality objectives are shown the table below.

Table 2.1.1-1 Target of Water Quality of the Tai Lake in 2000

Lake area	COD_{Mn} (mg/L)	TP (mg/L)	TN (mg/L)	TLIc
Wuli Lake	5.0 (Class III)	0.08 (Class V)	2.5 (Class V)	65
Meiliang Lake	4.0 (Class II)	0.08 (Class V)	2.0 (Class V)	65
West area	4.0 (Class II)	0.05 (Class V)	1.4 (Class V)	60
Center and east area	3.0 (Class II)	0.05 (Class V)	0.8 (Class V)	60
Tai Lake average	3.2 (Class II)	0.05 (Class V)	1.0 (Class V)	60

2 The major environmental problem in the eutrophication throughout the lake and localized organic pollution. The figure below illustrates with the 1994-1995 monitoring data. Between 1994 and 1995, 5% of the water in TLB belonged to Class V, 10% to Class IV, 70% to Class III, 15% to Class II. In terms of eutrophication, 1995 saw the fastest eutrophication in the TLB. The lake-wide overall yearly average TN and TP reached 17.5 and 6.6 times of the density that nitrification would require, indicating a much worse situation compared to 1994.

Figure 2.1.1-1 TLB Section Water Quality in 1995

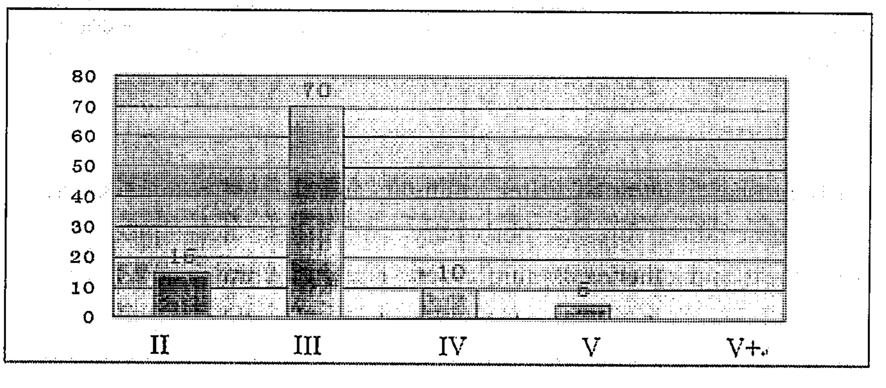


Table 2.1.1-2 Water Quality of the Monitoring Positions in the Tai Lake (2000 average)

No.	Monitoring position	COD_{Mn} Class	NH_3-N Class	TP Class	No.	Monitoring position	COD_{Mn} Class	NH_3-N Class	TP Class
H1	Tuoshan	III	I	Worse than V	H11	Dapukou	III	IV	Worse than V
H2	Jiaoshan	III	I	Worse than V	H12	Xintangxiang	III	I	Worse than V
H3	Wuguishan	III	I	Worse than V	H13	Xiaomeikou	III	I	Worse than V
H4	Manshan	III	I	Worse	H14	Xingangkou	III	I	Worse

No.	Monitoring position	COD_{Mn} Class	NH_3-N Class	TP Class	No.	Monitoring position	COD_{Mn} Class	NH_3-N Class	TP Class
				than V					than V
H5	Pingtaishan	III	I	Worse than V	H15	Shatangxiang	IV	V	Worse than V
H6	No.4 pharos	III	I	Worse than V	H16	Center of Wuli lake	IV	Worse than V	Worse than V
H7	Zeshan	III	I	Worse than V	H17	Shadunxiang	III	I	Worse than V
H8	Daleishan	III	I	Worse than V	H18	xukou	III	I	Worse than V
H9	Lvjiangkou	IV	Worse than V	Worse than V	H19	Dushankou	III	Worse than V	Worse than V
H10	Baidukou	III	V	Worse than V	H20	Zhongqiao water plant	III	I	IV

3 Comparison between the above two tables reveals that the TLB has basically fulfilled the planned COD water quality classification objectives, but the TP indicator has fallen far behind from the objectives.

2.1.2 Water Quality Review against 10th FYP Objectives

1 The TLB 10th FYP required that the Tai Lake water quality improve, and the water quality in the Wuli and Meilinag lakes significantly improve. Specifically the Tai Lake water pollution prevention and control objectives are with 80% of the water quantity guaranteed during even water years, by the end of 2005, the COD_{Mn} density reach 5.0-7.5mg/L, and TP density reach 0.1-0.2 mg/L at the Tai Lake water body; COD_{Mn} reach the surface water Class III water quality standard, and TP indicator should reach the water quality standard for surface water Class IV or V at major connected rivers and lakes and the bordering sections; water sections with water quality superior to the above-stated standard must not lower their water quality; and a reduction of 10%-25% of total discharge of major water pollutants based on the 2000 level.

2 The 10th FYP has set the concrete water quality objectives of the TLB (Table 2.1.2-1).

Table 2.1.2-1 Tai Lake Water Quality Target (2005)

Water area	Targets 2005			
	CODMn(mg/L)	TP(mg/L)	TN(mg/L)	TLIc
Wuli lake	7.5 (Class III)	0.18 (Worse than Class V)	6 (Worse than Class V)	65
Meiliang lake	7.5 Class(III)	0.2 (Worse than Class V)	5 (Worse than Class V)	65
West area	7 (Class III)	0.15 (Worse than Class V)	2.8 (Worse than Class V)	60
Center area	5 (Class III)	0.1 (Class V)	1.5 (Worse than Class V)	<60
East area	5 (Class III)	0.1 (Class V)	2.2 (Worse than Class V)	55

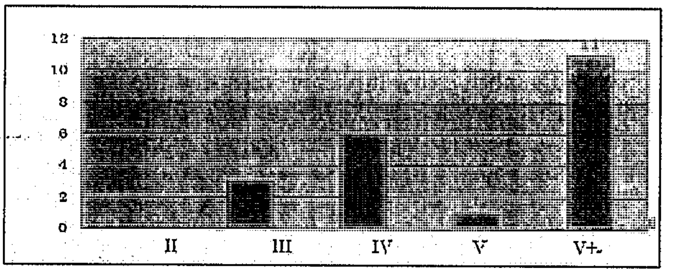
Note: Just for reference.

3 The 2004 monitoring data indicates that the TLB has a total of 109 state-controlled monitoring sections with monitoring data, 88 sections located at the major rivers of the watershed, 21 sections in the Tai Lake.

4 During the 2004 dry water season, 17 (19.3%) of the 88 river sections fulfilled their functional requirements; 71 (80.7%) did not. Worse than Class V water quality sections totaled 44 (50%); Class V water quality sections 17 (19.3%); Class IV water quality sections 19 (21.6%); and Class III water quality sections 8 (9.1%) with major non-compliance indicators of TN and COD.

5 Among the 21 lake sections, 1 (4.8%) has fulfilled its functional requirements; 20 (95.2%) did not. Worse than Class V water quality sections totaled 11 (52.4%); Class V water quality sections 1 (4.8%); Class IV water quality sections 6 (28.6%); and Class III water quality sections totaled 3 (14.3%) with major non-compliance indicators TN and COD. The figure below shows the section.

Figure 2.1.2-1 Water Quality of TLB Sections in 2004



6 The monitoring data suggests compliance of COD, TP, and TN except the TN of Wuli Lake, Meiliang Lake, the river bank areas in the west, and Lake District; nevertheless, those 4 districts have a large number of sections.

2.1.3 9th and 10th FYPs TLB Water Quality Changes

1 Table 2.1.3-1 shows the water quality changes of the Tai Lake from 1980 to1994; Table 2.1.3-2 exhibits the water quality changes of the Tai Lake from 1995 to 2004; Table 2.1.3-3 presents the water quality changes of the TLB water bodies from 1995 to 2004; and Figure 2.1.3-1 summarizes the percentage change of the Tai Lake water quality classes between 1980 and 2004.

Table 2.1.3-1 Water Quality of the Tai Lake (1980-1994)

Year	Class I water area (%)	Class II water area (%)	Class III water area (%)	Class IV water area (%)	Class V water area (%)	Worse than Class V water area (%)
1980/81	0.0	69.0	30.0	1.0	0.0	0.0
1987/88	0.0	59.4	36.6	3.2	0.8	0.0
1993/94	0.0	15.0	70.0	14.0	1.0	0.0

Data Source(s): Tai Lake water pollution control and prevention 9th FYP.

Table 2.1.3-2 Water Quality of the Tai Lake (1995-2004)

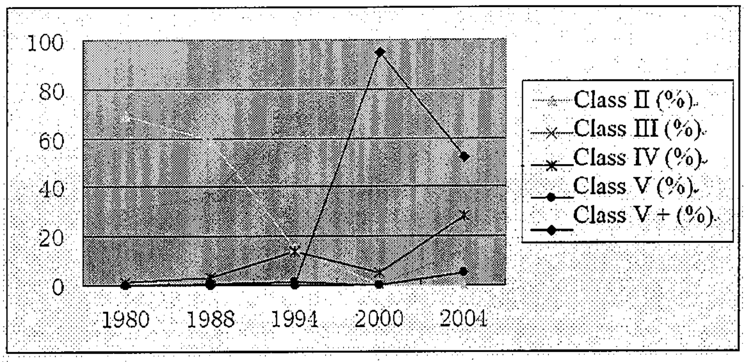
Year	Class I water area (%)	Class II water area (%)	Class III water area (%)	Class IV water area (%)	Class V water area (%)	Worse than Class V water area (%)
1994	0.0	15.0	70.0	14.0	1.0	0.0
2000	0.0	0.0	0.0	5.0	0.0	95.0
2004	0.0	0.0	14.2	28.6	4.8	52.4

Table 2.1.3-3 Water Quality of the Water Bodies in TLB (1995-2004)

Year	Class I water area (%)	Class II water area (%)	Class III water area (%)	Class IV water area (%)	Class V water area (%)	Worse than Class V water area (%)
1995	0	15	70	10	5	0
2000	0	0	0	13	6	81
2004	0	0	10	23	17	50

Note: The data of 2000 come from the monitoring results in Tai Lake water pollution control and prevention 9th FYP, which include 20 sections in the lake, 28 sections in the rivers to the lake and 50 sections of the boundaries that rivers pass.

Figure 2.1.3-1 Proportional Changes of Tai Lake Water Quality Classes 1980-2004



2 The above tables and figures indicate that the water quality of the Tai Lake in the decade prior to the 9th FYP had been satisfactory; nevertheless, starting in 1988, the water quality quickly deteriorated. It will be fair to say the water quality of both the Lake and the watershed water bodies has been deteriorating throughout the 2 FYPs. The 9th FYP, in particular, saw a dramatic deterioration of the lake water quality – proportions of Class II and III water bodies quickly diminished; proportions of Class IV and V water bodies, nevertheless, increased. Water bodies of quality class "Worse than V" have experienced the most dramatic surge. Although the water quality has been partially restored during the 10th FYP, severe pollution still persists, the water quality is still inferior to that of the beginning of the 9th FYP, let alone the quality prior to the 9th FYP.

3 The annual changes of the major pollution indicators suggest that in the past decade the COD_{Mn}, TP and TN levels in the Tai Lake are relatively stable. Year 2000 experienced high pollutants densities due to reduced water quantity in the lake. Year 2000 through 2004 exhibit a trend of decrease of the pollutants except the TN.

Figure 2.1.3-2 Annual Variations of COD_{Mn} and TP in TLB (1995-2004)

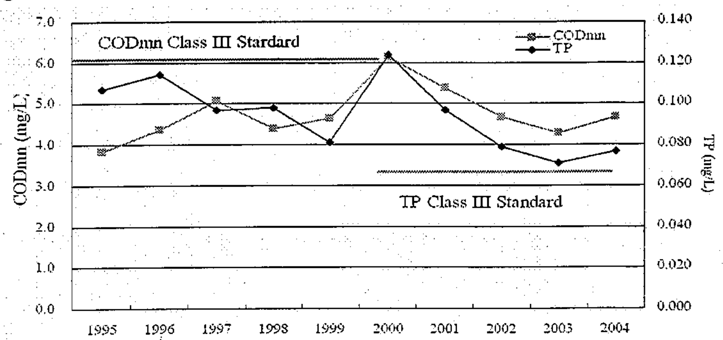
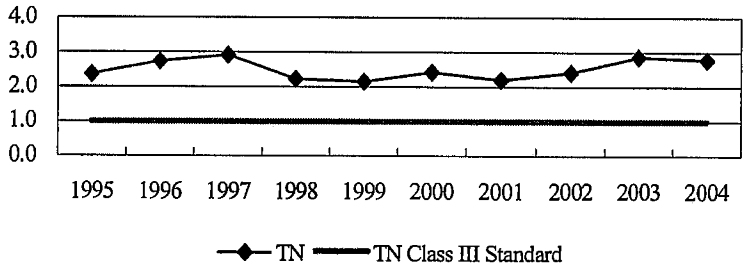


Figure 2.1.3-3 TN Annual Variations in TLB (1995=2004) (mg/L)



2.1.4 Pollutants Distribution

1 The pollution and pollutants in the TLB rivers and lakes are organic in nature. The major non-compliance water quality indicators have persistently been COD_{Mn}, NH_3-N, et al. An overwhelming amount of nutrients (pollutants containing N and P) flush into the Tai Lake and directly causes eutrophication. Current, the biggest source for water supply in the TLB, the Tai Lake, is suffering from severe eutrophication. The Tai Lake blue algae boom during the 2000 summer has returned the peak value of algae density at 2.1×10^8/L. Table 2.1.4-1 exhibits the conditions of the Tai Lake water body in 2000. No data is available for other years.

Table 2.1.4-1 Water Quality of Tai Lake (2000)

Water area	CODMn (mg/L)	TP (mg/L)	TN (mg/L)	TLIc
Wuli lake	8.1	0.2	6.6	64.8
Meiliangwan	7.8	0.26	5.6	55.9
West area	7	0.17	3.1	55.7
Center area	5.5	0.1	1.6	55.9
East area	5.9	0.11	2.4	54.5

Table 2.1.4-2 Water Quality Comparison in Meiliangwan Tai Lake from December 1998 to December 2000 (mg/L)

Year	Total abio-nitrogen	TN	Total abio-phosphorus	TP	COD	Chlorophyla
1998	1.18	1.892	0.002	0.0714	4.27	10.829
1999	1.241	2.654	0.002	0.26	5.267	11.097
2000	1.156	1.99	0.006	0.038	4.1	7.21

2 Moreover, the water quality problem of the rivers flowing to the Tai Lake surrounding the Tai Lake is more severe than the lake itself. Table 2.1.4-3 shows the monitoring data from the 35 monitoring sections at the inflow rivers in 2000. The data suggests that 80% of the year-round water quality at the monitoring sections have been Class IV or worse.

Table 2.1.4-3 Water Quality Assessment to the Rivers of TLB in 2000

Period	Class II		Class III		Class IV		Class V		Worse than Class V	
	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)
Low water season	4	0.2	329	20.6	363	22.7	505	31.6	397	24.9
High water season	21	1.3	260	16.3	513	32.1	465	29.1	339	21.2
Entire year	12	0.7	299	18.7	434	27.2	484	30.3	369	23.1

2.2 TML Control and its Reduction Objectives

2.2.1 During the 9th FYP

1 The 9th FYP has required that by 2000 the water quality of centralized drinking water source area and major inflow and outflow rivers reach surface water standard Class III. The 9th FYP has also articulated the Tai Lake region pollutants TMLL: TP 4112 ton/year, TN 199021 ton/year, COD 199097 ton/year, where Jiangsu Province maximum allowed pollutants discharge: TP 3255 ton/year, TN 12671 ton/year, COD 121866 ton/year; Zhejiang Province pollutants TMLL: TP 7645 at ton/year, TN at 3169 ton/year, COD at 53,636 ton/year. The table below shows the actual discharge of Jiangsu and Zhejiang provinces (the 9th FYP does not include Shanghai).

Table 2.2.1-1 COD TML Control in TLB in the 9th FYP

Index	Target of Jiangsu province	Jiangsu province discharged in 2000	Non-compliance rate	Target of Zhejiang province	Zhejiang province discharged in 2000	Non-compliance rate
TP (ton/year)	3255	7200	121.2%	764	7200	842.4%
TN (ton/year)	12671	63000	397.2%	3169	66000	1982.7%
COD_{cr} (ton/year)	121866	282000	131.4%	53636	209000	289.7%

Note: 1. The 10th FYP has substituted TN with NH_3-N.

2 The table above indicates that Jiangsu and Zhejiang provinces did not meet the targets of TMLL of the 9th FYP. Two major reasons for the drastically gap between the actual and the planned rates: (1) slack program implementation, and (2) the newly added non-point source data in 2000 widening the gap.

2.2.2 During the 10th FYP

1 the 10th FYP has set targets of pollutants TMLL in the Tai Lake area: 37.81×10^4 ton/year for COD, a 23% reduction from the 2000 level of 49.15×10^4 ton; 1.24×10^4 ton/year for TP, a 14% reduction from the 2000 level of 1.44×10^4 ton; 9.91×10^4 ton/year for NH_3-N, a 24% reduction from the 2000 level of 13×10^4 ton.

Table 2.2.2-1 Target of the TMLL and the Pollutants Discharge Reduction Rate in the TLB

Unit: $\times10^4$ ton/year

Region		10th FYP targets			10th FYP reduction rate		
		COD	TP	NH3-N	COD	TP	NH3-N
Jiangsu	Wuxi	8.00	0.17	0.71	26	11	26
	Changzhou	4.73	0.16	1.55	29	16	25
	Suzhou	6.48	0.24	2.13	25	17	22
	Zhenjiang	1.95	0.04	0.41	5	20	29
	Total	21.16	0.61	4.81	25	15	24
Zhejiang	Hangzhou	3.77	0.11	0.82	18	15	26
	Huzhou	6.03	0.20	1.81	18	13	23
	Jiaxing	6.85	0.32	2.47	24	12	22
	Total	16.65	0.63	5.10	20	13	23
Grand total		37.81	1.24	9.91	23	14	24

2 Table 2.2.2-2 tabulates the 2005 TLB major urban COD discharge from the survey results.

Table 2.2.2-2 COD Discharge of the Urban Areas in the TLB (2005)

Unit: $\times10^4$ ton

Region	Industrial COD discharge	Domestic COD discharge	Total COD discharge	COD discharge targets of the 10th FYP	COD discharge non-compliance rate
Shanghai Qingpu	0.0454	0.5524	0.5978	--	--
Total of Jiangsu province	5.3766	9.1401	14.5167	16.43	-11.65%
Wuxi	1.8269	2.7770	4.6039	8.00	-42.45%
Suzhou	3.5488	5.7367	9.2855	6.48	43.29%
Zhenjiang	0.0009	0.6264	0.6273	1.95	-67.83%
Total of Zhejiang province	2.4986	4.0029	6.5015	16.65	-60.95%
Hangzhou	1.2358	0.6988	1.9346	3.77	-48.68%
Jiaxing	0.7423	1.8280	2.5703	6.85	-62.48%
Huzhou	0.5205	1.4761	1.9966	6.03	-66.89%
Total	7.9206	13.6954	21.6160	--	--

Note: The data do not include Changzhou City.

Sources: CNEMC and the 10th FYP.

3 The TLB COD discharge totaled 21.62×10^4 ton, where Shanghai Qingpu District contributed 0.6×10^4 ton, Jiangsu contributed 14.52×10^4 ton, and Zhejiang contributed 6.50×10^4 ton. All areas achieved the 10th FYP COD discharge targets of TMLL except Suzhou.

4 Table 2.2.2-3 tabulates the 2005 TLB major urban NH_3-N discharge from the survey results.

Table 2.2.2-3 NH_3-N Discharge of the Urban Areas in TLB (2005)

Unit: $\times10^4$ ton

Region	Industrial NH3-N discharge	Domestic NH3-N discharge	Total NH3-N	NH3-N discharge targets of the 10th FYP	NH3-N discharge non-compliance rate
Shanghai Qingpu	0.0032	0.0393	0.0425	-	-
Jiangsu province	0.6111	0.7041	1.3152	3.25	-60%
Wuxi	0.1247	0.2073	0.332	0.71	-53%
Suzhou	0.4863	0.4543	0.9406	2.13	-56%
Zhenjiang	0.0001	0.0425	0.0426	0.41	-90%
Zhejiang	0.2065	0.4237	0.6302	5.1	-88%
Hangzhou	0.0231	0.0627	0.0858	0.82	-90%
Jiaxing	0.0579	0.1952	0.2531	2.47	-90%
Huzhou	0.1254	0.1658	0.2912	1.81	-84%
Total	0.8208	1.1671	1.9879	-	-

Sources: CNEMC

5 The TLB NH_3-N discharge totaled 1.99×10^4 ton, where Shanghai contributed 0.04×10^4 ton, Jiangsu contributed 1.32×10^4 ton, and Zhejiang contributed 0.63×10^4 ton. Although the domestic NH_3-N discharge of all areas have evidently exceeded the industrial NH_3-N discharge, the 10th FYP 的 NH_3-N target of TMLL has been universally achieved with plenty of leeway.

2.3 Investment in Pollution Control Programs

2.3.1 During the 9th FYP

1 The 9th FYP included two major program activities:

(1) Tai Lake Area Wastewater Universal Compliance Activity in 1998

2 By the end of 1998, industrial pollution sources to the Tai Lake area should achieve universal compliance to the discharge standards. The activity included: wastewater compliance action of intensive livestock raising and husbandry facilities, and hotels and restaurants along the Lake bank; lake surface pollution control action (including boxed freshwater aquaculture), tourism, waterway shipping); promotion of P-free detergents; urban domestic wastewater pollution control action; and demonstrative projects. The Activity has effectively deterred the deterioration of the water quality around the Tai Lake area.

3 The activity has been required to complete before the end of 1998. The total investment reached 40.96×10^8 yuan, where industrial pollutants discharge compliance cost 5.5045×10^8 yuan, domestic wastewater pollution control cost 33.4162×10^8 yuan, lakeside hotels and restaurants wastewater pollution control cost 1.5×10^8 yuan, and demonstrative projects cost 0.54×10^8 yuan. The investment distribution between the provinces and municipality is such : Jiangsu Province 24.4388×10^8 yuan, Zhejiang Province 16.50×10^8 yuan, and Shanghai municipality 0.0214×10^8 yuan.

(2) Clearing of the Tai Lake Water Body Activity in 2000

4 Year 1999 and 2000 have been crucial to the Tai Lake water pollution control. The activity objectives have been the clearing of the Tai Lake water, the overall improvement of the water environmental quality of the Tai Lake water bodies and the Tai Lake area, and the noticeable water quality improvement of key water bodies. The key indicators have been TP, TN, and COD_{Mn} or COD_{cr} for organic pollutants. The pollution control activity has placed dual emphases on TMLL and pollutants density (water quality indicators) control. The major actions include the lakeside pollution prevention and control, wastewater interception, drinking water assurance projects, hydraulic control programs, and enterprise clean production programs that revolve around comprehensive pollution control focusing on the urban domestic wastewater discharge universal compliance.

5 The total required investment between 1999 and 2000 reached 88.582×10^8 yuan, where Jiangsu Province counted up to 42.907×10^8 yuan (48.5%), Zhejiang Province counted up to 42.095×10^8 yuan (47.5%), and Shanghai municipality counted up to 3.58×10^8 yuan (4.0%).

6 During the 9th FYP, the Tai Lake planned pollution control investment was 129.5×10^8

yuan; the actually investment totaled approximately 100×10^8 yuan, leaving a gap of about 30×10^8 yuan, which mostly should have been used for urban WWTP construction. The planned 96 urban WWTPs were adjusted to 54 due to adjustments of jurisdictions. Twenty-nine with a total installed capacity of 118.65×10^4 ton/day have been completed by 2000. The detailed information on the WWTPs is presented in Table 2.3.1-1.

Table 2.3.1-1 Construction of WWTPs in TLB (2000)

Province	Progress of WWTP construction		WWTP treatment capacity ($x10^4$ ton /day)
	Number completed	Number under construction	
Jiangsu	26	-	75.15
Zhejiang	3	25	43.5

Data Source(s): The TLB pollution control and prevention 10th FYP

2.3.2 During the 10th FYP

1 The pollution control, ecological restoration and management intensification programs of the 10th FYP include a total of 255 projects worthy of a total investment of 220.1×10^8 yuan. Detailed provincial investment needs are listed in the table below.

Table 2.3.2-1 Request of Investment in the 10th FYP for TLB

Type of project	Jiangsu		Zhejiang		Shanghai		Total	
	# of project	Required investment ($x10^4$ yuan)	# of project	Required investment ($x10^4$ yuan)	# of project	Required investment ($x10^4$ yuan)	# of project	Required investment ($x10^4$ yuan)
WWTP	77	548755	14	495900	2	28500	93	1073155
Garbage treatment	4	30500	9	96425	-	-	13	126925
Industrial pollution control	62	8616	25	2644	-	-	87	11260
Ecosystem rehabilitation	4	208000	-	-	-	-	4	208000
Dredging	4	239948	3	158000	-	-	7	397948
Non-point source control	10	220933	4	8760	-	-	14	229693
Water resource protection	3	61000	9	78500	-	-	12	139500
Special industrial pollution control	3	3000	5	6200	-	-	8	9200
Management and capacity building	9	3500	6	1800	2	500	17	5800
Total	176	1324252	75	848229	4	29000	255	2201481

Data Source(s): The pollution control and prevention 10th FYP.

2 Table 2.3.2-2 summarizes the actual investments in the TLB provinces/municipality during the 10th FYP. Overall, 77.80% of the planned investment has taken place. In particular, the investment completion rate of Zhejiang Province reached 99.66%. The investment

completion rate of Jiangsu Province was 65.79%. The shortage of the investment occur mostly in the ecological restoration, dredging, non-point source pollution control, head water protection projects, where market-oriented financing mechanism is difficult to be employed. The projects received neither financial support from the state, nor the local matching funds proved adequate. Thus, the actual investment fell short of the planned level. Shanghai, nevertheless, fulfilled only 50.36% of the planned investment, because 2 of its WWTPs have been phased projects, where the construction is currently on-going.

Table 2.3.2-2 Actual Investment during the TLB 10th FYP

Unit: $\times 10^4$ yuan

Program	Jiangsu		Zhejiang		Shanghai		Total	
	Planned investment	Actual investment	Planned investment	Actual investment	Planned investment	Actual investment	Planned investment	Actual investment
WWTP	548755	558617	484900	495535	28500	14303	1062155	1068455
Garbage treatment	30500	11800	96425	93287	0	0	126925	105087
Industrial pollution control	8616	12307	2644	1322	0	0	11260	13629
Ecosystem rehabilitation	208000	65579	0	0	0	0	208000	65579
Dredging	239948	50628.16	86300	106335	0	0	326248	156963.16
Non-point source control	220933	139121	8760	9070	0	0	229693	148191
Water resource protection	61000	9512.63	78500	53500	0	0	139500	63012.63
Special industrial pollution control	3000	8470	4200	0	0	0	7200	8470
Management and capacity building	3500	15206.6	1800	1910	500	300	5800	17416.6
Total	1324252	871241.39	763529	760959	29000	14603	2116781	1646803.39
Ration of realized investment	65.79%		99.66%		50.36%		77.80%	

Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

3 Table 2.3.2-3 summarizes the actual investment of the 10th FYP major programs at the prefecture-city level. Since the 10th FYP did not divide the limited-time universal compliance programs of NH3-N and TP, and ecological restoration, ecological demonstration, and environmental management capacity building programs to the prefecture level, Table 2.3.2-3 does not include data of those programs.

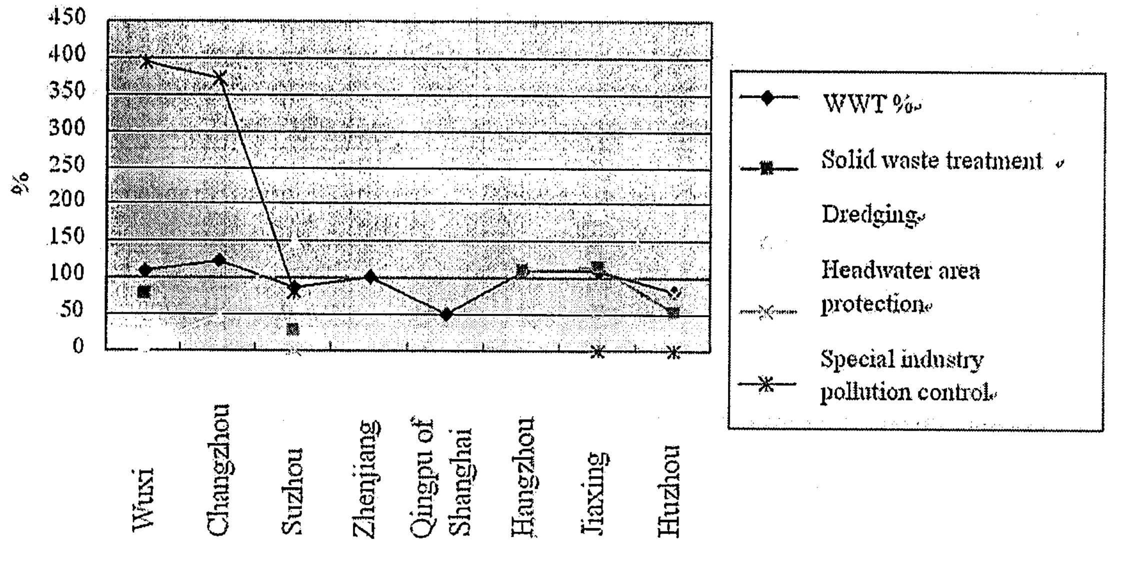
Table 2.3.2-3 Details of the Actual Investment of the TLB

Unit: $\times 10^4$ yuan

Region	WWTP		Garbage treatment		Dredging		Water resources protection		Special industry pollution control	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Wuxi	204788	225933	5800	4600	162000	9154	36000	8713	1000	3930
Changzhou	86600	107439	0	0	73548	34874	0	0	1000	3720
Suzhou	237237	205145	24700	7200	4400	6600	25000	800	1000	820
Zhenjiang	20130	20100	0	0	0	0	0	0	0	0
Shanghai Qingpu	28500	14303	0	0	0	0	0	0	0	0
Hangzhou	144800	156858	65000	70000	0	0	0	0	0	0
Jiaxing	235800	254763	10500	12000	11300	21470	37000	20500	2200	0
Huzhou	104300	83914	20925	11287	75000	84865	41500	33000	2000	0

Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

Figure 2.3.2-1 Investment Completion Rates of the Major Water Pollution Prevention & Control Programs in TLB during the 10th FYP



Data Source(s): *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control in Jiangsu Province during the 10th FYP*, *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control at Hangzhou-Jiaxing-Huzhou Cities Area during the 10th FYP*, and *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control in Shanghai Municipality during the 10th FYP.*

4 Figure 2.3.2-1 indicates that the actual completion rate of investment in the WWTPs have universally exceeded 50%; the completion rate of other programs, however, shows much larger regional differences.

3. Indicator System

3.1 Of the 9th FYP

3.1.1 9th FYP Indicator System

(1) Water Quality Indicators

- The Tai Lake eutrophication indicators: TLIc (Comprehensive Trophic Level Indices)
- The Tai Lake water quality indicators: TP, TN, COD_{Mn}
- Water quality indicators for the inflow rivers: TP, TN, COD_{Mn}

(2) Pollutants TML Control Indicators

- Indicators for pollutants discharge and quantities entering into the Tai Lake: TP, TN, CODcr (Chemical Oxygen Demand)

3.1.2 Analysis of the 9th FYP Indicators

1 The Tai Lake 9th FYP indicators represent a comprehensive selection based on the lake's natural attributes. However, during the FYP implementation, different objectives were not prioritized, and pollution control programs targeted at various pollutants were launched all at once. Limited by the economic resources during the 9th FYP period, many objectives eventually could not be met.

3.2 Of the 10th FYP

3.2.1 10th FYP Indicators

(1) Water Quality Indicators

- Basic indicators for the Tai Lake: COD_{Mn}, TP, NH_3-N (for drinking water source water area only)
- Reference indicators: TN, Comprehensive Trophic Level Indices (TLIC)
- Basic indicators for the inflow rivers: COD_{Mn}, TP
- Reference indicators: NH_3-N

(2) Pollutants TML Control Indicators

- Basic indicators: COD, TP
- Reference indicators: NH_3-N

3.2.2 Analysis of the 10th FYP Indicators

1 The TLB 10th FYP has provided a detailed indicator system, which incorporates water quality, TML, projects, and investment. Within the water quality indicators, the water quality of the lake, water bodies surrounding the lake, and the intersections have been defined

individually with an emphasis on the lakeside water body qualities.

2 The targets of TMLL have been set to match with the jurisdictions and control units.

3 Through the pollution control efforts during the 10^{th} FYP, the TLB water quality has retained its original level under the influence of rapid economic growth; the water quality even improved. The objectives of the 10^{th} FYP have been largely achieved. The experience from the 10^{th} FYP also draws useful lessons for the 11^{th} FYP.

4 A major deficiency of the TLB 10^{th} FYP is the underestimation of the enormity of the task. Some ecological restoration tasks have been too ambitious to identify viable approaches and define realistic goals, leaving the talks unfulfilled on paper.

4. Sources of and Factors Impacting Pollutants Discharge

4.1 Sources of Pollutants Discharge

4.1.1 Industrial Point Sources

4.1.1.1 During the 9th FYP

1 The 2000 TLB pollution discharge reports from the enterprises indicate a total industrial wastewater discharge of 7×10^8 ton and COD discharge of 7.98×10^4 ton in the TLB in 2000. The table below presents the industrial wastewater and COD discharge of the cities. Comparatively, Suzhou and Changzhou have a high wastewater and COD discharge, while Zhenjiang and Huzhou have a relatively low level.

Table 4.1.1.1 Wastewater and Pollutants Discharge of the Areas in TLB (2000)

Region	Wuxi	Suzhou	Zhenjiang	Hangzhou	Jiaxing	Huzhou	Changzhou
Wastewater discharge (x104 ton)	7431.5	27037.0	2183.6	9482.4	7056.4	4785.0	11950.4
COD discharge (x104 ton)	0.60	2.99	0.38	1.26	1.11	0.42	1.22

Note: The data are from the Statistic Data of Enterprises Pollution Discharge Application and it lack of the data from Shanghai Qingpu. This data are different from the data used in the 10th FYP.

4.1.1.2 During the 10th FYP

1 The 2005 TLB reported discharge by enterprises statistics indicates a total industrial wastewater discharge of 8.6×10^8 ton, COD discharge of 7.92×10^4 ton, and NH_3-N discharge of 0.82×10^4 ton in 2005. Excluding the impact from misting data of Shanghai in 2000, compared to 2000, the 2005 industrial wastewater discharge increased by 1×10^8 ton, but the COD discharge decreased by 0.06×10^4 ton. This suggests that the COD density in the industrial wastewater has dropped. Among the cities, Wuxi and Suzhou saw the largest increase in both industrial wastewater and COD discharge. Zhenjiang saw the most significant reduction in both industrial wastewater and COD discharge. No other significant changes have been spotted in other cities.

2 The following table exhibits the wastewater discharge of the cities in the TLB in 2005.

Table 4.1.1.2-1 Wastewater and Pollutants Discharge of the Areas in TLB (2005)

Region	Wuxi	Suzhou	Zhenjiang	Hangzhou	Jiaxing	Huzhou	Shanghai
Wastewater discharge (x104 ton)	20958.7	42127.1	13.0	7974.4	7768.2	6103.9	716.0
COD discharge (x104 ton)	1.83	3.55	0.0009	1.23	0.74	0.52	0.05
NH3-Ndischarge (x104 ton)	0.12	0.49	0.000092	0.023	0.058	0.13	0.0032

4.1.2 Urban Domestic Wastewater Discharge

4.1.2.1 During the 9th FYP

1 Rarely any data on domestic wastewater is available. Only part of the 1998-2000 data of Hangzhou has been discovered.

Table 4.1.2.1-1 Hangzhou Domestic Wastewater Discharge during 9th FYP

Year	1998	1999	2000
Domestic wastewater discharge ($x10^8$ ton)	1.92	2.04	2.09
Domestic COD discharge ($x10^4$ ton)	5.91	5.86	3.97

4.1.2.2 During the 10th FYP

1 Table 4.1.2.2-1 summaries the survey results of the 2005 urban wastewater discharge of the TLB provinces. The 2005 TLB industrial wastewater and urban residential domestic wastewater discharge totaled 14.05×10^8 ton, where the domestic wastewater discharge takes up to 5.4821×10^8 ton (39%). Specifically, Qingpu District of Shanghai contributed 0.3741×10^8 ton, Jiangsu 3.6896×10^8 ton, and Zhejiang 1.4184×10^8 ton. The proportions of domestic to total wastewater discharge are: 83.9% for Qingpu District of Shanghai, 36.9% for Jiangsu (excluding *Changzhou*), and 39.4% for Zhejiang Province.

Table 4.1.2.2-1 Regional Wastewater Discharge in TLB (2005)
Unit: $\times10^8$ ton

Region	Total municipal wastewater	Domestic wastewater discharge	Ratio of domestic wastewater to municipal wastewater
Shanghai Qingpu	0.4457	0.3741	83.9%
Jiangsu (except Changzhou)	9.9995	3.6896	36.9%
Zhejiang	3.6031	1.4184	39.4%
Total	14.0483	5.4821	39.0%

Data Source: CNEMC

2 Table 4.1.2.2-2 tabulates the 2005 TLB major pollutants discharge from urban domestic wastewater. Among the total 21.62×10^4 ton COD discharge in the TLB, Qingpu District of Shanghai contributed 0.60×10^4 ton, Jiangsu (excluding Changzhou) contributed 14.52×10^4 ton, and Zhejiang contributed 6.50×10^4 ton. The domestic COD percentages out of total COD of each province are: Qingpu District of Shanghai 92.4%, Jiangsu Province (excluding Changzhou) 63.0%, and Zhejiang Province 61.6%.

3 The 2005 TLB total NH_3-N discharge reached 1.99×10^4 ton, where Qingpu District of Shanghai contributed 0.04×10^4 ton, Jiangsu Province (excluding Changzhou) contributed 1.32×10^4 ton, and Zhejiang Province contributed 0.63×10^4 ton. The proportions of domestic COD in each province are: Qingpu District of Shanghai 92.5%, Jiangsu Province (excluding Changzhou) 53.5%, and Zhejiang Province 67.2% respectively.

Table 4.1.2.2-2 Regional Pollutants Discharge in TLB (2005)

Unit: $\times 10^4$ ton

Region	Total COD discharge	Domestic COD discharge	Ratio of domestic COD discharge	Total NH3-N discharge	Domestic NH3-N discharge	Ratio of domestic NH3-N discharge
Shanghai Qingpu	0.5978	0.5524	92.4%	0.0425	0.0393	92.5%
Jiangsu (except Changzhou)	14.5167	9.1401	63.0%	1.3152	0.7041	53.5%
Zhejiang	6.5015	4.0029	61.6%	0.6302	0.4237	67.2%
Total	21.616	13.6954	63.4%	1.9879	1.1671	58.7%

Data Source: CNEMC

4 The above table suggests that by either COD or NH_3-N, the 2005 TLB domestic wastewater has contributed to over 50% of the total pollutants discharge. Domestic pollution, therefore, has become the key area for pollution control in the TLB during the 10^{th} FYP.

4.1.3 Agricultural Non-Point Sources

4.1.3.1 Non-Point Sources and Pollution Pathways in the TLB

1 The major non-point sources in the TLB include the livestock raising and husbandry, farmland nutrients loss, rural domestic, plantation wastes, and aquaculture. No existing studies on the pollutants discharge from planting wastes have been found, while studies on the pollution discharge intensity of the rest 4 sources to a certain degree exist (Table 4.1.3.1-1). However, due to the inconsistency of the study scopes, Table 4.1.3.1-1 attempts to illustrate the discharge intensity of various non-point pollution sources by presenting their relative ratios. Table 4.1.3.1-2 presents the relative weights between industrial, agricultural, and domestic pollution contributions. The results of Table 4.1.3.1-1 indicate that the significant variations in the non-point source contribution rate to CODcr, TN, and TP makes it unadvisable to attribute any single source as the major non-point source of pollution.

Table 4.1.3.1-1 Ratio of Non-Point Source CODcr, TN and TP in TLB

Type of non-point source	CODcr	TN	TP
Livestock: Nutrient loss from farmland: Household: Acquaculture[1]	29:0:37:1	27:84:10:37	12:10:70:26
Livestock: Nutrient loss from farmland: Household: Acquaculture[2]	-	34:24:14:6	-
Nutrient loss from farmland: Household: Acquaculture[3]	-	11:37:15	7:17:30

Note:

1. Wan Xiaohong, Qiudan, Zhao Xiaoming, The Pollution Characteristics Analysis of Livestock Plant, Agricultural Environment and Development, 2000, 17 (2) : 35-38.
2. Zhu zhaoling, Sun Botao etc., Agricultural Non-Point Source Pollution Control Policy and Measure, Guide of Science and Technology, 2005, 23 (4) : 47-51.
3. Yang Linzhang, Wang Dejian, Xia Lizhong, The Characteristic of the Non-Point Source in TLB and its Control Method, China Water Resources, 2004 (20) : 29-30. The results of nutrient loss from farmland, household and aquaculture are from the data of TN, TP discharge intensity of unit farmland.

2 Table 4.1.3.1-2 shows the ratio of pollution intensities between the TLB point and non-point sources. It suggests that non-point source has contributed 41%-77% TN and

26%-70% TP in the TLB water body. Non-point sources have surpassed the point sources to become the major contributor of the TLB TN and TP sources.

Table 4.1.3.1-2 Proportion of the Point Source to Non-Point Source Discharge Intensity

Type of the pollution source	CODcr	TN	TP
Industry : Domestic : Non-Point source[1]		15.7 : 25.1 : 54.1	10.4 : 59.9 : 24.5
Point source : Non-Point source[2]		59 : 41	30 : 70
Industrial source : Domestic : Non-Point source[3]	44 : 29 : 27	5 : 18 : 77	7 : 27 : 66

Notes:
1. Cheng Be, Zhang Ze, Chen Lin, Yuan Zhihua, Sun Xiaorong, The Tai Lake Eutrophication and Agricultural Non-Point Source Control, Agriculture Environmental Science 2005, 24 (supplement) : 118-124.
2. Ma WQ, DR Mao, FS Zhang. The Problems in Fertilization and Measurements of Preventing Them in Protective Vegetable Ground in Shandong [A]. In XL Li, FS Zhang, GH Mi (eds.). Fertilizing for Suitable Production of High Quality Vegetables [M]. Beijing: Chinese Agricultural University Press, 2000.41-47.
3. TLB Water Pollution Prevention and Control FYP.

3 The TLB presents a ranger terrain clouded with the rivers. Except wastes from freshwater aquaculture in and near the river way, other 2 major non-point pollution sources are the surface pollutants and nutrients washed away by surface runoff into the rivers and pollutants permeation into the water bodies (Table 4.1.3.1-3).

Table 4.1.3.1-3 TLB Major Non-Point Sources Pollution Pathway

Non-point sources	Pollution Pathways
Livestock	Except for direct discharge of wastewater from aquacultural sites near the rivers, a major pollution pathway is through the surface runoff from washing off the casual stacking of organic wastes.
Nutrient loss from farmland	N and P nutrients enter the water bodies through surface runoff.
Household	Rural domestic wastewater, human excreta and rural domestic solid waste enter into the water bodies mainly through surface runoff and permeation.
Aquaculture	In freshwater aquaculture in the rivers, excessive feed and excreta from fish sink directly into rivers; in other aquaculture, pollutants enters into the water bodies though pond cleaning or discharges.
Planting waste	NOx from burning returns to the ground with precipitation and enters the water bodies.

4.1.3.2 Production of Non-Point Source Pollution and Amounts Discharged into the Environment

1 The discharge intensities of livestock raising and husbandry, farmland nutrients loss, rural domestic living, and aquaculture have been estimated using the data items available in the Chinese county-level rural statistics – rural population, numbers of large livestock, number of pigs, number of poultry, area of freshwater aquaculture, N-fertilizer usage, P-fertilizer usage (Table 4.1.3.2-1), the non-point sources pollutants discharge coefficient from references and survey data (Table 4.1.3.2-2) and the unit non-point sources pollution generation intensity (Table 4.1.3.2-3).

Table 4.1.3.2-1 Statistic Data of TLB

Region	Rural population ($x10^4$)	N-fertilizer ($x10^4$ ton N)	P-fertilizer ($x10^4$ ton P)	Large livestock ($x10^4$ head)	Pig ($x10^4$ head)	Freshwater breed area ($x10^4$ ha)
1995						
Shanghai	256.8	103111.7	9846.6	2.6	413.6	23.4
Wuxi	72.6	23527.0	1587.3	0.2	24.7	6.1
Changzhou	204.0	73582.3	5911.9	0.4	90.7	36.1
Suzhou	141.6	74647.3	5746.4	0.1	48.1	42.9
Zhenjiang	108.5	38546.3	4676.6	1.8	42.7	11.8
Hangzhou	206.6	54014.7	3477.6	2.8	77.2	19.6
Jiaxing	154.8	67557.3	5173.1	0.0	172.7	4.2
Huzhou	121.9	44787.0	5056.3	0.8	63.8	6.0
TLB	1266.9	479773.7	41475.8	8.7	933.5	150.0
2000						
Shanghai	314.2	161833.3	9184.9	0.0	127.2	36.5
Wuxi	251.2	79131.7	7333.5	1.7	87.3	30.5
Changzhou	193.7	73776.7	5861.9	0.5	86.2	51.0
Suzhou	331.8	116763.7	12804.7	0.9	104.7	133.2
Zhenjiang	165.8	63133.7	7601.2	1.3	59.0	34.9
Hangzhou	394.6	76328.0	8928.4	1.9	96.1	61.3
Jiaxing	252.7	88208.0	7354.1	2.2	126.0	17.0
Huzhou	190.2	32466.3	3983.1	1.0	47.9	20.6
TLB	2094.2	691641.3	63051.7	9.3	734.4	385.0
2004						
Shanghai	280.3	103611.0	6845.1	3.2	163.8	36.1
Wuxi	288.2	64408.0	2966.2	2.5	67.3	24.2
Changzhou	235.2	66756.7	2071.3	0.6	69.1	35.0
Suzhou	354.5	81673.0	3556.2	2.3	76.0	88.6
Zhenjiang	172.4	93810.0	3537.3	1.0	64.9	24.2
Hangzhou	659.0	126600.0	13358.8	4.9	240.8	61.3
Jiaxing	309.1	99277.7	9035.5	0.2	430.5	13.0
Huzhou	270.6	48762.3	4204.9	0.9	109.5	20.1
TLB	2569.3	684898.7	45575.4	15.5	1222.0	302.4

Note: The data are the interior survey data of MOA in 1996, 2001 and 2005, however there is no data about poultry.

2 The major non-point sources pollutants discharge coefficients[1] of the HRB are obtained through the MOA partial regional survey and references. The aquaculture scale in the TLB region is large, leaving a relatively low wastes pollutants discharge coefficient. Moreover, the TLB freshwater aquaculture adopts intensive fish farming. For example, the feed intensity in Zhejiang Province is 3998 kg/ha, and about 48.3% of the feed enters into the environment (internal survey data). The CODcr discharge per unit freshwater aquaculture area should also be high. However, due to data unavailability, the estimation of the CODcr discharge from freshwater aquaculture is unviable.

[1] That is the discharge into the environment divided by the total pollutants generated.

Table 4.1.3.2-2 Non-point Sources Pollution Discharge Coefficient in TLB

Type of the non-point sources	Items	TLB (%)			Data Source(s)
		CODcr	TN	TP	
Livestock	Large livestock excrement	15	15	15	Survey data of MOA, 2005
	Large livestock stale	90	90	90	ditto
	Pig excrement	15	15	15	ditto
	Pig stale	90	90	90	ditto
	Poultry excrement	10	10	10	ditto
Nutrient loss from farmland	N-fertilizer	0	6.36	0	Yang Linzhang, etc. 2003
	P-fertilizer	0	0	1.93	Yang Linzhang, etc. 2003
Household	Rural domestic wastewater	100	100	100	Survey data of MOA, 2005
	Human excrement	30	30	30	ditto
Aquaculture	Freshwater breed	-	10.9	8.0	Yang Linzhang, etc. 2003

Table 4.1.3.2-3 Generation Intensity of Non-Point Source Pollutant

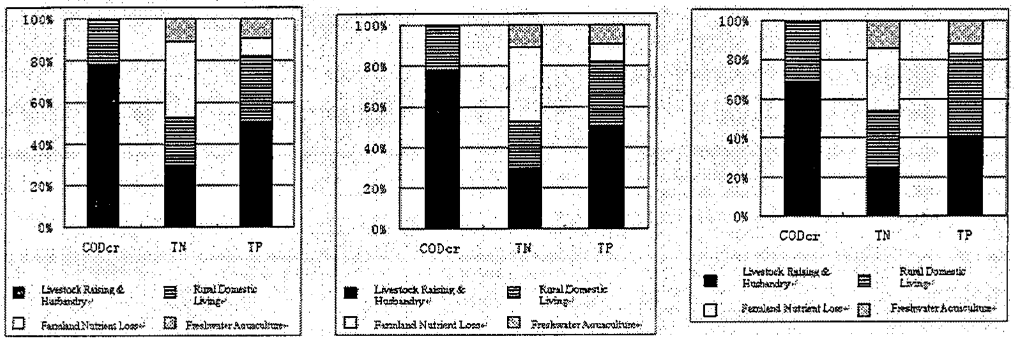
Type of non-point sources	Items	CODcr (g /kg)	TN (g N/kg)	TP (g P/kg)	Amount generated annually (kg/head, kg/person, kg/ha)	Data Source(s)
Livestock	Large livestock excrement	3.17	3.83	0.95	9855	China Organic Fertilizer Records,1998; Survey data of MOA,2005; Study on Control and Management of Rural Non-Point Source Pollution in the PRC TA No.3891-PRC
	Large livestock stale	38.04	5.01	0.17	4380	
	Pig excrement	3.99	5.47	2.45	730	
	Pig stale	31.92	1.66	0.22	1204.5	
	Poultry excrement	24.44	10.32	4.13	43.8	
Nutrient loss from farmland	N-fertilizer					
	P-fertilizer					
Household	Rural domestic wastewater	0.35	0.012	0.0017	18250	Survey data of MOA, 2005; Study on Control and Management of Rural Non-Point Source Pollution in the PRC TA No. 3891-PRC
	Human excrement	7.27	6.43	1.06	693	China Organic Fertilizer Records, 1998
Aquaculture	Freshwater breed 2	-	568.9	75.0	-	Yang Linzhang, etc. 2003

Notes:
1. The generation intensity of non-point source pollutant means the intensity of pollutants discharge to environment including land, water or any other types of places.
2. The discharge intensities of CODcr, TN and TP entering into the environment from livestock raising and husbandry, farmland nutrients loss, rural domestic, aquaculture in the TLB in 1995, 2000, and 2004 (Table 4.1.3.2-4) have been estimated using the agricultural statistical data of the TLB, the major non-point sources pollutants discharge coefficient, and the production intensity of the major non-point sources pollutants.

3 Table 4.1.3.2-4 lists the intensity of non-point source CODcr, TN, and TP in the TLB in 1995, 2000 and 2004. The figures suggest that since the 9th FYP, pollutants from non-point sources show the tendency of increase.

4 Figure 4.1.3.2-1 below suggests that the ranks of rate of contribution of CODcr in the TLB are livestock raising and husbandry, rural domestic; the ranks of the rate of contribution of TN are livestock raising and husbandry, farmland nutrients loss, rural domestic, aquaculture; and the ranks of the rate of contribution of TP are livestock raising and husbandry, rural domestic, aquaculture, and farmland nutrients loss. Therefore, livestock raising and husbandry is the most significant contributor of non-point source pollution in the TLB. The TN rate of contribution of farmland nutrients loss exceeded that of rural domestic, and the TP rate of contribution of freshwater aquaculture exceeded that of farmland nutrients loss.

Figure 4.1.3.2-1 Rates of CODcr, TN and TP Contribution of Major TLB Non-Point Sources



1995 2000 2004

Table 4.1.3.2-4 Amount of Non-Point Source Pollutant Entering Environment in TLB

Non-Point Sources	Livestock (ton)	Household (ton)	Nutrient loss from farmland (ton)	Freshwater breed (ton)
		1995		
CODcr	340558	100058	-	-
TN	24601	19710	30514	9302
TP	4911	3185	800	900
		2000		
CODcr	271719	165398	-	-
TN	19978	32582	43988	23874
TP	3915	5265	1217	2310
		2004		
CODcr	452165	202921	-	-
TN	33248	39973	43560	18752
TP	6514	6459	880	1814

Table 4.1.3.2-4 Discharge Intensity of Non-Point Source Pollutant to Environment in TLB (1995, 2000 and 2004)

Unit: ton COD, N, P

Region	CODcr				TN					TP				
	Livestock	Household	Freshwater breed	Total	Livestock	Household	Nutrient loss from farmland	Freshwater breed	Total	Livestock	Household	Nutrient loss from farmland	Freshwater breed	Total
1995														
Shanghai	148949	20282	na	169230	10581	3995	6558	1451	22585	2150	646	190	140	3126
Wuxi	8964	5734	na	14698	643	1130	1496	378	3647	129	183	31	37	379
Changzhou	32400	16112	na	48512	2277	3174	4680	2239	12369	468	513	114	217	1311
Suzhou	17009	11183	na	28193	1179	2203	4748	2660	10790	246	356	111	257	970
Zhenjiang	17746	8569	na	26315	1482	1688	2452	732	6353	254	273	90	71	688
Hangzhou	31381	16317	na	47698	2563	3214	3435	1215	10428	449	519	67	118	1153
Jiaxing	60515	12226	na	72741	4142	2408	4297	260	11108	875	389	100	25	1389
Huzhou	23593	9628	na	33221	1734	1897	2848	372	6851	340	306	98	36	780
TLB	340558	100058	na	440616	24601	19710	30514	9302	84126	4911	3185	800	900	9797
2000														
Shanghai	44572	24815	na	69387	3051	4888	10293	2263	20495	645	790	177	219	1831
Wuxi	33219	19840	na	53059	2526	3908	5033	1891	13358	478	632	142	183	1434
Changzhou	30978	15298	na	46276	2195	3014	4692	3163	13063	447	487	113	306	1353
Suzhou	38079	26205	na	64284	2740	5162	7426	8260	23588	549	834	247	799	2430
Zhenjiang	22684	13095	na	35779	1745	2580	4015	2164	10504	326	417	147	209	1099
Hangzhou	36612	31165	na	67777	2788	6139	4854	3801	17583	526	992	172	368	2059
Jiaxing	47553	19958	na	67511	3581	3931	5610	1054	14177	684	635	142	102	1563
Huzhou	18331	15022	na	33353	1403	2959	2065	1277	7704	263	478	77	124	942
TLB	271719	165398	na	437117	19978	32582	43988	23874	120422	3915	5265	1217	2310	12706

	CODcr				TN					TP				
	2004													
Shanghai	62345	22138	na	84483	4742	4361	6590	2239	17931	896	705	132	217	1950
Wuxi	27448	22762	na	50210	2249	4484	4096	1501	12330	393	725	57	145	1320
Changzhou	25141	18576	na	43717	1810	3659	4246	2170	11885	363	591	40	210	1204
Suzhou	30187	27998	na	58185	2407	5515	5194	5494	18611	433	891	69	532	1924
Zhenjiang	24288	13616	na	37904	1811	2682	5966	1501	11960	350	433	68	145	997
Hangzhou	91955	52047	na	144002	7021	10253	8052	3801	29126	1322	1657	258	368	3604
Jiaxing	151159	24412	na	175572	10376	4809	6314	806	22305	2186	777	174	78	3215
Huzhou	41896	21372	na	63268	2855	4210	3101	1246	11413	574	680	81	121	1456
TLB	468623	202921	na	671544	33248	39973	43560	18752	135533	6514	6459	880	1814	15667

Note: na = No data.

4.1.3.3 Non-Point Source Contribution to the HRB Water Pollution

1 According to the survey results, there are no existing quantitative researches, models, or methods on the affect of the non-point sources on the water bodies. The connection between the amount of pollution in the water bodies from the non-point sources and the amount of total discharge from the non-point sources has not been established. Such situation is largely due to (1) the requirement for comprehensive monitoring and testing of the river hydraulic process, surface runoff and its characteristics, water and soil erosion, the dissolving, transfer, and migrating process of pollutants, and (2) insufficient attention from the governments to the non-point sources. According to the above estimates, from the dawn of the 9th FYP to the end of the 10^{th} FYP, the non-point source COD, NH3-N, and TP entering into the environment show an upward trend indicating no sign of effective control or reduction.

2 Consequently, the existing estimates on the TBL non-point source discharges alone are insufficient to deduce quantitatively their contributions to the TLB water pollution. Qualitatively, however, TLB's rainfall pattern favors the non-point source pollutants migration through surface runoff. The TLB multi-year average rainfall reaches 1181 mm, 1.3 times the HRB amount. Precipitation distributes unevenly within the year. The flood season (May-September) accounts for 60% of the total annual precipitation. The flood season is usually consisted of the rainy season, or the "plum rains,"[2] from May to July and the typhoon season from August to September. Occasionally the plum rains and typhoon season would overlap. Plenty, concentrated precipitation can easily transfer the non-point sources pollutants from the field to the water bodies with the dense river network in the TLB. Therefore the TLB non-point pollution is likely an important source of water pollution, especially as point source pollutants are being diminished gradually. Non-point source pollution will eventually become a main factor of the water pollution.

4.2 Factors Impacting Sources of Pollution

4.2.1 Development Level

1 The table below compares the wastewater and pollutants discharge of the TLB at the end of the 9^{th} FYP (2000) and the 10^{th} FYP (2005) to the China average and those of the major developed countries.

Table 4.2.1-1 Pollutants Discharge per Unit GDP in TLB and National Average

Region	TLB		Nationwide area	
Year	2000	2005	2000	2005
GDP (x108 yuan)	6183.32	14058.99	99214.6	183084.8
GDP of unit territory area (x104 yuan/km2)	1676	3810	103	191
Wastewater (x108 ton)	15.01	14.1	415.2	524.5
COD (x104 ton)	49.15	21.616	1445	1414.2
NH3-N (x104 ton)	13	1.9879		149.8
Wastewater /GDP(kg/×104yuan)	24.27	10.03	41.85	28.65
COD /GDP(kg/×104 yuan)	7.95	1.54	14.56	7.72
Ammonia /GDP(kg/×104 yuan)	2.10	0.14	-	0.82

2 The rainy season in the lower Yangtze valley coincides with the maturing of plums; therefore, the it may also be called the "plum rains."

Source(s): China Statistics Yearbook 2006, China Environmental Statistics Yearbook 2006.

Table 4.2.1-2 Pollutants Discharge per Unit GDP in Developed Countries

Country	Year	COD (kg/day)	GDP (million US$)	COD /GDP (kg/×10^4 yuan)	GDP of unit territory area (x10^4 yuan/km^2)
France	1996	585382	1540100	0.17	2232
	2003	281747	1757613	0.07	2547
Germany	1996	811315	2353200	0.16	5273
	2003	1020145	2403160	0.19	5385
Britain	1996	695784	1145801	0.28	3741
	2003	615410	1794878	0.16	5861
USA	1996	2559947	7341900	0.16	627
	2003	1897480	10948547	0.08	935

Data Source(s): World Development Indicator (1998,1999,2003-2006)

2 The results shows that by 2005 the wastewater and pollutants discharge per unit GDP in the TLB has reduced significantly compared to its 2000 level, and compared to the China average discharge level, the TLB levels are only as half as the national average. This shows that the HRB discharge intensity is low **within China**. However, the GDP per unit area in the TLB is high – nearly 16 times that of the national average in 2000, about 20 times in 2005, and equivalent to 4 times of the US level and 1.5 times of the French level in 2003. And the pollutant discharge intensity compared to the **developed countries** is no longer low. Even for year 2005, where the per unit GDP pollutants discharge had been low in the TLB, its unit COD discharge had been 5 times more than that of the UK in 1996 and 10 times more than that of USA, France, or Germany. Therefore, a relatively low unit GDP PDI (compared to the Chinese levels) still leads to a large amount of pollutants. There is still a long way to go for the HRB in controlling PDI.

4.2.2 Economic Growth

4.2.2.1 Growth during the 9th FYP

1 The National Economic and Social Development FYP is an important basis for the water pollution control and prevention planning. A review of the *9th National Economic and Social Development FYP* (9th FYP) objectives and its implementation will help understand the water pollution control and prevention plan and implementation.

2 The following paragraphs will analyze the achievement of the economic development objectives of the *National Economic and Social Development 9th FYP and Outline of Development Vista of the Year 2010* for the provinces in the TLB by looking at the provincial GDPs and the outputs from the primary, secondary, and tertiary industries of the provinces in the TLB.

3 Data on the provincial economic development come from the *55-Year Compiled Statistics of the PRC 1949-2004*. The economic development objectives and data in the 9th FYP based on the 1995 price will be adjusted using the consumer price index (CPI) to reflect the 2000 price level. Meanwhile, the table below indicates that both provinces failed to meet the economic development objectives for both GDP and the industry outputs. The percentage shortages calculated based on the objectives are listed below.

Table 4.2.2.1-1 Economic Development Target and Result at the End of 9th FYP in Jiangsu and Zhejiang Provinces

($x10^8$ yuan) (2000 price)	Province	GDP	Primary industry	Secondary industry	Tertiary industry
The target of 9th FYP	Jiangsu	9826.5	1080.9	5208.1	3537.6
	Zhejiang	6069.1	667.6	3216.6	2184.9
The result in 2000	Jiangsu	8582.7	1031.2	4435.9	3115.7
	Zhejiang	6036.3	664.2	3183.5	2188.7
Gap between target and result	Jiangsu	-12.66%	-4.60%	-14.83%	-11.92%
	Zhejiang	-0.54%	-0.51%	-1.03%	0.18%

4 By the end of the 9th FYP, neither province has met the target GDP level. Zhejiang Province showed a minor gap from its objectives, while Jiangsu Province ran short on the secondary and primary industries.

5 On the contrary, both TLB provinces exceeded the pollutants discharge objectives by over 100% during the 9th FYP (Table 4.2.2.1-2). In particular, all provinces have exceeded the COD discharge objectives by over 100%. Zhejiang Province even had a stunning number of 1982.7% in TN discharge. Given the fact that the provinces fell short on economic performance, it is hard to argue that fast economic growth had led to the fall-short on the 9th FYP environmental objectives. What remains on the top list of the major causes are the completion of projects and investments. The detailed analysis will be presented in future paragraphs.

4.2.2.2 Growth during the 10th FYP

1 Similarly, a review of the *10th National Economic and Social Development FYP* (10th FYP) objectives and its implementation will help understand the water pollution control and prevention plan and implementation. The following paragraphs will analyze the achievement of the economic development objectives of the *National Economic and Social Development 9th FYP and Outline of Development Program of the Year 2010* for the provinces in the TLB by looking at the provincial GDPs and the outputs from the primary, secondary, and tertiary industries of the provinces in the TLB based on data availability.

2 Data on the provincial economic development between 2000 and 20005 come from the *55-Year Compiled Statistics of the PRC 1949-2004* and the provincial statistical yearbooks. The economic development objectives and data in the 10th FYP based on the 2000 price will be adjusted using the consumer price index (CPI) to reflect the 2005 price level.

3 The table below indicates that both provinces had exceeded the economic development objectives for both GDP and the industry outputs. The percentage differences calculated based on the objectives are listed below.

Table 4.2.2.2-1 Economic Development Target and Results at the End of 10th FYP in Jiangsu and Zhejiang Provinces

($x10^8$ yuan) (2005 price)	Province	GDP	Primary industry	Secondary industry	Tertiary industry
The target of 10th FYP	Jiangsu	13681.8	1368.2	6840.9	5472.7
	Zhejiang	9318.7	745.5	4752.5	3820.7

($x10^8$ yuan) (2005 price)	Province	GDP	Primary industry	Secondary industry	Tertiary industry
The result in 2005	Jiangsu	18305.7	1461.5	10335	6489.2
	Zhejiang	13437.85	892.83	7166.15	5378.87
Gap between target and result	Jiangsu	33.80%	6.82%	51.08%	18.57%
	Zhejiang	44.20%	19.76%	50.79%	40.78%

4 The table indicates that the 2 TLB provinces have basically managed to tame the pollutants discharge with unexpected high economic growth during the 10^{th} FYP. This suggests that during the 10^{th} FYP implementation the TLB has fully taken into consideration of the increase in pollutants discharge coupled with fast economic development and taken adequate measures to control the pollution.

4.2.3 Factors Impacting Industrial Point Source Discharge

4.2.3.1 Discharge (Non-)Compliance

1 The number and proportion of enterprises who reached the secondary discharge standards[3] of COD in 2000 and 2005 and of NH_3-N in 2005, as well as those who have met the secondary discharge standards for both indicators in 2005 calculated using the self-reported industrial pollutants discharge statistics have been listed in Table 4.2.3.1-1, Table 4.2.3.1-2, Table 4.2.3.1-3, and Table 4.2.3.1-4.

Table 4.2.3.1-1 COD Discharge Compliance Condition (2000)

Region	# of sampling enterprises	# of enterprises complying with discharge standards	Ratio of compliance
Changzhou	289	222	76.8%
Hangzhou	203	149	73.4%
Huzhou	106	95	89.6%
Jiaxing	236	207	87.7%
Suzhou	549	453	82.5%
Wuxi	157	148	94.3%
Zhenjiang	58	34	58.6%

Table 4.2.3.1-2 COD Discharge Compliance Condition (2005)

Region	# of sampling enterprises	# of enterprises complying with discharge standards	Ratio of compliance
Shanghai	81	77	95.1%
Wuxi	362	338	93.4%
Suzhou	506	491	97.0%
Zhenjiang	6	5	83.3%
Hangzhou	182	129	70.9%
Jiaxing	309	296	95.8%
Huzhou	229	213	93.0%

[3] The *Comprehensive Wastewater Discharge Standard (GB8978-1996)* demands for secondary standards for the Class IV and V water discharged into GB 3838 and wastewater discharged into Class III water bodies in GB3097.

Table 4.2.3.1-3 NH_3-N Discharge Compliance Condition (2005)

Region	# of sampling enterprises	# of enterprises complying with discharge standards	Ratio of compliance
Shanghai	79	75	94.9%
Wuxi	176	173	98.3%
Suzhou	173	166	96.0%
Zhenjiang	5	5	100.0%
Hangzhou	103	96	93.2%
Jiaxing	148	144	97.3%
Huzhou	159	153	96.2%

Table 4.2.3.1-4 Condition of both COD and NH_3-N are in Compliance (2005)

Region	# of sampling enterprises	# of enterprises complying with discharge standards	Ratio of compliance
Shanghai	79	74	93.7%
Wuxi	176	166	94.3%
Suzhou	173	162	93.6%
Zhenjiang	5	4	80.0%
Hangzhou	103	91	88.3%
Jiaxing	148	122	82.4%
Huzhou	159	146	91.8%

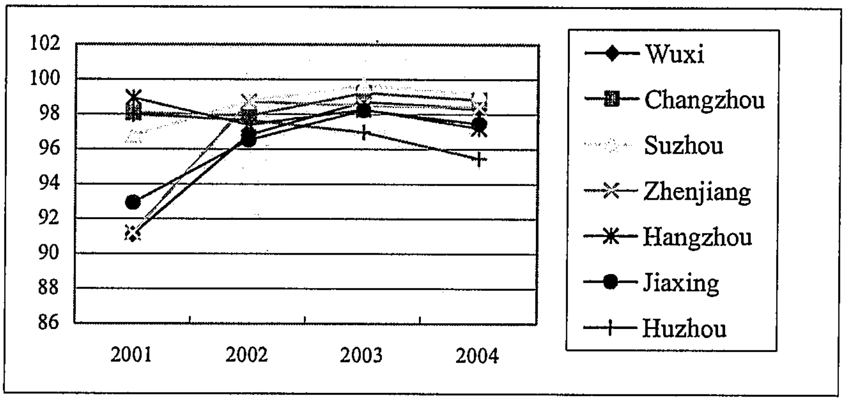
Notes:
1. Data Source(s): CNEMC
2. In 2000 there are only the data of COD.
3. Some enterprises did not have the data regarding Ammonia discharge.

2 The tables suggest that in 2000 most of the cities have had relatively high COD compliance rate. Only Changzhou, Hangzhou, and Zhenjiang had industrial COD compliance rates under 80%. The 2005 compliance rates in the TLB of both COD and NH_3-N have been universally higher than 80%.

4.2.3.2 WWTPs of Enterprises

3 Figure 4.2.3.2-1 shows the industrial wastewater discharge compliance rate of the major cities during the 10th FYP.

Figure 4.2.3.2-1 Industrial Wastewater Discharge Compliance Rate of Major Cities during the 10th FYP



Data Source(s): Wuxi Statistics Yearbook 2002-2005, Changzhou Statistics Yearbook 2002-2005, Suzhou Statistics Yearbook 2002-2005, Zhenjiang Statistics Yearbook 2002-2005, Hangzhou Statistics Yearbook 2002-2005, Jiaxing Statistics Yearbook 2002-2005, Huzhou Statistics Yearbook 2002-2005

4 During the 10th FYP, the industrial wastewater discharge compliance rates of the major cities have all exceeded 90%. Except Hangzhou and Huzhou, the cities exhibit a trend of increasing of the compliance rates.

5 The table below summarizes the operational data of enterprise WWT facilities in the major TLB cities from 2001 to 2003.

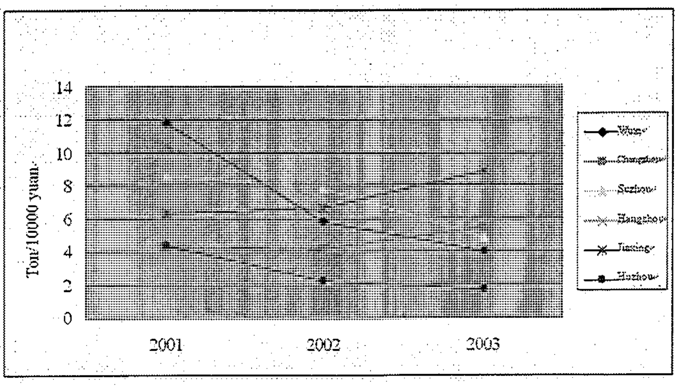
Table 4.2.3.2-1 Industrial WWT at Enterprises in TLB (2001-2003)

Region	Year	# of sampled enterprises	# of WWT facility	WWTP O&M Costs ($\times10^4$ yuan)	COD removed from industrial wastewater (ton)	NH3-N removed from wastewater (ton)
Wuxi	2001	524	371	17724.6	208190.8	1202.1
	2002	572	434	25630.8	149488.5	1964.8
	2003	578	480	27096.8	108133.7	1344.8
Changzhou	2001	491	322	11621.6	50104.8	161.1
	2002	503	350	11541.1	48288.7	159.8
	2003	498	379	13228.1	71963.1	414.4
Suzhou	2001	800	677	31991.2	276440.4	7903.6
	2002	780	677	42282	332457.8	21396.1
	2003	758	697	45998.9	223076.6	10807.9
Hangzhou	2001	1040	987	35618	371890.6	2539.2
	2002	1013	934	37096.4	264741.4	892.6
	2003	982	896	40131.3	292687.5	2406.1
Jiaxing	2001	615	424	10876.1	69070.3	388.1
	2002	610	434	12354.1	82483.3	1083.1
	2003	623	443	14083.6	124721.7	4087.4
Huzhou	2001	342	234	105720.1	46454.2	9.7
	2002	411	259	15475.4	34902.6	10.4
	2003	423	307	16254.7	28072.7	16.5

Data Source(s): China environmental Yearbook 2002-2004

6 Figure 4.2.3.2-2 compares the COD and NH_3-N removal per unit cost and the average operational cost of WWT facilities.

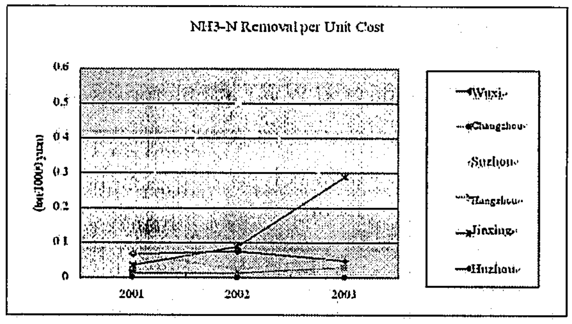
Figure 4.2.3.2-2 COD Removal per Unit Cost in Major TLB Cities



Data Source(s): China Environment Yearbook 2002-2004

7 Except Jiaxing and Changzhou, the COD removed per unit cost has been decreasing gradually. This is largely due to the increase in the number of enterprises, growth in production scale, and the increase of various costs from operating the facilities.

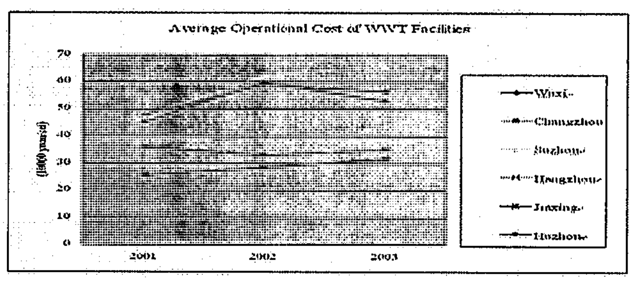
Figure 4.2.3.2-3 Comparison of NH_3-N Removal among the Major Cities



Data Source(s): China Environment Yearbook 2002-2004

8 No consistent pattern or trend has been identified for the NH_3-N removal per unit operational cost. This indicator has to relate to the industrial structure, production process selected, and the attributes of the pollutants.

Figure 4.2.3.2-4 Comparison of WWT Facility Average Operational Cost among Major TLB Cities



Data Source(s): China Environment Yearbook 2002-2004

9 Except in Changzhou, the average WWTP operational costs have been increasing. This is consistent with the above analysis of the decreasing pollutants removal per unit cost.

10 In summary, the industrial wastewater discharge compliance rates steadily increase in the TLB major cities, while the WWTP operational costs have been steadily increasing during the 10^{th} FYP. This suggests the sound operation of the WWTPs at the enterprise level in the major TLB cities.

4.2.4 Factors Impacting Urban Domestic Wastewater Discharge

4.2.4.1 Municipal WWTP Construction

1 Due to data unavailability of the TLB municipal WWTP construction during the 9^{th} FYP, only construction data of the 10^{th} FYP will be analyzed below.

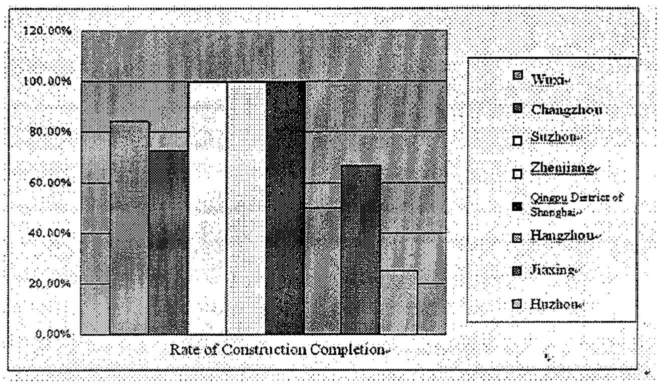
2 Table 4.2.4.1-1 and Figure 4.2.4.1-1 exhibit the construction progress and completion rate of municipal WWTPs in the TLB reported by the provinces/municipality during the 10^{th} FYP.

Table 4.2.4.1-1 Construction Progress of WWTPs in TLB until the End of the 10th FYP

Region	# of projects planned	Capacity planned (x104 ton/day)	# projects completed	# projects under construction	# of projects not started	Installed capacity (x104 ton/day)
Wuxi	32	46.5	27	5	0	54.5
Changzhou	11	33.5	8	3	0	32.8
Suzhou	32	70	32	0	0	70.2
Zhenjiang	2	6.5	2	0	0	6.5
Shanghai Qingpu	2	6.5	2	0	0	6.5
Hangzhou	4	73.7	2	2	0	46
Jiaxing	6	57.6 (sewer 511.5km)	4	2	0	52
Huzhou	4	24.8 (sewer140km)	1	3	0	15

Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

Figure 4.2.4.1-1 Municipal WWTPs Completion Rate during the 10th FYP



Data Source(s): *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control in Jiangsu Province during the 10th FYP*, *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control at Hangzhou-Jiaxing-Huzhou Cities Area during the 10th FYP*, and *Evaluation Report of Program Implementation of the TLB Water Pollution Prevention and Control in Shanghai Municipality during the 10th FYP.*

3 Figure 4.2.4.1-1 and Table 4.2.4.1-1 indicate a relatively satisfactory construction progress and completion rate in the TLB WWTPs. The WWTP completion rate of Suzhou, Zhenjiang and Shanghai even reached 100%. This explains the high discharge compliance rate of these cities.

4.2.4.2 Rapid Urban Population Growth and Urbanization

1 Another key factor leading to the domestic wastewater and pollutants growth is the rapid actual urban population growth and urbanization. The TLB's high development and urbanization level and their continuous progress have added to the negative impact on the Tai Lake water environmental quality: domestic wastewater discharge, impact from human and livestock excreta on water quality, fertilizer usage, and the loads of non-point source pollution have increased, while the pollutants degrading capacity of the natural ecosystem has decreased.

2 The total industrial and agricultural outputs in the TLB in 1983 was 1350×10^8 yuan. In 1999 this number has surged to 31000×10^8 yuan, marking a 24-fold increase. Urbanization has equally

speedy in the past 2 decades. By 1999, the TLB urbanization rate has reached 51%, leaving the national average of 31% far behind. Together surges the water usage – the 1980 figure of 226.6×10^8 m^3 went to 285×10^8 m^3 in 1999. Accordingly, the industrial and domestic wastewater discharge has increased from the 36×10^8 ton in 1987 to 49×10^8 ton in 1999, equivalent to 1/3 of the TLB multi-year average water quantity.

3 Rapid rural urbanization triggers significant changes in land use patterns, especially in the small cities. Over the past 20 years, the TLB saw an addition 2800 km^2, 10% of its plane terrain, converted to urban areas

4 Grows even faster is the actual urban population, which has been an important contributing factor to the growth in pollutants and domestic wastewater. Table 4.2.4.2-1 shows the total population in the major cities in the TLB, while Table 4.2.4.2-2 exhibits the urban population[4] only of those cities.

Table 4.2.4.2-1 Total Population of Major Cities in TLB (1995-2006)

Unit: $\times10^4$ person

Year	Suzhou	Wuxi	Zhenjiang	Jiaxing	Huzhou	Hangzhou	Shanghai Qingpu
1995	-	429	-	-	-	598	-
1996	-	431	-	-	-	603	-
1997	-	432	-	-	-	607	-
1998	-	432	-	330	255	612	-
1999	576	433	266	330	255	616	-
2000	578	435	267	331	256	622	-
2001	-	435	266	332	256	629	-
2002	584	439	267	331	256	637	62.7
2003	590	442	267	333	257	643	72.8
2004	599	447	267	334	257	652	72.8
2005	606	557	296	334	258	660	77.4
2006	616	-	-	-	-	666	89.8

Data Source(s): China Statistics Yearbook, Provinces Statistics Yearbook (1995-2006)

Table 4.2.4.2-2 Urban Population in Major Cities in TLB (1995-2006)

Unit: $\times10^4$ person

Year	Suzhou	Wuxi	Zhenjiang	Jiaxing	Huzhou	Hangzhou	Shanghai Qingpu
1995		107.48		76.72	50.03	143.52	
1996		108.43		77.31	51.82	166.73	
1997		109.56		77.76	54.2	169.29	
1998		110.21		78.06	58.98	171.89	
1999	576	111.69	266	78.36	60.56	175.27	
2000	578	112.99	267	78.8	65.56	179.18	
2001	580	213.06	266	79.11	70.96	379.49	
2002	584		267	79.45	72.21	387.01	62.7
2003	590		267		74.47	393.19	72.8
2004	599		267		76.37	401.59	72.8
2005	606		296		77.81	409.52	77.4
2006	616						89.8

Data Source(s): China Statistics Yearbook, Provinces Statistics Yearbook (1995-2006)

[4] The total population of a city is the sum of its "urban" and "rural" populations. The "rural" population in a city refers to the residents in the suburb areas and registered as a non-urban resident.

5 The above table indicates that the growth in urban population of the major TLB cities even outpace the already impressive growth in total population. For example, Wuxi doubled its urban population between 1995 and 2001, and Hangzhou's urban population soared from 143.52×10^4 in 1995 to 409.52×10^4 in 2005, adding an additional 185% to the city core. The dramatic urban population increase will inevitably lead to dramatic increase to the domestic wastewater discharge. Using Suzhou as an example, its annual domestic wastewater discharge from 2001 to 2005 has been increasing at an annual rate of 23%[5].

6 Moreover, the improvement in living standards also contributes to the increase in per capita domestic water use and wastewater discharge. For example, in Wuxi, the average per capita domestic water use increased from 105 L/day in 1980 to 284 L/day in 1999, and the city aggregated daily domestic water use increased from 8×10^4 ton to 32×10^4 ton for the same period. Assuming a discharge coefficient of 0.8, urban domestic wastewater discharge would have increased from 6.4×10^4 ton to 25.4×10^4 ton.

7 The above analysis suggests that the rapid economic development and the associated industrialization and urbanization have led to steady increase in urban population, living standards, and waste discharge, creating tremendous pressure to the TLB water environment.

4.2.4.3 Improper Operation of WWTPs

1 A number of factors have caused the low operation rate or improper operation of the constructed WWTPs:

(1) Lack of Wastewater Distribution Networks

1 The construction of WWTPs and their connection networks do not match. Many constructed WWPTs do not have wastewater collection network, thus the wastewater collection rate remains low. The actual pollution removal falls far behind the designed capacity. Table 4.2.4.3-1 shows the scale and efficiency of the WWTPs during the 9th and 10th FYPs (1996-2005) in the TLB. By 2005, the centralized treatment rates in WWTPs of Hangzhou, Shanghai, Wuxi, and Changzhou have reached above 70%. This rate for other cities generally remained lower than 55%. As of 2005, the centralized treatment rates of Suzhou and Zhenjiang were only 32.23% and 40.1% respectively. Table 4.2.4.3-1 indicates that the growth in annual wastewater treatment quantity falls far behind the growth in WWTPs daily treatment capacity but well correlates to the growth in drainage pipe length. This suggests that the lagged network construction has directly limited the effective centralized treatment at municipal WWTPs.

[5] The specific numbers for 2001 through 2005 are 1.8, 2, 2.13, 2.8, and 3.89 ($\times10^8$ ton) respectively.

Table 4.2.4.3-1WWTPs and their Capacities Added during 9-10th FYPs in TLB

Region	Year	Length of drainage pipe (km)	Length of sewage pipes (km)	Annual wastewater discharge (x10^4 m3)	Annual WWT (x10^4 m3)	WWT rate (%)	Municipal WWTP			
							# of Plants	Treatment capacity (x10^4 m^3/day)	Annual centralized treatment quantity (x10^4 m^3)	Centralized treatment rate (%)
Hangzhou	1996	993	-	50157	23727	47.31	3	41.4	-	-
	1997	1115.53	-	31082	17669	56.85	3	41.01	-	-
	1998	1231.33	-	26465	18031	68.13	5	41.19	-	-
	1999	1252.39	-	24284	13268	54.64	5	41.19	-	-
	2000	1430.64	-	26980	15312	56.75	3	41.01	-	-
	2001	1664.2	-	35576.1	22625.1	63.6	1	60	17491.0	49.17
	2002	2114.1	749.82	48508.1	32757.25	67.53	2	72	26161.8	53.93
	2003	2570.39	779.78	44837.96	34019.38	75.87	3	102	28999.08	64.68
	2004	2711.46	1160.51	45927.24	33299.84	72.51	3	113	25778.24	56.13
	2005	2945	1251.5	55141	43352	78.62	3	139	42835	77.68
Jiaxing	1996	124	-	6172	2431	39.39	-	-	-	-
	1997	151	-	5658	3120	55.14	-	-	-	-
	1998	199.3	-	5208	2355	45.22	-	-	-	-
	1999	259.32	-	4946	2262	45.73	-	-	-	-
	2000	291.93	-	5408	2240	41.42	-	-	-	-
	2001	337.7	-	4826	2235	46.31	-	-	-	-
	2002	412.65	112.73	5409.3	2831	52.34	-	-	-	-
	2003	490.41	273.36	5254.42	2819.08	53.65	1	30	2814.66	53.57
	2004	575.36	329.97	7958	4315	54.22	1	30	4315	54.22
	2005	669.5	402.1	9865	5551	56.27	1	30	5551	56.27
Huzhou	1996	291	-	5523	1452	26.29	2	11	-	-
	1997	304.16	-	5691	1524	26.78	-	-	-	-
	1998	319.2	-	5590	1820	32.56	-	-	-	-
	1999	335.2	-	5620	1825	32.47	-	-	-	-
	2000	343.2	-	5140	1800	35.02	-	-	-	-
	2001	653	-	5880	2185	37.16	4	10	205.0	3.49
	2002	696	253	5882	2262	38.46	4	10	282	4.79
	2003	1120.87	325.5	8057.28	5620.6	69.76	4	10	3451.6	42.84
	2004	1197.87	366.5	5234	2600	49.68	4	10	2600	49.68
	2005	1339.9	330.5	4998	3351	67.05	6	14.5	3193	63.89
Shanghai	1996	2898	-	228478	141503	61.93	13	49.3	-	-
	1997	3722.3	-	210960	150622	71.4	12	188.7	-	-
	1998	3651.07	-	289833	223343	77.06	34	111.7	-	-
	1999	4577	-	295984	208236	70.35	34	111.32	-	-
	2000	3736	-	193363	138857	71.71	27	101.11	-	-
	2001	3953.9	-	195029	120896.6	61.99	27	463	120896.6	61.99
	2002	4001.16	1333.35	192064	147624.25	76.86	34	489.54	147624.25	76.86
	2003	5882	1722	182236.0	150547	82.61	36	484.6	147511	80.95
	2004	6469	3228	205400	154193.4	75.07	38	442.6	152971	74.47
	2005	6933	3434	217175	153847.5	70.84	40	471	152570	70.25
Wuxi	1996	1288	-	16809	2145	12.76	1	20	-	-
	1997	1176	-	19056	9900	51.95	2	20	-	-
	1998	1113.12	-	18605	3485	18.73	2	21.5	-	-
	1999	1243.18	-	19494	9817	50.36	2	22	-	-
	2000	1255.73	-	18227	9291	50.97	2	21.5	-	-
	2001	2913.2	-	19121	9796.1	51.23	3	36.5	4065.4	21.26
	2002	3153.26	621	17842	10097.08	56.59	14	32.9	5534.08	31.02
	2003	3356.26	810.23	18010	11393	63.26	9	35.3	6723	37.33

							Municipal WWTP			
	2004	4633	1012	15858	11101	70	14	41.8	11101	70.00
	2005	5176	1375	19115	13785	72.12	16	47.8	13785	72.12
Changzhou	1996	714	-	9798	2511	25.63	4	1.85	-	-
	1997	736	-	9920	2656	26.77	3	7.5	-	-
	1998	817.61	-	10148	4667	45.99	3	7.5	-	-
	1999	893.64	-	12470	7939	63.66	3	12.5	-	-
	2000	928.98	-	11506	7937	68.98	3	12.5	-	-
	2001	1040.1	-	12453.5	8211	65.93	3	19	3753.0	30.14
	2002	1544.31	547.29	22156.97	18235.7	82.3	10	30.8	8519	38.45
	2003	2414.15	604.76	27227.28	22704.33	83.39	12	34.8	9426.25	34.62
	2004	2774.94	673.89	27010.6	22778	84.33	15	43.3	11204	41.48
	2005	2917.6	736.2	10853	7839	72.23	6	36	7839	72.23
Suzhou	1996	856	-	14989	7603	50.72	4	13	-	-
	1997	895	-	14288	7257	50.79	5	23	-	-
	1998	1022.31	-	16116	10522	65.29	5	23	-	-
	1999	1051.48	-	15026	10265	68.31	5	25	-	-
	2000	1097.18	-	14701	12869	80.74	5	25	-	-
	2001	1017.1	-	36178	28481.8	78.73	6	27.5	5087.7	14.06
	2002	1453.9	430.06	40494.68	30834.74	76.15	10	37.75	6548.46	16.17
	2003	1767.28	790.15	35958.57	28149.26	78.28	12	43.75	7531.66	20.95
	2004	3030.29	1127.94	32954.74	28854.92	87.56	15	50.45	10622.03	32.23
	2005	3609.8	1359.5	46497	33861	72.83	16	54.8	15629	33.61
Zhenjiang	1996	269	-	11523	5769	50.07	-	-	-	-
	1997	315	-	10163	5945	58.5	1	1.5	-	-
	1998	323.4	-	9025	5999	66.47	1	2	-	-
	1999	364.22	-	9098	6050	66.5	1	2	-	-
	2000	381.4	-	9973	6968	59.87	1	8	-	-
	2001	428.9	-	9506	6893.6	72.52	8	37.2	3380.5	35.56
	2002	465.53	38	8826.2	6225.33	70.53	10	38.35	3868.63	43.83
	2003	710.77	45.25	8279.4	6001.35	72.49	2	11	3341.35	40.36
	2004	851.41	260.86	10187.51	7404.01	72.68	2	11	4327.51	42.48
	2005	1092	335.4	11536	8758	75.92	5	12.5	4615	40.01

Notes:

1. Source(s): *China Urban Construction Statistics Yearbook* (1996-2005) (by MOC Comprehensive Accounting Division);
2. The TLB include the following cities: Hangzhou, Jiaxing, Huzhou, Shanghai, Wuxi, Changzhou, Suzhou, and Zhenjiang ;
3. "-" represents missing values in the *China Urban Construction Statistics Yearbook* (1996-2005);
4. The *China Urban Construction Statistics Yearbook* (1996-2001) does not include the "length of wastewater pipes (kilometer)"; the *China Urban Construction Statistics Yearbook* (1996-2000) does not include the "WWTPs treatment quantity ($x10^4$ m^3)";
5. No reliable official data has been found for the network wastewater collection rate, numbers of regular, semi, and non-operation WWTPs.

(2) Lack of Maintenance[6]

2 Limited by operational funds and personnel technical proficiency, some installed facilities experience rapid aging, corrosion, and hidden danger on safe operation.

(3) Over Polluted WWTP Inlet Water

6 Municipal WWTP Construction

3 A universal problem persists for the quality of the WWTP inlet water in almost all the cities. The over polluted inlet water affects the operations of the WWTPs and leads to non-compliance outlet water quality[7].

(4) Insufficient Operational Cost Recovery

2 Municipal WWTPs requires enormous initial investment and high operational costs. Imperial data from the constructed WWTPs suggest that, on average, the construction of a WWTP with a 10000-ton daily capacity costs 500×10^4 yuan, and operating of such a WWTP costs another 52×10^4 yuan per year. In order to remain in operation, some have kept raising debts; others have relied on government subsidies. Those who cannot even repay the construction costs have been forced out of operation.

(5) Low Collection Rate of Local Municipal WWT Fee

4 Low WWT fee collection. Under the national regulations, the local governments have made municipal WWT fee collection policies. However, in general most of the cities face difficulties in WWT fee collection, especially the fees from firms and users of self-supplied water sources, and have low WWT fee collection rates. This makes the self-raised fund unsustainable. The collection rates of WWT fee have been universally low in the surveyed cities[8].

(6) Lack of Economic Incentive[9]

5 The rates of the water tariff and WWT fees have been set relatively low to take into consideration the affordability of the urban residents. The fees are also set at fixed rates, which will not float with the amount of water use or wastewater discharge, thus creating little or no incentive for the users to reduce wastewater discharge.

4.2.4.4 Capacity, Effectiveness and Efficiency of Municipal WWTPs

(1) Environmental Benefits

1 Due to the lack of data of the installed WWTP treatment capacity during the 9th FYP, the following analysis will look at the benefits from the treatment capacity of the municipal WWTPs installed during the 10th FYP.

2 Analysis of the pollutants removal capacity of the constructed WWTPs (Table 4.2.4.4-1) will be limited to the COD and NH3-N reduction capacity in Wuxi, Changzhou, Suzhou, Zhenjiang, and Qingpu District of Shanghai during the 10th FYP. The lack of specific requirements of COD and NH3-N reduction objectives by the WWTPs in the TLB 10th FYP makes it difficult to evaluate the treatment capacity and environmental benefits of the constructed WWTPs. In addition, due to the data unavailability of the WWTPs COD and NH3-N reduction in Hangzhou, Huzhou, and Jiaxing, these 3 cities have been included from the analysis.

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[7] Operational Situation and Improvement Solutions to the Municipal WWTPs in China

[8] Solving WWTP operation through WWT fee collection.

[9] Study on Fee Collection from the Centralized Urban Domestic Wastewater Treatment

Table 4.2.4.4-1 WWTP Construction and Capacities in Wuxi, Changzhou, Suzhou, Zhenjiang and Shanghai Qingpu at the End of 10th FYP

Region	Planned capacity (x10^4 ton/day)	Actual capacity (x10^4 ton/day)	COD removed (ton/year)	NH_3-N removed (ton/year)
Wuxi	46.5	54.5	92589	3321.75
Changzhou	33.5	32.8	42873	2486.5
Suzhou	70	70.2	85148	82307
Zhenjiang	6.5	6.5	1022	194.3
Shanghai Qingpu	6.5	6.5	794.7	16.45
Hangzhou	73.7	46	-	-
Jiaxing	57.6 (sewer511.5km)	52	-	-
Luzhou	24.8 (sewer140km)	15	-	-

Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

(2) Economic Benefits

3 The operational cost of WWTPs correlates not only closely to the treatment processes selected but also the operational rate of the WWTPs. A low operation rate will lead to a much higher operational cost than it should have been. And besides the lack of wastewater distribution networks, the over design in treatment capacity has also led to the low operation rate of the WWTPs. This is particularly evident in newly developed urban areas. Although the WWTPs have been built, the relatively low population density and insufficient source wastewater will lead to at least partial idle facilities.

4 Currently, the major source for WWTPs' operational expenses is the collected WWT fee. Following the WWT tariff increase from 0.6 to 1.1-1.15 yuan/ton in the 4 prefecture-level cities in Jiangsu on March 1st, 2002, the county-level cities have raised their tariff to approximately 1 yuan/ton to ensure the operational cost recovery of the WWTPs. Starting from 2005, WWT tariffs have been adjusted around the Hangzhou-Jiaxing-Huzhou Cities region according to the requirements of *Circular on Accelerating the Establishment of WWT Tariff System* (Zhejiang-Pricing-Commercial [2005] No. 16) of the Zhejiang Province Pricing Bureau. By the end of November 2005, the WWT tariffs of residential domestic, regular industries, and non-profit organizations have been adjusted to 0.50, 1.20, and 1.00-1.10 yuan/ton respectively in the 3 prefecture-level cities. If the WWTPs treat only urban wastewater, the 0.50 yuan/ton WWT tariff will not recover the WWTP operation.

4.2.5 Factors Impacting Non-Point Source Discharge

1 The TLB 9th FYP has clearly articulated that the non-point source pollution is one of the pollution control targets and required to implement 8 non-point source pollution control demonstrative projects including agricultural non-point source pollution, ecological agricultural, and dredging of polluted sludge with a total investment 5400×10^4 yuan before 1998. Nevertheless, the TLB non-point source pollution prevention and control investment reached 2.9×10^8 yuan during the 9th FYP. The actually implemented projects included agricultural non-point source pollution prevention and control project at the "class one" protection zone along the Jiangsu and

Zhejiang lake banks and the lakeside protection zone and pre-reservoir projects to the west and southwest of the Tai Lake. The actual investment has far exceeded the 5400×10^4 yuan originally in the FYP. This is resulted from the gradual finding of the significance of non-point source pollution prevention and control during the 9th FYP implementation.

2 Although the non-point source pollution projects of the 9th FYP have been implemented, N and P pollutants from non-point sources were not effectively reduced, and the non-compliance indicators at the end of the 9th FYP have been TP and NH_3-N, because the dense water network favors the non-point source pollution entering to the TLB, and the agricultural non-point source pollution prevention and control lacks legal support and effective control technologies. During the 9th FYP, the central government did not implement monitoring of non-point source pollution, and only Zhejiang Province conducted province-wide non-point source pollution survey and monitoring at the end of the 9th FYP.

3 The 10th FYP has intensified non-point source pollution control. The 10th FYP has specified its non-point sources pollution control contents and investment requirements: 4 ecological restoration projects (20.8×10^8 yuan), 14 agricultural non-point source pollution control projects (10 in Jiangsu , 4 in Zhejiang ; 23.0×10^8 yuan). The Plan also articulates the specific objectives of the control programs: <u>Strickly control the scale of fenced aquaculture</u>: Limit the scale of fenced aqualcuture to under 1.5×10^4 mu before the end of 2002 using quota or other measures; adjust the aquaculture structure and limit the highly pulluting cultivating projects. <u>Emphasize the control of the livestock raising and husbunary pollution:</u> close off or relocate all the aqualcural sites within the lakeside class-one protection zone before the end of 2001; achieve universal wastewater discharge compliance of the large-scale breeding farms in the Suzhou, Wuxi, and Changzhou area before the end of 2002; achieve universal wastewater discharge compliance of all breeding farms by the end of 2003. <u>Emphasize the reduction of agricultural non-point source pollution:</u> prohibi the use of fertilizers and pesticides within a 5 km radius of the Tai Lake, limit the use in other areas in the watershed; guide and ecourage reduction of fertilizer and pesticide use, promote scientific fertilizer usage, and encourage the use of organic fertilizers; aim at reducing fertilizer and pesticide use to the national average before the end of 2003 and to the lowest by the end of 2005; develop water, fertilizer, and pesticide conservation agricultural production; establish ecological agricultural demonstration zones and non-environmental damage agricultural product, green and organic food bases. Plans to install online monitoring equipment, implement dynamic monitoring to monitor the water quality at the major inflows to the lake have been included in the TLB 10th FYP, but there is no plan for non-point source pollution monitoring.

4 The ecological restoration, ecological dredging, agricultural rural wastes centralized utilization demonstrative, livestock raising and husbunary comprehensive pollution control, and organic food base construction programs required by the 10th FYP have all been successfully implemented. For husbandry pollution, "prohibited areas," "limited areas," and required the environmental impact assessment for new breeding farms have been required. Ecological husbandry has been promoted. By the end of 2005, the "closing, merging, transforming" of the breeding farms have been completed. The successful promotion of healthy cultivation of aquatic products and closed management of aquacultural water body have effectively controlled the impacts on the external water system from the aquacultural tail water. For plantation pollution

prevention and control, the TLB has been actively promoting the development of practical technologies on highly effective ecological agriculture, the balanced fertilization, and returning straw stalk into the field.

5 Nevertheless, the implementation of the 10th FYP only alievated the non-point source pollution in the key areas. Particularly successful is the wide promotion of husbandry and healthy cultivation of aquatic products. The ever growing non-point source pollution still presents severe problems: intensive use of fertilizers and pesticides, widely dispersed livestock raising and husbunary, decreasing utilization of human and animal extracta with the increasing rural living standards, the relative high cost of centralized rural domestic pollution treatment, and the lack of effective collection-treatment system and the construction and operation mechanism. These issues have all made the agricultural non-point source pollution a growing and major N and P sources of pollution.

6 Realizing the lack of basic understanding of the non-point sources pollution, in 2005 MOA conducted a rural non-point sources pollution survey in the TLB. However, limited by funding and other resources, this survey alone did not provide sufficient information to understand the non-point sources pollution situations. As no monitoring of the non-point sources pollution in the TLB exists, even the official data has been insufficient for concluding the contribution rate of the non-point sources to the Tai Lake water body pollution.

7 Table 4.2.5-1 shows that the agricultural non-point source COD entering into the environment in the TLB is about 1-3 times of the point source contribution, and the non-point TN into the environment before 2000 is approximately same as the point source TN. During the 10th FYP, point source TN decreased, while the non-point source TN increased. As a result, by the end of the 10th FYP, agricultural non-point source TN entering into the environment has exceeded point source discharge. The agricultural non-point source TP entering into the environment approximately equaled that from the point sources prior to 2000. Although no point sources data at the end of the 10th FYP is available, the evolution of the shares between point and non-point sources is likely similar to that of TN. Although, unlike the point sources, a majority of non-point source pollutants will not end up in the water bodies, the agricultural non-point source pollution is still a big threat to the TLB water body.

Table 4.2.5-1 Agricultural Non-Point Source COD Discharge to Environment of TLB

Item	1994/1995[1]	2000	2004/2005[2]
Agricultural non-point source COD discharged to environment ($x10^4$ ton)	440616	437117	655085
Point source COD discharge to environment ($x10^4$ ton)	282404	491000	216161
Ratio of non-point sources COD to point source COD	1.6	0.9	3.0

Note:

1. Agricultural non-point sources COD discharged to environment were the estimated data of 1995. The point source COD discharged came from statistics of 1994.
2. Agricultural non-point sources COD discharged to environment were the estimated data of 2004. The point source COD discharged came from statistics of 2005.

Table 4.2.5-2 Agricultural Non-Point Source Ammonia Discharge to Environment in TLB

Item	1994/1995[1]	2000	2004/2005[2]
Agricultural non-point source TN discharged to environment (ton)	84126	120422	135533
Point source TN/NH_3-N discharge to environment (ton)	79552	129000[3]	19879[3]
Ratio of non-point sources TN to point source TN	1.1	0.9[4]	6.8

Note:

1. Agricultural non-point sources TN discharged to environment was the estimated data of 1995. The point source TN discharged was statistic data of 1994.
2. Agricultural non-point sources TN discharged to environment was the estimated data of 2004. The point source TN discharged was statistic data of 2005.
3. The data of 2000 and 2005were total NH_3-N.

Table 4.2.5-3 Agricultural Non-Point Source TP Discharge to Environment in TLB

Item	1994/1995[1]	2000	2004/2005[2]
Agricultural non-point source TP discharged to environment (ton)	9797	12706	15667
Point source TP discharge to environment (ton)	5660	14400	na
Ratio of non-point sources TP to point source TP	1.7	0.9	na

Note:

1. Agricultural non-point sources TP discharged to environment was the estimated data of 1995. The point source TP discharged was statistic data of 1994.
2. Agricultural non-point sources TN discharged to environment was the estimated data of 2004. The point source TN discharged was statistic data of 2005.

8 Besides the agricultural non-point sources, the urban non-point sources will also pollute the water bodies. However, since almost no previously existing studies or data could be found for the urban non-point sources in the TLB, this study will not be able to draw conclusions on the impact from the urban non-point sources.

9 In summary, (1) during the 9th and 10th FYPs, agricultural non-point sources pollution has not been effectively controlled; (2) the agricultural non-point sources pollution has become a noteworthy threat to the TLB water bodies; and (3) the studies and understanding of the HRB agricultural and urban non-point sources pollution are still quite limited.

5. Water Resource Review and Evaluation

5.1 Water Resource and its Impact on Water Environment

5.1.1 Change of the Water Resources

1 The TLB has a multi-year average rainfall of 1181 mm and annual total precipitation of $414 \times 10^8 m^3$. The rainfall distribution within and across the years has been uneven. The TLB water system centers at the Tai Lake and can be divided into upper stream and downstream sub-systems. The upper stream water system includes Tiaoxi, Yili River, Taoge, and Wujin Habor-Zhihu Harbor water systems. The downstream mainly consists of plane and river networks. The east part of the downstream centers on the Huangpu River, one of Tai Lake's major water division river ways. In the northern Yangtze-side water system, the Wangyu River is one of the two major water outlets of the Tai Lake. The TLB presents a smooth topography with river courses spreading across. Resisted by the tides, the Tai Lake water has a slow speed, volatile flows, highly complex afflux characteristics, and slow water level fluctuation. The TLB has a relatively small volume and thus small water storage capacity, but this is favorable to the mixing of the river and lake water.

2 Annual runoff varies significantly spatially within the watershed. The west Zhejiang area sees the maximum at $39.8 \times 10^8 m^3$, and the Tai Lake area sees the minimum at $5.35 \times 10^8 m^3$. In terms of monthly allocation, the runoff peaks in summer (June-August) and reaches its minimum in winters. The TLB 1956-2000 yearly water volume data suggests that the annual total water volume averages at $177.4 \times 10^8 m^3$, where the multi-year average the TLB surface water volume amounts to $161.5 \times 10^8 m^3$, and the groundwater volume amounts to $26 \times 10^8 m^3$. Table 5.1.1-1 shows the multi-year average (1956-2000) water volume in the TLB regions.

Table 5.1.1-1 Multi-Year Average Precipitation and Runoff in TLB

Region	Area (km^2)	Depth of precipitation (mm)	Depth of runoff (mm)	Total volume of runoff ($10^8 m^3$)
West lake area	7549	1115.3	366	27.6
West Zhejing area	5931	1452.3	722	42.9
Wu-Cheng-Xi-Yu area	3928	1065.4	370	14.5
Yang-Cheng-Ding-Mao area	4393	1065.9	355	15.6
Hangzhou-Jiaxing-Huzhou area	7436	1214.1	485	36.1
Tai Lake	3192	1126	245	7.8
Pudong and Puxi area	4466	1100.2	381	17
Total	36895	1177.3	438	161.5

3 Table 5.1.1-2 shows the runoff eigenvalues at major hydraulic monitoring stations.

Table 5.1.1-2 Runoff Eigenvalues at the Main Monitoring Stations

Water system	River name	Monitoring station	Catchment area (km^2)	# of years	Runoff on different guaranteed probability ($10^8 m^3$)				
					Average	20%	50%	75%	95%
Tiaoxi	East Tiaoxi	Pingjiao	1420	24	9.72	12.4	9.33	7.19	4.86
	West Tiaoxi	Fanjiacun	1940	24	13.9	17.7	13.3	10.6	7.23
Nanxi	Shahe	Shahe Reservoir	149	24	0.672	0.907	0.625	0.45	0.269
Tai Lake	Tiaoxi	Zhudaogang	235	24	1.4	1.82	1.33	1.02	0.658
Tai Lake	Tai Lake	Yangdianpian	7410	24	20.6	29.6	18.3	11.5	5.4

4 Following the floods in 1995, 1996, and 1999, the TLB has been mainly in its low water period. In 2000, the TLB surface water volume was only $116\times10^8 m^3$, a 23.8% drop compared to the regular years, and the total water volume was only $133.53\times10^8 m^3$, a 17.7% decrease. In particular, the past 3 years have seen a 37.7%-24.6% drop in the TLB water volume compared to its multi-year average. The Tai Lake has been in its relatively dry years.

Table 5.1.1-3 Water Resource of TLB (2003-2005)

Year	Total water resource ($10^8 m^3$)	Surface water resource ($10^8 m^3$)	Groundwater resource ($10^8 m^3$)
2003	110.6	95.3	36.9
2004	125.9	109.4	39.8
2005	133.7	118.8	39.4

Note: The value in the table includes water resource in Shanghai.

5 Table 5.1.1-4 exhibits the water volume in the major jurisdictions within TLB in 2005.

Table 5.1.1-4 Water Resources of each Province in TLB in 2005

Region	Water resource (108m3)		
	Surface water resource	Groundwater resource	Total water resource
Jiangsu	47.4	14.7	56.9
Zhejiang	49.0	17.0	53.5
Anhui	1.1	0.2	1.1

5.1.2 Watershed Water Usage Variations

1 Between 1997 and 2000, the TLB water use totaled approximately $290\times10^8 m^3$. In 2000 the watershed-wide water use reached $293\times10^8 m^3$, where agricultural water use accounted for $107.9\times10^8 m^3$, industrial water use took $41.7\times10^8 m^3$, domestic water use took $32.6\times10^8 m^3$, and thermal power plants took about $110.8\times10^8 m^3$. In 2000 the TLB per capita water resource amounted less than 375 m^3, but the current per capita water use has reached 797 m^3 (excluding the thermal power plants water use at 496 m^3). The watershed water resource has generally maintained its balance through diverting the Yangtze water and highly efficient water reuse. Nevertheless, constrained by the water pollution in the river network, the usage of the reused water is limited. Table 5.1.2-1 shows the water supply and use in the TLB between 2003 and 2005.

Table 5.1.2-1 Water Supply and Consumption in TLB (2003-200)

Year	Water supply (108m3)	Water consumption (108m3)
2003	306.3	306.3
2004	344.3	344.3
2005	354.5	354.5

Note: The amounts of water supply and consumption includes Shanghai.

2 A comparison among the water uses in the major administrative districts in the TLB in 2005 suggests that the production water use is still the major cause of water consumption in the TLB (Table 5.1.2-2).

Table 5.1.2-2 Regional Water Consumption in TLB

Region	Water consumption (108 m3)			
	Domestic water consumption	Industrial water consumption	Ecological water consumption	Total water consumption
Jiangsu	9.4	164.7	1.0	175.1
Zhejiang	4.7	52.2	3.2	64.1
Anhui	0.01	0.21	0.0	0.2

3 Together with the economic development in the cities and the improvement of living standards, grows the exploitation of deep groundwater. In the mid 1990s both quantity and scale of exploitation peaked. In 1996, the watershed-wide groundwater exploitation totaled $7.4\times10^8 m^3$. By 2000, this numbers shrunk to $5.25\times10^8 m^3$, where Jiangsu took $2.88\times10^8 m^3$, Zhejiang took $1.5\times10^8 m^3$, and Shanghai took $0.87\times10^8 m^3$.

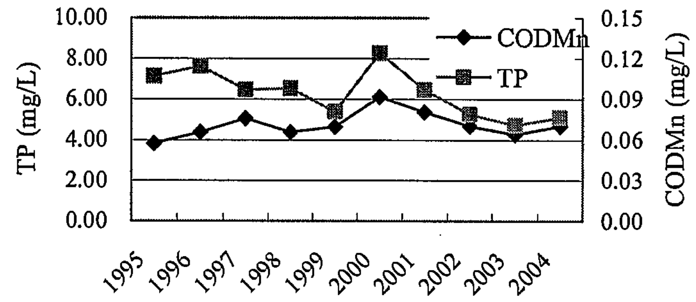
4 The over exploitation of groundwater has led to severe ground subsidence, the lowering of the flood prevention and diversion engineering quality, and distortion of the standard point. Estimates show that the total exploitable deep groundwater in the Suzhou-Wuxi-Changzhou area approximates $1.5\times10^8 m^3$, however, by the end of 2000 exploited groundwater in this area has reached $2.88\times10^8 m^3$, about 1.92 times of the exploitable amount. Till 2003, a 5483 km^2 wide, 80 m deep grand groundwater funnel has been formed around Suzhou, Wuxi, and Changzhou.

5.1.3 Impact from Water Quantity Change on Water Quality

1 Throughout the 9th and 10th FYPs, the TLB has experienced floods in 1995, 1996, and 1999. Since the low water year in 2000, the TLB has been in its dry period.

2 The 1999 flood was triggered by the rainfall during the rainy season. The maximum 30-day rainfall in the Hangzhou-Jiaxing-Huzhou Cities, West Zhejiang District, and the Tai Lake area reached record high since 1922. Correspondingly, the typical pollutants indicators in 1999 have been low. The low water year 2000 saw the drop of water level and water volume in the rivers and lakes as well as the decrease in the environmental capacity and water body self-purification capacity. Figure 5.1.3-1 exhibits the densities of the major pollution indicators in the TBL during 2000.

Figure 5.1.3-1 Annual Changes in COD_{Mn} and TP in the Tai Lake



Note: The data of 2000 come from the monitoring results in Tai Lake water pollution control and prevention 9th FYP, which include 20 sections in the lake, 28 sections in the rivers to the lake and 50 sections of the boundaries that rivers pass.

3 Table 5.1.3-1 shows assessment results of the TLB river water quality in 2000. The results suggest that the TLB water quality correlates with the water quantity – the water quality during the high water seasons is much better than during the dry water season (QIN Boqiang, et al., 2004).

Table 5.1.3-1 TLB River Water Quality Assessment 2000

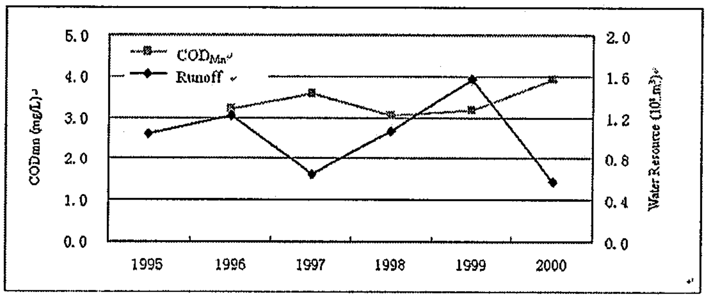
Time period	Class II		Class III		Class IV		Class V		Worse than Class V	
	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)	Length of the river (km)	Ratio (%)
Low water season	4	0.2	329	20.6	363	22.7	505	31.6	397	24.9
High water season	21	1.3	260	16.3	513	32.1	465	29.1	339	21.2
Whole year	12	0.7	299	18.7	434	27.2	484	30.3	369	23.1

4 Noticeable is that although since 2000 the TLB has been suffering from the low water volume (Table 5.1.3-1) and reduced environment capacity triggered by persistent dry period, and certain areas have been experiencing nitrification, the typical pollutants indicators have showed the trend of decreased, thanks to the TLB10th FYP pollutants discharge TMLL.

Case on the Nexus between the TLB Water Quantity and Quality

Figure 5.1.3-2 exhibits the dynamics between the average annual runoff and COD_{Mn}, a water quality indicator, at Pingyao Station of the Tiaoxi water system at the TLB upper stream. The graph indicates that the high COD_{Mn} levels corresponded to low runoff at 1997 and 2000.

Figure 5.1.3-2 Relationship of Water Flow-rate and Water Quality



Monitoring station	Year	Flow-rate	CODMn
Pingyao	1995	1.05	-
Pingyao	1996	1.22	3.20
Pingyao	1997	0.66	3.58
Pingyao	1998	1.07	3.04
Pingyao	1999	1.58	3.18
Pingyao	2000	0.58	3.94

5.2 Impact of Hydraulic Facilities on Water Environment

5.2.1 Hydraulic Facilities

1 Geared to the dense water network in the TLB, low water body exchange capacity and the need to ensuring production and domestic water use objectives, the current TLB hydraulic engineering and operation emphasize on flood diversion coordinated flood storage with its main objectives in flood prevention. The TLB hydraulic engineering has been in long standing. The hydraulic engineering in the TLB can be categorized to reservoirs, river dikes and seawalls, and the TLB Pollution Control Hydraulic Projects.

(1) Reservoirs

2 Table 5.2.1-1 lists the current 7 major reservoirs in the TLB. They in total count as a storage volume of 10×10^8 m^3, where 4.94×10^8 m^3 is designated to flood prevention.

Table 5.2.1-1 Reservoirs in TLB

Reservoir	Storage capacity (108 m3)	Catchment area (km2)	Functions
Qingshan	2.15	603	Major in flood prevention, combined with irrigation and power generation.
Duihekou	1.16	164.7	-
Laoshikan	1.17	272	Flood prevention, power generation, irrigation.
Fushi	2.18	328	Major in flood prevention
Shahe	1.03	148.5	Major in flood prevention, power generation, and aquiculture.
Daxi	1.71	90	Major in flood prevention and irrigation, combined with power generation and aquiculture.
Hengshan	1.12	154.8	Major in flood prevention and water supply, combined with power generation and aquiculture.

3 The TLB reservoirs have been constructed for a relatively long period and designed mainly for flood prevention, irrigation, and power generation.

(2) River dikes and seawalls

4 With flood prevention as the major objective, the river dikes and seawalls in the TLB have basically been furnished up to the defense standard for climatic tidal level of 50 years plus 11 levels of wind, some have been designed for climatic tidal level of 100 years. The entire watershed currently has a total dike area of 14500km^2 (among which 8934 km^2 is farmland), covering over 60% of the TLB plane area and provide a flood division capacity over 10000 m^3/s (Table 5.2.1-2).

Table 5.2.1-2 Levees in the TLB

Province	Sea levee (km)	River levee (km)	# of gate	Anti-tide bank protection (km)
Zhejiang	-	2500	1	134
Shanghai	-	-	8	171
Jiangsu	-	-	20	207

(3) TLB Pollution Control Hydraulic Projects

5 With the major objective as to improve the flood prevention and diversion capacity, 11 Key TLB Pollution Control Hydraulic Projects, have been implemented since 1991. The major projects include flood diversion and levee engineering. Specifically, they are: Taipu River, Wangyu River, Hangzhou-Jiaxing-Huzhou Cities South Diversion Channel, Link Lake Main Dike, East-West Tiaoxi Flood Prevention Project, West Lake Diversion and Discharging Project, Wuchengxi Diversion and Blocking Port, Red Flag Pond, Hangzhou-Jiaxing-Huzhou Cities North Diversion Channel, and the Huangpu River Mainstream Flood Prevention Project.

5.2.2 Features of Hydraulic Facilities

1 Similar to the HRB, limited by the objectives of the TLB hydraulic engineering construction and operation, the current spatial distribution of the existing hydraulic facilities in the TLB does not coordinate with need and planning of the pollution control in the watershed.

2 Reservoirs, dredging, enforcing levees and seawalls and plane dike area have been the major contents of the TLB hydraulic engineering. Building upon the previous long-term hydraulic engineering, in 1991 the Key TLB Pollution Control Hydraulic Projects took over and became the main contents of the current TLB hydraulic engineering. Flood prevention has been the major objective of the current hydraulic engineering and operations, where the upper stream and the lake area have set flood prevention levees as its major objective, and the downstream along the Yangtze River mainly targets at flood diversion and directing, which diverts flood to the Yangtze River during high waters and draws water from the Yangtze River during low waters.

3 Most of the large and middle scale reservoirs are located around Tiaoxi water system of the west Zhejiang hilly area at the TLB upper stream and the South River water system of the west lake Yili hilly area. The 11 Key TLB Pollution Control Hydraulic Projects can be categorized to 3 classes: the first category directly relates to the Tai Lake flood prevention, which includes the Taipu River, Wangyu River, Link Lake Dike, and Hangzhou-Jiaxing-Huzhou Cities South Diversion project that directly diverts the Tai Lake flood; the second is regional projects that aim at regional flood control; the third is the province boarder projects aiming at resolving the transjurisdictional hydraulic disputes and diverting water from the neighboring province.

4 The existing hydraulic engineering construction and planning do not fully take into consideration the factors of watershed pollutants discharge and impacts on the TLB water environment.

5.2.3 Impacts from Hydraulic Operations

1 The spatial and temporal distribution of the TLB water resources and the objectives of ensuring production and domestic water use have required the current TLB hydraulic engineering and operation emphasizing on flood prevention, irrigation and aquaculture. The gap between objectives in pollution control and hydraulic engineering has caused negative impacts on the environmental protection.

(1) Engineering and Operation of Flood Prevention

2 The TLB flood prevention is mainly consisted of levee, diversion projects, and polder claim. The hydraulic engineering for flood prevention is achieved mainly through flood storage at the reserved storage at the Tai Lake and the diversion through the Taipu River and the Wangyu River.

3 The TLB once had favorable natural conditions, with interlinked rivers and lakes to even out water resources during draughts and floods. Nevertheless, dredging and reclamation of land have reduced the TLB's flood resistance capacity and completely changed the flora in the watershed, which led to the reduction of water self-purification capacity. Topped with obstructed water exchanged, the water quality deteriorated in the lake, and nitrification began. The river levee construction and river way widening converted the natural river ways into artificial systems, destructed the river- and lake-side wetland ecosystems, and led to reduced water body self-purification capacity.

4 While the flood prevention and operation prevents floods during the flood seasons, it brings negative impacts to the water body pollution prevention and control during drier seasons.

The 1991 flood brought a watershed-wide average of a once-every-25-year, second record high rainfall. Only in the west and north lake area the precipitation broke the record to a once-every-100-to-200-year level. However, the highest water level recorded for the year (4.78m) had exceeded the historical high in 1954 and triggered the launching of the Key TLB Pollution Control Hydraulic Projects.

(2) Aquaculture

5 The TLB is one of China's key freshwater aquacultural bases. The TLB aquacultural produce alone takes to approximately 10% of the total national output. With over 30 species, the Tai Lake provides wide, shallow habitats suitable for fish migration and spawning. The aquaculture requires a relatively stable water body. But the artificial stability facilitated by hydraulic engineering has significantly reduced the water body self-purification capacity and facilitated nitrification.

The east Tai Lake houses one of China's most developed aquaculture water body. In a total of 131 km^2, the east Tai Lake has an aquacultural area of 5400 hm^2. Nevertheless, the east Tai Lake is also a major water outlet of the Tai Lake. It provides flood storage and diversion function and supplies water to Shanghai and east Zhejiang. The large amounts of aquacultural feeds in the water body add to its N and P loads, and the lowered water body liquidity promoted the algae growth, setting the favored conditions for eutrophication in motion. The monoculture of fenced aquaculture further facilitates water body eutrophication.

(3) Water Supply Hydraulic Engineering

6 The water supply engineering in the TLB is mainly consisted of upper stream reservoirs and downstream diversion and direction engineering. Generally, the TLB water quantity will be able to meet the production and domestic water demands. Usually only during draught when the water shortage occurs will water from the Yangtze River be needed.

7 Currently, the "Coordinated Water Quality and Quantity Operation" has been receiving more and more attention, as it improves the water body self-purification capacity and water environment capacity by using the existing hydraulic facilities. Through directing the Yangtze River water into the Tai Lake through the Wangyu River, the coordinated operation accelerates water flow and shortens the Tai Lake water trading cycles.

8 When alleviating the water shortage in certain areas within the watershed, the water supply engineering that employs the Yangtze River water to shorten the Tai Lake water trading cycle has received growing attention due to the positive influence to the Tai Lake and its downstream water qualities. However, the quality of water from the Yangtze River, as well as its water environment and water ecological conditions, is raising new concerns for the potential negative influence it could bring about to the TLB water environment: (1) Mud from the Yangtze River water body subsides after entering into the Tai Lake due to reduced flow rate. The mud settlement alters the original water and sediment balance and leads to accumulated siltation in the river networks. (2) The pollution discharge to the source water area (e.g., the banks of the Wangyu River) will influence the water environment in the water receiving area. (3) The aquatic life originally in the Yangtze River may enter the TLB through the water supply operations and potentially threat the original flora and fauna in the TLB.

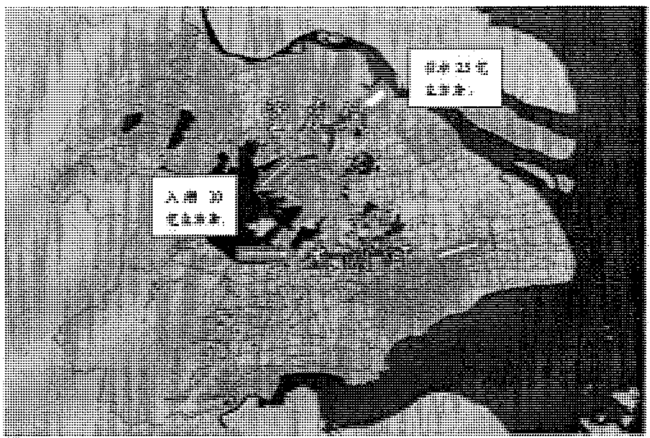
9 The water supply engineering and "Coordinated Water Quality and Quantity Operation" will bring positive influence to the TBL water environment in the short run; however, in the long term, they could possibly bring negative influence to both the watershed water environment and water ecological conditions.

Case of "Aiding Tai Lake with Yangtze Water" Engineering Impacting the Water Environment

On January 30th, 2002, the "Aiding Tai Lake with Yangtze Water" experiment officially launched (Figure 5.2.3-1). By April 3rd, when the Phase I pumping ended, a total of 10.68×10^8 m^3 water has been directed through the Changshu hydraulic facility on the Wangyu River, $6.79 \times 10^8 m^3$ water through the Wangting hydraulic facility to the Tai Lake in a total of 64 days.

The 2002 water quality and quantity monitoring data of the Phase I operation indicates that the proportions of water quality of Class III and better have increased since the water direction. During the Phase I experiment, the water quality in the Tai Lake has been good in general and further improved. The flagship indicator of eutrophication, TP density, has reached its lowest level in 5 years. Because the lake water entrance was not completely shut during the experiment, some wastewater entered the Tai Lake and affected the water quality.

Figure 5.2.3-1 Demonstration of the Water Flows during the "Aiding Tai Lake with Yangtze Water" Experiment (LIU Chunsheng and WU Haoyun, 2003)



Noteworthy is that the experiment also incurred certain negative impacts. The hydraulic conditions of the east and Tiaoxi at the Tai Lake upper stream have been altered. The interlinked river networks and slow water speed have lead to low water body self-purification capacity and could easily trigger downstream cross-pollution. Meanwhile, artificial engineering of the river ways destructed the riverside wetlands. The link lake flood prevention dike disconnected the transitional area between the river and the Tai Lake wetland and reduced the natural pollutants purification effects of wetlands.

10 In summary, the TLB water resource distribution and variation are important natural factors that influence the watershed water pollution prevention and control. The overall pollutant contents had been relatively high during 2000, a typical dry water year. The watershed flood prevention engineering negatively impacts the watershed water environment during the dry seasons while provide flood prevention in flood seasons. Although the coordinated watershed-wide water supply engineering and "coordinated storage and diversion" measures could improve the water quality in the short run. They may incur long-term negative effects to the water environment and water ecological conditions.

11 The comprehensive analysis on the water quantity variation of the Huai River and the Tai Lake and on the impacts from hydraulic engineering and operation on the watershed water environment conditions concludes that the gaps between the management objectives of watershed water resource, water environment planning and management, hydraulic engineering and operation, and pollution sources distribution have largely caused the negative impacts from current hydraulic engineering and operation to the water environment.

12 Therefore, a number of recommendations have been provided overcome this problem:

13 Take into consideration of both water resource conditions and hydraulic engineering operation objectives during watershed water pollution prevention and control planning and implementation. Specifically, 2 steps are recommended: (1) understand the water environment capacity of various areas within the watershed, especially those close to the major pollution sources according to the water resource spatial and temporal variations and the current distribution of hydraulic facilities, and (2) support the watershed water pollution prevention and control planning and implementation according to the spatial and temporal attributes of the watershed water environment capacity.

14 Hydraulic engineering and operation will also need to consider the needs of overall watershed water pollution prevention and control and water environmental and ecological protection objectives. When considering the watershed-wide production and domestic water use and flood prevention objectives, the objectives of improving water environment capacity and ensuring the ecological water demands at various levels also need to be considered during the hydraulic engineering and operation.

15 Comprehensively plan and control the pollution discharge in the watershed by considering and using the built hydraulic facilities in the watershed; achieve coordinated management of hydraulic facility and pollution sources by integrating the distributional attributes of the major pollution sources during the planning of new hydraulic facilities.

16 Through the unified planning and dredging of the water quality control sections, integrate the water quality monitoring resources of the WRBs and EPBs, establish the overall monitoring system of watershed water quality, avoid waste of resources, and unify the monitoring indicators, methods, and results.

17 Through coordinating the policy, management mechanism and measures of the hydraulic, environmental and ecological protection, establish a watershed-wide coordinating mechanism of water resource, environment and ecological management to achieve the conformity of policy, planning, and implementation objectives on the watershed-wide water resource and quality management, in order to more effectively allocate water resources between the mainstream and major tributaries according to the variations in water flows and water quality conditions, so as to ensure the basic self-purification capacity of the water body and to fulfill the integrated management of water quality and quantity at watershed level.

18 Conduct watershed comprehensive planning of the current built hydraulic facilities, pollution sources and water quality monitoring stations to fulfill resource sharing and integrated management of water quality and quantity at watershed level and avoid the negative impacts on water pollution prevention and control caused by the current policy-making and the objective gaps in planning and management.

6. Legal Review and Evaluation

6.1 Laws

6.1.1 Basic Legislative Framework of China's Transjurisdictional Water Environment Management and Disputes Resolution

1 China's legislation on transjurisdictional water environment management mainly include:

(1) Constitution on water environment management

2 The Constitution is the fundamental law of China. It is the country's ultimate statute authenticated by the highest authority of the PRC. In China's legal system, Constitution has the highest legal status and authority. Article 9 of the *Constitution* of the PRC specifies: "All natural resources including minerals, streams, forests, mountains, grassland, wasteland, and shoals belong to the State, that is, all the people." Its Article clearly defines that "The State protects and improves the living and ecological environment, and prevents pollution and other public hazards. The state organizes and encourages afforestation and the protection of existing forests and trees. "

(2) Legal specifications of transjurisdictional water environment management and disputes resolution

3 The National People's Congress and its Standing Committee execute the state legislative authority. The legal status and effectiveness of its laws are under the *Constitution* but are higher than the regulatory statutes by other state agencies. They are the legal basis of other laws.

4 a. ***General Principles of the Civil Law*** (issued on April 12, 1986, enacted on January 1, 1987) Article 83 and 124.

5 b. ***Property Law*** (issued on March 16, 2007, to be enacted on October 1, 2007) Article 32, 33, 35-38, 117, 118-123.

6 c. ***Criminal Law*** (issued on March 14, 1997 and enacted on October 1, 1997) Article 338-346, and Article 408. Prior to the Criminal Law revised on March 14, 1997 and effective on October 1, 1997, no criminal conducts have been defined in China's environmental offense. As a result, environmental offenses are resolved with administrative means such as fines, shutting of plants, and dismissal of the heads. The 1997 revision of the Criminal Law has set the severe destruction of land, air, water bodies, forests and other natural resources as crimes. In Part II Specific Provisions of the Criminal Law, Chapter VI Section 6 "Crimes of Undermining Protection of Environmental Resources" clearly spells out environmental crimes of various types and the punishments for severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health.

7 d. ***Environmental Protection Act.*** The Environmental Protection Act spells out the

basic principles and institutions of environmental protection in China. The Chinese environmental legislative and law practices have regarded it as the environmental basic law of China. It has clearly defined the environmental protection authorities, subject of water pollution control, and the transjurisdictional pollution prevention and control.

8 For example, **Article 7** reads that "The competent department of environmental protection administration under the State Council shall conduct unified supervision and management of the environmental protection work throughout the country. The competent departments of environmental protection administration of the local people's governments at or above the county level shall conduct unified supervision and management of the environmental protection work within areas under their jurisdiction. The state administrative department of marine affairs, the harbor superintendency administration, the fisheries administration and fishing harbor superintendency agencies, the environmental protection department of the armed forces and the administrative departments of public security, transportation, railways and civil aviation at various levels shall, in accordance with the provisions of relevant laws, conduct supervision and management of the prevention and control of environmental pollution. The competent administrative departments of land, minerals, forestry, agriculture and water conservancy of the people's governments at or above the county level shall, in accordance with the provisions of relevant laws, conduct supervision and management of the protection of natural resources."

9 **Article 10** reads that "The competent department of environmental protection administration under the State Council shall, in accordance with the national standards for environment quality and the country's economic and technological conditions, establish the national standards for the discharge of pollutants. The people's governments of provinces, autonomous regions and municipalities directly under the Central Government may establish their local standards for the discharge of pollutants for items not specified in the national standards; with regard to items already specified in the national standards, they may set local standards which are more stringent than the national standards and report the same to the competent department of environmental protection administration under the State Council for the record. Units that discharge pollutants in areas where the local standards for the discharge of pollutants have been established shall observe such local standards."

10 **Article 12** reads that "The competent departments of environmental protection administration of the people's governments at or above the county level shall, in conjunction with relevant departments, make an investigation and an assessment of the environmental situation within areas under their jurisdiction, draw up plans for environmental protection which shall, subject to overall balancing by the department of planning, be submitted to the people's government at the same level for approval before implementation."

11 **Article 15** reads that "Work for the prevention and control of the environmental pollution and damage that involve various administrative areas shall be conducted by the

relevant local people's governments through negotiation, or by decision of the people's government at a higher level through mediation."

12 **Article 16** reads that "The local people's governments at various levels shall be responsible for the environment quality of areas under their jurisdiction and take measures to improve the environment quality."

13 **Article 24** reads that "Units that cause environmental pollution and other public hazards shall incorporate the work of environmental protection into their plans and establish a responsibility system for environmental protection, and must adopt effective measures to prevent and control the pollution and harms caused to the environment by waste gas, waste water, waste residues, dust, malodorous gases, radioactive substances, noise, vibration and electromagnetic radiation generated in the course of production, construction or other activities."

14 **Article 27** reads "Enterprises and institutions discharging pollutants must registered according to the regulation issued by the environmental protection administration under the State Council.

15 **Article 28** reads that "Enterprises and institutions discharging pollutants in excess of the prescribed national or local discharge standards shall pay a fee for excessive discharge according to state provisions and shall assume responsibility for eliminating and controlling the pollution. The provisions of the Law on Prevention and Control of Water Pollution shall be complied with where they are applicable. The income derived from the fee levied for the excessive discharge of pollutants must be used for the prevention and control of pollution and shall not be appropriated for other purposes. The specific measures thereof shall be prescribed by the State Council."

16 **Article 29** read that "If an enterprise or institution has caused severe environmental pollution, it shall be required to eliminate and control the pollution within a certain period of time. For enterprises and institutions directly under the jurisdiction of the Central Government or the people's government of a province, an autonomous region, or a municipality directly under the Central Government, the decision on a deadline for the elimination or control of pollution shall be made by the people's government of the province, autonomous region and the municipality directly under the Central Government. For enterprises and institutions under the jurisdiction of a people's government at or below the city or county level, such decision shall be made by the people's government of the city or county. Such enterprises and institutions shall accomplish the elimination or control of pollution within the specified period of time."

17 e. Other major laws concerning water environment protection include:

- The ***Water Act*** (issued on January 21, 1988, revised on August 29th, 2002). The new *Water Act* has been enriched from the original 7 chapters, 53 articles to 8 chapters, 82 articles. The transjurisdictional water environment management represents an important revision. The revised law granted the title of monitoring and law enforcement to the watershed management authorities.

- ***Water Pollution Control and Prevention Act*** (issued in 1984, revised on May 15th, 1996) is a law specialized in water pollution prevention and control. Its Article 10 addresses the planning and execution of transjurisdictional river pollution control and prevention. Article 18 clarifies the water quality monitoring of inter-provincial, key watersheds identified by the state. Article 26 identifies the dispute resolutions to transjurisdictional water pollution issues.

- ***Water and Soil Retention Act*** (issued on June 29th, 1991). Article 31 addresses the transjurisdictional soil erosion prevention and control disputes.

- ***Flood Prevention Act*** (issued on August 29th, 1997). Article 2 and 5 address the transjurisdictional flood prevention.

- ***Fishery Law*** (issued in 1986, revised in October 2000). Article 7 in the new *Fishery Law* specifies the fishery and fishing quota management in transjurisdictional.

(3) Administrative statutes and regulatory policies

18 Administrative statutes are provisions, regulations, circulars, and decisions concerning the administration of the state issued by the State Council according to the Constitute and other laws.

19 a. ***Provisions on River way Management*** (issued on June 3rd, 1988 by the State Council). Article 5, Item 2.

20 b. ***Provisions on Flood Prevention*** (issued on July 2nd, 1991 by the State Council). Article 6, 11-13, 18, 34.

21 c. ***Implementive Provisions on Water Use Permitting System*** (August 1, 1993 issued by the State Council). Article 6.

22 d. ***Interim Provisions on the HRB Water Pollution Control and Prevention*** (State Council Order No. 183 on August 8th, 1995) is China's first formal administrative statute on trans-watershed water pollution control and prevention.

23 e. ***Circular on Trial of the HRB Municipal WWT Fee*** (June 4th, 1997) specifies the collection, management, and use of the HRB municipal WWT fee.

24 f. ***Provisions on Interest Subsidy to Liao River Watershed Water Pollution Control and Prevention Projects Pollutants Discharge Fee*** (December 15th, 1997).

25 g. ***Reply on the 9th FYP and 2010 Plan of the HRB Water Pollution Control and Prevention by the State Council*** has issued unified comprehensive planning and management requirements.

26 h. ***Reply on the 9th FYP and 2010 Plan of the TLB Water Pollution Control and Prevention by the State Council*** (January 6th, 1998).

27 i. ***Circular on the Approval of the Huai and Hai Rivers Watershed Water Pollution Control and Prevention Plan by the Office of the State Council*** (March 11th, 1999).

28 j. ***Circular on the Approval of the 9th FYP and 2010 Plan of the Liao River Watershed Water Pollution Control and Prevention by the State Council***

29 k. ***Implementive Provisions on Water Pollution Control and Prevention Act*** (March 24th, 2002) strengthens the management of transjurisdictional water pollution control and prevention.

(4) Administrative rules

30 Except the national laws and acts on water environment management and the State Council administrative statutes, relevant agencies under the State Council also issue administrative rules on the water environment management. A number of such rules on transjurisdictional water environment management, on water pollution control and prevention, include:

31 a. ***Interim Provisions on Water Pollutants Discharge Permits Management***: Article 13, 21

32 b. ***Pollution Prevention and Control Provisions of the Drinking Water Source Protection Zone***: Article 5, 6, 21

33 c. ***Procedural Specifications of Fishery Water System Polluting Incidents Investigation and Handling***: Article 11

34 d. ***Management Provisions on Natural Protection Zone for Aquatic Animals and Plants***

35 e. ***Management Provisions on Ships and Coastal Solid Waste pollution Prevention in the Yangtze River Water System***

36 f. ***Trial Management Provisions on Huai River and the Tai Lake Key Water Pollutants Discharge Permits (2001)*** is the first administrative rule on watershed pollution prevention and control permits management.

37 g. ***Circular on Strengthen Environmental Monitoring and Management and Pollution Incidents Prevention during Low Water Seasons (2001)***

(5) Local legislations

38 Chapter 4 of the *Legislation Act* specifies that the People's Congress and its standing committee of provinces, autonomous regions, and municipalities may issue local laws and regulations according to the local conditions and needs, provided that the local legislations do not conflict with the Constitute, laws, and administrative rules. The People's Congresses at autonomous regions are entitled to issue autonomy regulations based on local political, economic and cultural needs. Ministries and committees under the State Council, People's Bank of China, Audit Commission and other direct administrative management subordinating agencies may issue regulations within their own authorities according to the laws and the administrative statutes, orders, and decisions of the State Council. Local governments issued transjurisdictional water environment management legislations. The

table below is the water environment management regulations and policies in the TLB provinces.

Table 6.1.1-1 Provincial Policy and Regulation on Water Environmental Management in TLB

Province	Policy and regulation
Zhejiang	Measures of Zhejiang Province on Implementation of *PRC Water Pollution Control and Prevention Act* (July 9,1996)
	Decision on the Establishment of Ecological Province from Zhejiang Province People's Congress Standing Committee (June 27, 2003)
	Management Measures on Zhejiang Province Construction Project Environmental Protection (December 15, 2003)
	Zhejiang Province Environmental Supervision Measures (September 1, 1999)
	Hangzhou-Jiaxing-Huzhou District Water Pollution Control and Prevention 10th FYP (2001)
	Circular on the Strengthening of Rural Area Agricultural Pollution Control and Prevention from Province EPB and Province Agricultural Department (2002)
	Circular on the Strengthening of Livestock and Poultry Breeding Pollution Control and Prevention (2002)
	Standard and Management Regulation on Zhejiang Province Ecological Village Construction (2002)
	Circular on Expediting the Development of Environmental Protection Industry (2002)
	Measures on Sorting and Management of Zhejiang Province Construction Project Environmental Protection (2002)
	Circular on Extending Authorization of City/County regarding Construction Project Environmental Protection Management (2002)
	Zhejiang Province Ecological Construction Plan (2003)
	Mayor's Responsibility Pledge of Ecological Province Construction Objectives between 2003 and 2007 (2003)
	Assessment Measures on Zhejiang Province Ecological Construction (2003)
	Assessment Indicators of Ecological Province Construction (2003)
	Tasks of Cities in 2003 on Ecological Province Construction (2003)
	Circular on the Rectification of Illegal Discharge Pollutant Enterprise to Ensure the Citizen's Health (2003)
	Zhejiang Province Construction Project Environmental Protection Audit and Check Records Measures (2003)
	Zhejiang Province Construction Project "Three Synchronous" Management (2003)
	Regulation on the Environmental Protection Approval of Zhejiang Province Construction Project (2003)
	Prescript on the Strengthening of Supervision of Zhejiang Province Construction Project "Three Synchronous" (2004)
	Circular on the Environmental Supervision in the Construction Project (2004)
	Zhejiang Province Circulation Economic Development (2005)
	Circular on Zhejiang Province Government Improvement to the Ecological Compensation Mechanism (2005)
	Circular on the Strengthening of the Industrial New Pollution Control
	Circular on the Compensation Policy of Enterprises Moving, Changing Product or Close because of Environmental Pollution
	Province Environmental Protection Rectification Reception Regulation
	Zhejiang Province Pollutant Discharge Tariff Collection and Usage Management
	Zhejiang Province Environmental Pollution and Ecological Damage Emergency Reaction Plan

Province	Policy and regulation
Shanghai	Shanghai Environmental Protection 9th FYP and 2010 Long Term Plan Shanghai Environmental Protection 10th FYP Shanghai Water Environmental Protection and Pollution Control - the 10th FYP Shanghai Environmental Protection Regulation (1994, 1997, 2005, 2006) Shanghai Government Respond to the People's Letter and Visit Regulation (2003) Shanghai Restaurant Service Environmental Pollution Control Management Measures (2004) Shanghai Livestock and Poultry Breeding Management Measures (2004) Measures of Shanghai on the Implementation of PRC EIA Law (2004) Shanghai Administration Permit Regulation 2005) Interpreting of the Shanghai Environmental Protection Regulation (2006) Shanghai EPB Administration Permit Operation Process (2006) Circular on the Management of Construction Project EIA (2005) Circular on the Adjusting of the Ranges of Authorization on Pollution Control with Limited Period (2005) Circular on the Implementation of *Environmental Pollution Control Facility Operation License Management* (2005) Circular on the Management of the Enterprise Pollution Discharge Point Shanghai Drinking Water Sources Pollution Control Measures Clean Production Audit Regulation (2004) Circular on the *ISO14000 National Demonstration Area Management* (2006) Circular on the Clean Production Audit Process (2005) Shanghai EPB Environmental Pollution Incident and Dispute Supervision and Monitoring Response Plan Circular on the Shanghai Water Environmental Function Zone Plan Circular on the Shanghai Water Environmental Function Zone Borderline Circular on Administration Audit, Enforcement and Punish Regulation in Shanghai Environmental Protection System Circular on the Regulation of Calling to Account the Official Regarding Environmental Protection Noncompliance Behavior (2004) Circular on the Implementation of the *PRC Clean Production Promotion Law*
Jiangsu	Jiangsu Province Environmental Protection Regulation (1993) Jiangsu Province Water Resource Management Regulation (1993) Jiangsu Province Pollutants Discharge TMLLs Regulation (1994) Circular on Promotion of Environmental Protection by Credit Loan Policy, Jiangsu Province EPB and PRC Bank Jiangsu Branch (1996) Jiangsu Province Pollution Control Fund Management Measures, Jiangsu Province Finance Department, Province EPB (1996) Circular on the Implementation of Clean Production Audit, Jiangsu Province (1996) Circular on the Strengthening of Environmental Protection, Jiangsu Province (1996) Policy on the Expediting of Industrial Pollution Control and Realizing Discharge in Compliance with Standard, Jiangsu Province (1997)

6.1.2 On China's Legislation on Transjurisdictional Water Environment Management

1 Although China's transjurisdictional water environment management policies and legislations experience fast growth and development, lack of standardization, inconsistency, and conflicts and gaps between the major laws (such as between the *Water Pollution Control and Prevention Act* and the *Water Act*) have troubled the transjurisdictional water environment management.

Table 6.1.2-1 Major Legislation and Policy Issues on China's Transjurisdictional Water Environment Management

Legislative Issue	Room for Improvement
1, Lack of delineation and definition of water usage rights between upper and downstream regions in water rights policies	The water usage rights of upper streams and downstreams for rivers cross jurisdictions are not clarified in policies or regulations.
2, Lack of effective water quality guarantee policy	No articulated transjurisdictional water bodies quality assurance policy in the legal system.
3, Lack of concrete policies on comprehensive exploitation	Although many laws have required coordinated planning and comprehensive development, but no concrete policies exist to direct the actions. The various regions within a watershed and the various sectors involved in water management usually select self-favored development policies to handle transjurisdictional water environment.
4, Lack of comprehensive decision-making and management policy	Transjurisdictional water environment management often relate to the decision-making on important issues and allocation of the management and monitoring authorities among multiple regions and sectors. Since China does not have a comprehensive decision-making and management mechanism on transjurisdictional water environment, the sectors and regions manage and make decisions basic on their own concerns. The uncoordinated decisions and management may appear beneficial locally, but may turn out harmful as a whole, and cause overlaps and conflicts. Therefore, the policy and a coordinated decision-making making mechanism is needed for transjurisdictional water environment management.
5, Lack of systematic and clearly defined disputes treatment policy	The current uncoordinated exploitation, development, and management often cause conflicts and incur disputes. Although the existing Chinese laws have already included provisions on transjurisdictional water environment disputes, systematic, finite, and concrete policies on dispute resolution is still lacking. The lack of designated dispute resolution organization and sound dispute process disfavors the early resolution of disputes. Some extreme cases have caused ship sinking.
6, To-be-perfected legal system	One could conclude from the above legal framework of transjurisdictional water environment management that the current legislation needs to be further perfected.
7, Lack of comprehensive water environment management laws for trans-jurisdictions	Provisions and regulations on transjurisdictional water environment management are dispersed among various laws. Systematic and comprehensive management can hardly be implemented with the fragmented legislation.
8, Lack of national individual legislation on the key watersheds	The State has selected the Yangtze, Yellow, Pearl, Huai, Hai, Liao, and Songhua rivers as key watersheds that need specialized statutes and regulations due to their particular natural geographic, economic and cultural characteristics. Nevertheless, such laws are still unavailable. This deviates from the regular international watershed management practices.
9, Lack of laws on the procedures	Most of the existing national transjurisdictional water environment management legislations provide only substantive rules but not the

Legislative Issue	Room for Improvement
	implementive rules. As a result, the substantive rules are not matched up with implementive rules, and the objectives of the substantive rules can hardly be achieved.
10, Lack of sound management institutions	China's water environment management legislation has defined many management institutions including transjurisdictional water environment management institutions, such as the planning, fee mechanism, and environmental impact assessment. Those institutions have facilitated the rational exploitation and protection of the water environment. However, the legislations still face the issue of incomplete and imperfect management institutions.
11, Lack of institutions necessary for trans-administrative water environment management	These mechanisms include: Economic compensation between upper and down-streams; Water use rights trading; Water information disclosure (including pollution information); Tort compensation through pollution affirmation and evaluation; Pollution damage insurance; Downstream's legal rights to require upper stream pollution control actions
12, Other burning issues	Insufficient coordination between MWR and SEPA during watershed planning; Lack of broad participation and implementation safeguard mechanism for watershed planning; Dependence on pollutants discharge fee collection and conflicts of interests of fee allocation among local EPBs; Lack of unified provisions on water quality monitoring, reporting, and administration conducts with clearly defined responsibilities at provincial boarders during polluting events; Mismatched management institutional set-up and needs. For example, the water & soil conservation bureaus, although only administratively mapped under the MWR, will need to report data to SEPA. The watershed committees do not have authorities for unified water resource management, as pollution management is out of their authorities; Lack of public monitoring toward law enforcement; Entities and individuals are not entitled to prosecute on public affairs to safeguard the public interests.

Table 6.1.2-2 Major Issues & Recommendations of Water Pollution Control and Prevention Act and Water Act

Current Issues	Recommended Revisions
Definitions are imprecise, or absent, or ambiguous.	Revise the *Water Pollution Control and Prevention Act* and the *Water Act*, and offer clear definitions
Inconsistent authority allocation between management agencies among the laws	Future revisions should incorporate coordinated definition of the duties of environmental protection authorities and WRBs among the legal provisions.
Compared to the western legal system, the legal provisions are short and abstractive, and lack of provisions on the procedures	Revise the *Water Pollution Control and Prevention Act* by adding implementive provisions concerning transjurisdictional water issues
The conflicts and overlaps between the *Water Pollution Control and Prevention Act* and *Water Act* have led to conflicts in the environmental	This is recommended to be discussed with the ministry-level joint commission issue.

protection	

Table 6.1.2-3 Major Issues on Transjurisdictional water pollution management in the Water Pollution Control and Prevention Act

Major Issues	Recommended Revisions
General provisions not provide sufficiently concrete and finite interpretations. Lack of provisions directing local legislation and provisions on dispute resolutions through administrative mediation or litigation.	Add specific articles to the *Water Pollution Control and Prevention Act.*
Lack of provisions on transjurisdictional water pollution disputes. The *Water Pollution Control and Prevention Act* defines water pollution incidents as events that caused direct economic losses. However, water pollution incidents could cause not only economic losses but also human injury and ecological degradation. Moreover, certain economic losses will only become evident long after the actual event. The handling of the incidents tends to be untimely.	Add definitions of transjurisdictional water pollution to the *Water Pollution Control and Prevention Act* as the basis for administrative negotiation or judiciary interference. Establish provincial transjurisdictional water environment standards according to the defined procedures; Clearly define the dispute resolution procedure and the specific offense situation when violating the standards. Define the rights and responsibilities of each region when violating the transjurisdictional water environment standards according to the dispute resolution procedure.
No assignment of water quality responsibilities between the upper and downstreams at boarders.	Clarify the upper stream' responsibilities for the potential losses of the downstream when boarder water quality violates the standards.
Lack of concrete dispute resolution procedure. Often water pollution disputes face problems such as lack of authorized dispute handling organization, prolonged and unfruitful process, or the government officials shirking responsibilities.	Two sets of procedures should be specified for environmental disputes handling: (1) Procedure for disputes between individuals and organizations, and (2) Procedure for disputes relating to government offices and transjurisdictional water environment pollution disputes; The legal status of the data used in the disputes and the requirements imposed to disputes handling.
Inadequate provisions on watershed planning, insufficient consistency and coordination in water resource planning. Provisions on clear procedure and responsibility assignment are needed for the SEPA and MWR to improve coordination when creating integrated watershed planning; Since SEPA does not have designated agency at the watershed, a coordinating committee will need to be established; WRBs and EPBs have partially overlapping and conflicting responsibilities.	Responsibilities need to be clarified and collaboration need to be strengthened when making comprehensive watershed planning; A watershed joint committee among SEPA, MWR, and representatives from each province can be established as the coordinating institution among the government agencies and provinces.
Lack of clear regulations on TMLL The existing regulations on TMLL provide no clear allocation of authorities and responsibilities between SEPA and MWR.	Provide clear provisions on the objectives, TML statistics, survey and monitoring, distribution, and the applicable procedures; Provide clear provisions on the monitoring responsibilities of SEPA and MWR, as well as the specific measures of mutual cooperation of the two ministries when enacting and implementing the

Major Issues	Recommended Revisions
	TMLL measures.
Lack of provisions on data and information disclosure Currently no articles in the *Water Pollution Control and Prevention Act* refer to data and information disclosure.	Provide clear provision that the water environment information owned by the government and its environmental monitoring organizations should open to the public or justify the reasons why the information cannot be publicized; Prevent the randomness of government responses to the information disclosure requests from social entities and citizens; Increase transparency to the policy on data publicity, confidentiality, and the cost of information acquisition.
Unarticulated legal status and the quality control requirements of the water environment monitoring data.	Grant the water environment monitoring data universal legal effect across the jurisdictions to serve as the basis to start administrative or litigation procedures. The data effectiveness cannot be denied only because the data comes from the monitoring organization of another jurisdiction. Although the Metrology Law has provided provisions, the *Water Pollution Control and Prevention Act* should still require certain quality standards for the water environment monitoring data to be effective.
Inadequate execution of the responsibilities specified in the *Water Pollution Control and Prevention Act* by certain local officials.	It is important for the government officials in the jurisdictions to be responsible for the pollution caused in the zone. However, the current *Water Pollution Control and Prevention Act* cannot support investigation in the related responsibility.

6.2 Standard System

6.2.1 Overview of Standards

1 Environmental control standards that match the environmental legislations can be classified into 2 categories by functions-the environmental quality standards and pollutants discharge standards-or 4 categories by the scope of effectiveness-national comprehensive, national specialized, sectoral, and local standards.

2 Environmental control standards measure the effects of law enforcement. Environmental control standards can be classified to 2 categories by functions: environmental quality standards and pollutants discharge standards. According to the management rules of Chinese standards, for standards of the same subject, the local and sectoral standards should be stricter than the national standards; the standards set by the lower levels must be stricter than the standards by the upper level.

3 Moreover, to standardize environmental monitoring, the State has issued series of technical specifications, pollutants monitoring methods and standards for standard samples regarding environmental management and monitoring. Almost every pollutant has a corresponding code of monitoring. These codes and standards for standard samples, as part of the national standards, are compulsory.

6.2.2 Environmental Quality Standards

- In China, environmental quality standards are often issued by the central government according to the environmental quality control requirements. They are usually compiled by SEPA and co-issued with the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and SEPA

- China does not have watershed-wide or regional environmental quality standards presumably for 2 reasons. (1) The national environmental quality standards are already strict. The local governments generally will not issue local environmental quality standards that are stricter. (2) The pollutants migration in the watershed through rivers and lakes are generally trans-jurisdictions. Fully localized standards will not be necessary.

- The major environmental quality standards include:
  - Surface water environmental quality standard, GB3838-2002
  - Groundwater environmental quality standard, GB-T 14848-93
  - Farmland irrigation water quality standard, GB5084-92
  - Fishery water quality standard, GB11607-89
  - Drinking water sanitation standard, GB5749-85
  - Soil environmental quality standard, GB15618-1995
  - Seawater quality standard, GB3097-1997

1 China has a relatively complete water environment quality standard system with a relatively comprehensive coverage of the major areas. However, the current serious water environment pollution problems in the HRB have identified a number of shortcomings and revealed further needs for the improvement in the water environment quality standard system:

2 Low number of control indicators in the standards. The diversity of pollutants discharged into the water bodies has significantly increased with the fast economic development in the region. The current level of development of the chemical, petroleum, steel, mining, pharmaceuticals, food processing and light industries in the HRB would discharge roughly the same complex pollutants composition as the developed and industrialized countries would. However, the *Surface Water Environment Quality Standard* has only 30 control indicators, *Groundwater Environment Quality Standard* 39, *Domestic Drinking Water Hygiene Standard* 35, and *Farmland Irrigation Water Quality Standard* 29-all under the average of the industrialized countries or the Drinking Water Control Indicators issued by WHO. This shortage will impede the comprehensive control of the water environment quality.

3 Lack of specifications on water body restoration. Parts of the HRB surface and groundwater bodies have been severely polluted. Pollution control could prevent further deterioration of the water qualities, but the polluted and degraded water bodies will require proper restoration to meet certain water body functions. The Water Environment Quality Standard needs to specify the threshold criteria as when the restored water bodies can be

qualified to the pre-selected functions.

6.2.3 Pollutants Discharge Standards

1 Pollutants discharge standards, issued to control the discharge of pollutants, can be classified into 4 categories according their scope of effectiveness: national comprehensive standards, national specialized standards, sectoral standards, and local standards.

2 a. National comprehensive discharge standards are the standards developed for pollutants for particular environmental elements. They include:

- Integrated wastewater discharge standard, GB8978-1996
- Integrated air pollutants emissionstandard,GB16297-1996

3 b. National specialized standards address the pollution or pollutants discharge control for certain sector, a particular purpose, or specified environmental elements. This set of standards includes the industrial sectoral environmental quality control standards.

a) Control Standards for Urban Wastes for Agricultural Use, GB8172-87
b) Discharge Standard of Pollutants for Municipal WWTP, GB18918-2002
c) Odorous Pollutants Emission Standard, GB 14554-93
d) Standard for Pollution Control on the Landfill Sites for Domestic Wastes, GB16889-1997
e) Control Standards for Pollutants in Sludge for Agricultural Use, GB4284-84
f) Discharge Standard of Pollutants for Livestock and Poultry Breeding, GB18596-2001
g) Shipping Industry Pollutants Discharge Standard, GB 4286-84
h) Pulp Mill Water Pollutants Discharge Standard, GB 3544-2001
i) Textile and Dyeing Industry Water Pollutants Discharge Standard, GB 4287-92
j) Iron and Steel Industry Water Pollutants Discharge Standard, GB 13456-92
k) Effluent Standards for Oil-Bearing Wastewater from Offshore Petroleum Development Industry, GB 4914-85
l) Phosphor Fertilizer Industry Water Pollutants Discharge Standard, GB15580-95
m) Discharge Standard for Wastes Containing PCBs, GB 13015-91
n) Citric Acid Industry Pollutants Discharge Standard, GB19430-2004
o) Meat Processing industry Water Pollutants Discharge Standard, GB13457-92
p) Monosodium Glutamate Industry Pollutants Discharge Standard, GB19431-2004
q) Types of Natural Resource Protection Zone and their Classification Criteria, GB-T 14529-93

4 c. Sectoral standards and technical specifications, issued by the state or government agencies, address the pollution control or environmental management in particular sectors. They usually have limited scope of effectiveness. Major sectoral standards include:

- Water quality standard for wastewater discharge into municipal sewer system, CJ 3082-1999
- Environmental monitoring technical standard for domestic waste landfill, CJ-T

3037-1995

- Municipal water supply standard, CJ T206-2005

5 Major technical specifications include:

- Environmental impact assessment technical guideline, HJ-T 2.1-2.4 1993-1995
- Environmental impact assessment technical guideline for surface water, HJ-T 2.3-1993
- Water resource assessment guideline, SL-T 238-1999
- Drinking water resource water quality monitoring assessment and publishing program, SEPA [2002]No.144
- Environmental impact assessment technical guideline for planning, HJ-T 130-2003
- Water pollutants total discharge amount monitoring technical guideline, HJ-T 92-2002
- Surface water and wastewater monitoring technical guideline, HJ-T 91-2002
- Ecological condition assessment technical guideline, HJ-T 192-2006
- Construction project soil conservation planning technical guideline, SL-T 204-98

6 d. Local standards vary with locality but are all stricter than the national standards. Local standards include administrative regional standards and watershed standards.

7 Administrative regional standards are pollutants discharge control standards issued by the local governments at various levels according to the local needs while abiding by the national or sectoral standards. The effectiveness of such standards is limited to particular jurisdictions. A partial list of such standards include: *Henan Province pulp mill industrial water pollutants discharge standards, Shandong Province Pulp industrial water pollutants discharge standards (DB37/336-2003), Shandong Province livestock and poultry breeding pollutants discharge standards,* Shandong *Province domestic waste landfill water pollutants discharge standards (DB37/ 535-2005), Shandong Province textile and dyeing industrial water pollutants discharge standards (DB37/533-2005),Shandong Province amylum processing industrial water pollutants discharge standards (DB37/595-2006), Shandong Province SNWD water pollutants integrated discharge standards (DB37/599-2006), Zhejiang Province pulp mill wastewater discharge standards (DHJB1-2001), Jiangsu Province Chemical industry water pollutants discharge standards.*

8 China has a relatively sophisticated and complete collection of standards on water environment protection and discharge control. However, the enforcement of the standards presents the following issues.

9 Lack of a comprehensive discharge standards system. The number of government offices and the variety of fields involved in the discharge standards setting have triggered an unsystematic collection of standards. It is advisable to fit all current and future possible standards into one consistent framework and clearly spell out the scope, targets, compulsiveness, and monitoring of the standards.

10 An example on the industrial wastewater discharged into the municipal sewage illustrates this problem. The EPBs as empowered by law monitor the discharge from the plants (including municipal WWTPs) with the Wastewater Comprehensive Discharge Standards. Municipal construction committees also monitor all wastewater that enters into the municipal network (regardless if it belongs to industrial discharge) with the Water Quality Standards for Wastewater Entering into Urban Sewage. By law, the municipal construction committee could disconnect the connection between the wastewater outlets and the sewage but not to penalize the plants who fail to comply with its standards. The same wastewater outlets are subject to 2 sets of standards enforced by 2 different government agencies, leading to management overlaps and inefficient resource use.

11 Lack of a standard system for the pollutants discharge TMLL. Pollutants discharge TMLL and pollutants discharge permits are closed related. In HRB, the pollutants discharge TMLL has been adopted according to the *Interim Statues on the HRB Water Pollution Control and Prevention.* Nevertheless, the discharge TMLL are chosen by SEPA and MWR rather than set according to a systematic TMLL standard.

6.3 Judicial System

6.3.1 Judicial Institutions and Dispute Resolution Mechanism

6.3.1.1 Overview

1 China's judicial system refers to the nature, mission, organizational system, principles of organization and activity, and the work institutions of the judiciary and other judicial institutions. China's judicial system is a set of punctilious judicial institutional system of the people. It includes investigation, prosecution, trial, prison, arbitration, judicial administration, mediation, attorney, notary, state compensation, and legal aid systems. The judiciary here refers to the public security (including state security), the procuratorial, judicial, and prison authorities in charge of investigation, prosecution, trial, and enforcement. The judicial organizations refer to the attorney, notary, and arbitration organizations. The people's courts at various levels nationwide and the People's Procuratorate conduct independent trial and legal monitoring abiding the *Organizational Law of the People's Courts*, the *Organizational Law of the People's Procuratorate*.

2 In China, water pollution disputes usually refer to the civil disputes between the victims and tortfeasors of the water pollution regarding the tortfeasors' damage compensation liability and the amount of compensation. According to Article 41 of China's current *Environmental Protection Act*, the parties are entitled go to the people's courts and sue the accused tortfeasors. Therefore, when the victims raise civil procedure to the people's courts, the courts grant admission by the *Civil Procedural Law*. On the other hand, Article 338 and 408 of the current *Criminal Law* have spelled out that "severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen

contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health" will be convicted the crime of undermining protection of environmental resources and subject to crime punishments. Therefore, according to the *Organizational Law of the People's Procuratorate*, the People's Procuratorate will initiate the legal procedure starting with investigation when potential criminal conducts have been detected. At the end of the investigation, the People's Procuratorate will either prosecute the defendant or revoke the original case depending on the investigation results. Through this process, the court and the procuratorate execute their judicial authorities in the environmental pollution cases.

3 In China, the parties of the water pollution disputes have unequal positions. Unlike parties in other disputes, the victims of water pollution disputes often are the general public. Compared to the perpetrators the victims are often the disadvantaged group, while the perpetrators are often corporative groups with financial, technology, information, and human resources. When such corporations are of significant economic importance, the dispute could even be tied to the economic performances of the local governments.

4 Within the current Chinese legal institutions, the current Chinese environmental disputes resolution mechanism is consisted of non-litigation and litigation resolution mechanism.

6.3.1.2 Alternative Dispute Resolution (ADR)

1 The non-litigation resolution mechanism refers to the mechanism where the environmental disputes are resolved through non-litigative negotiation, mediation, arbitration, administrative ruling, etc. In the US, the non-litigation resolution mechanism is also called the ADR (Alternative Dispute Resolution). The ADR mechanism has become an important part of the environmental dispute resolution mechanism around the world. In China, the ADRs for environmental disputes mainly include:

(1) Negotiation

1 Article 51 in the *Civil Procedural Law* entitles the parties to choose negotiation. In terms of environmental disputes, usually the victims will demand the perpetrators stop polluting the environment and compensate for the losses incurred when realizing the environmental torts. When this happens, some perpetrators will agree to compensate for the environmental pollution and the victims often prefer negotiation to a prolonged law suit. Thus, the parties could resolve the environmental disputes through signing negotiation agreement. Therefore, negotiation is a relatively easy solution for both parties.

2 However, in the real life, perpetrators of environmental pollution usually will not admit their environmental liability, and negotiation is seldom practices in China. This approach has not played its role in China.

Case Study: wastewater pollution from enterprises in Yixing City, Xingzhuang County causes all rice shoots to wither

The 2005 pollution case in Yixing City, Xingzhuang Country that caused all rice shoots to wither happened after negotiation failed. In May 2005, because of the heavy pollution from local enterprises, people in Hexing Village near the Tai Lake noticed the absence of frog croaking in the rice paddies. They could only see the mosquitoes and insects but not the rice shoots. Local farmer tried to petition the government, but no solution was reached. On June 17th, 2005, local farmers found that all the newly planted rice seedlings roots withered. On June 19th, the situation worsened. 1200 Mu of rice paddies were damaged. On the afternoon of June 19th, helpless farmers blocked the lakeside highway to protest. On the 20th and 21st, besides protesting, other farmers turned their anger to the Yixing Hongda Plastics Chemical Inc. and Yixing Xingzhuang Chemical Assistant Inc. The two companies were smashed by the local people.

(2) Mediation

2 Mediation refers to the facilitated agreement between the disputes parties mediated by the third party by the laws and policies. By the current Chinese law, China's mediation institutions include the court mediation, people mediation and administrative mediation. Despite that the court mediation belongs to litigative mediation, the people mediation and administrative mediation belongs to non-litigation mediation.

3 The People mediation refers to the medication of civil disputes facilitated by the mediation committee by the laws, statutes, policies, and social norms. The people mediation is an important part of the current mediation institutions unique to China. The people mediation committee is a civil organization under the rural or urban residents committees. By the People Mediation Committee Organizational Regulations, the people mediation committee may act upon the request of the parties or initiate mediation by itself. The people mediation is mainly used to resolve the environmental disputes among individuals or between individuals and township, community, or individual enterprises.

4 The administrative mediation refers to the mediation of certain civil disputes and minor criminal cases by the government agencies within their authorities. The scope of the mediation encompasses civil, economic, and minor criminal disputes. Without specialized articles, the administrative mediation of environmental disputes will abide the general provisions on administrative mediation of all disputes. In general, administrative mediation of environmental disputes is often carried out by the EPBs or other related administrative authorities. For example, the fishery administrative authorities mediate fishery pollution disputes. In addition, according to Article 15 of the *Environmental Protection Act* that the local government is responsible for the negotiation, thus including mediation, of transjurisdictional environmental pollution prevention and control; government of higher level could assist in the resolution. Administrative mediation is one of China's primary approaches to resolve environmental disputes, especially cross-watershed disputes.

3 For example, the "River Blocking incident in Jiangsu-Zhejiang Boundary River" in TLB has been resolved through the administrative approach.

The River Blocking incident in Jiangsu-Zhejiang Boundary River in TLB [10]

Suzhou City, Shengze County of Jiangsu Province neighbors Zhejiang Jiaxing City of Zhejiang Province. Maxigang is the boundary river of the two provinces. Since 1990s, the dying industry of Shengze County has developed rapidly. The water pollution problem became very severe. Without necessary treatment facility and sufficient treatment capacity, the wastewater generated from the dyeing industry can bring disasters to the downstream river system. Maxigang is one of the downstream rivers in Jiaxing City. For many years, the wastewater from upper stream has troubled the local residents. Aquaculture has been severely damaged. Domestic water quality has also deteriorated. As early as in 1993, great amount of fish was killed by the wastewater from upper stream. For over a decade, local residents tried many means to petition, but the water pollution problem has never been solved. According to the monitoring results from the TLB management bureau, the upper stream water quality in Maxigang is consistently Class IV to worse than Class V all year round.

This transboundary water pollution conflicted has lasted for many years. On May 14th, 2001, State Environmental Protection Administration organized a conference on this subject, and issued a conference memo to the two provincial governments. The conference memo specifically required the Jiangsu province to improve water quality leaving Jiangsu Province to meet statutory requirement. In addition, Suzhou City should compensate Jiaxing City 1 million Yuan for the pollution.

In the small hours of Nov. 22nd, 2001, Jiaxing City residents sank boats to block the boundary river Maxigang. The local government tried to intervene and mediate; nevertheless, the river was completely blocked. The incident was a violation of Water Act, Flood Prevention Act, and Waterway Management Statute. In the morning of Nov. 22nd, the news reached Ministry of Water Resources and SEPA, leaders of the State Council also issued instructions. Administers from the Ministry of Water Resources and SEPA were sent to Jiaxing to mediate.

On the afternoon of Nov. 22nd, after consulting with local governments of the two provinces, the working groups of the Ministry of Water Resources and SEPA issued a joint opinion. First, since the major cause of pollution was the high volume of wastewater discharge that exceeds the replenish rate of local watershed, the government should first determine the replenish rate and adjust upper stream industries, especially in Shengze County. Some companies should be closed and some others should be controlled. Second, Shengze County should establish a domestic wastewater treatment plant. Third, a joint prevention scheme should be established between the upper stream and the downstream. Whenever new problems occur, the joint prevention scheme should try to solve the problem through negotiation. Fourth, an auto-monitoring station should be established to monitor the discharge of wastewater at the provincial boundary. The focus of these measures is the adjustment to the upper stream industries and especially the Clean Production technologies adopted in the companies. On Nov. 24th, administrators from the two provinces and the two ministries signed the mediation opinion. The mediation opinion explicitly requires

[10] International Financial News, Fu Chen: "How far may the wastewater flow, http://www.people.com.cn/GB/paper66/9773/899297.html

Jiangsu Province to issue an injunction to all companies in Shengze County that exceeded their discharge limits, and punished all companies according to laws. Meanwhile, all hidden pollution discharge pipes should be sealed. Zhejiang Province should restore the waterway.

However, because the water pollution treatment facility would take some time to take effect and compensation has not been negotiated, local residents in Zhejiang Province were worried that wastewater would be discharged once they restore the waterway. Local government tried to persuade local residents and restore the waterway on Dec. 14^{th}.

After the mediation conference, Suzhou City established an integrated management working group on the water environment of Wujiang Shengze county, and took measures to control water pollutions from major dyeing companies. On Jan. 11^{th} of 2002, the TLB water environment monitoring center surveyed again the water quality in neighboring rivers. The water quality in Shengze improved to Class 3 and Class 4.

4 The conflict between Jiaxing City Xingzhuang Town farmers and Yixing Hongda Plastics Chemical Inc. and Yixing Xingzhuang Chemical Assistants Inc.

The aforementioned conflict between Jiaxing City Xingzhuang Town farmers and Yixing Hongda Plastics Chemical Inc. and Yixing Xingzhuang Chemical Assistants Inc. was eventually solved through mediation organized by local government. After the incidents, the local party organization and government intervened promptly. After mediation, all the parties accepted a compromise.

(3) Administrative Punishment

5 Article 41 of the *Environmental Protection Act* requires "the tortfeasors of environmental damages remove the harms and compensate the directly impacted entities or individuals. Disputes on the pollution liability and the amount of compensation can be handled by the environmental protection administrative authorities or other designated agencies upon the request of the parties involved. If either of the parties disagrees with the rules, the party is entitled to litigate at the people's courts. Either party is also entitled to litigate directly without administrative ruling." Therefore, the victims of environmental liabilities could resolve the dispute through either the environmental protection administrative authorities or other designated governmental agencies or litigation. The former resolution approach has been widely practiced, as it not only saves time and effort but also is well accustomed to the Chinese tradition of resorting to the government during disputes. The government agency usually will first try to mediate, and only when mediation fails, provide rulings according to the *Environmental Protection Act*.

6 However, the current administrative punishment mechanism of environmental disputes institutions presents a number of issues. First, Article 41 of the *Environmental Protection Act* does not impose the potency of enforcement of the rulings from the environmental protection administrative authorities, the parties could reject the rulings by litigation at the people's courts; thus the disputes resolution decisions by the environmental protection administrative authorities often will not be able to timely control the pollution and aid the victims. Second, because either party disagreeing with the

decisions by the environmental- protection administrative authorities could sue the authorities through administrative litigations, a few environmental legislation in the late 1990s tried to amend this problem but actually add more to the existing issue: Article 71 Item 2 of the *PRC Solid Waste Pollution Prevention & Control Act* issued on October 30th, 1995, Article 61 Item 2 of the *PRC Environmental Noise Pollution Prevention & Control Act* issued on October 29th, 1996; Article 62 Item 2 of the revised *PRC Air Pollution Prevention & Control Act* issued on April 29th, 2000 have defined the "administrative punishment" by the environmental protection administrative authorities or other designated agencies as "handling upon mediation," and therefore lowering the potency of "administrative punishment" to "mediation." Statistics suggests that about 70% of China's environmental disputes are resolved through medication or administrative punishment, a broad-sensed mediation. Further perfecting the mechanisms of mediation and administrative punishment has become a matter of urgency in China.

(4) Arbitration

5 The current Chinese *Arbitration Act* does not specify if environmental disputes (except for marine pollutions) can be subject to arbitration. Thus two schools of thoughts current exist among the Chinese environmental law community. One school of thoughts disapproves the application of arbitration to environmental disputes because the arbitration subjects articulated in the *Arbitration Act* does not include environmental disputes. The other school, however, considers that eligible parties who opt arbitration for dispute resolution can apply for arbitration to the authorities. This existing debate indicates that the Chinese *Arbitration Act* should clarify the applicability of arbitration. Currently in China, the practices of arbitration to environmental disputes are rather limited.

6.3.1.3 Litigation

1 Victims of environmental pollution can opt for the litigation resolution mechanism beyond the ADRs. On the one hand, the victims can sue the polluters at the people's courts according to the *Civil Procedural Law*, other civil laws and statues, and the *Environmental Protection Act* for damage remedy and compensation. On the other hand, the People's Procuratorate could prosecute the infringer of the environment should the criminal provisions be applied. The civil and criminal litigation procedures have been the most potent and effective judicial solution of environmental pollution disputes in China.

(1) Criminal Liability Regime

2 In order to increase the punishment severity against environmental crimes, and protect the ecological environment through stricter legal measures, the 1997 revised *Criminal Law* lists acts of serious destruction of land, air, water, forests and other natural resources as criminal infractions. A separate section on "Crimes of destroying environmental resources" is included in Chapter Six, and stipulates different kinds of environmental crimes. This set up the criminal liability regime in China's environmental protection institutions. Article 338 of the *Criminal Law* specifies that severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen

contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health will be subject to up to 3 years of imprisonment or criminal detention and/or fine; particularly serious consequences will be subject to 3 to 7 years of imprisonment and fine. Therefore, in case of severe environmental pollution incidents, according to Article 3 of the *Criminal Litigation Act*, the public security authorities will take charge of the investigation, detention, arrest, and pre-trial; the procuratorate will take chare of the approve the arrest and prosecution; and the people's courts takes charge of the trial.

3 In Part II Specific Provisions of the Criminal Law, Chapter VI Section 6 "Crimes of Undermining Protection of Environmental Resources" clearly spells out environmental crimes of various types and the punishments for severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health.

4 According to the statistics from SEPA's China Environmental Yearbook, there were 5 in 2001, and 4 were crimes of serious environmental pollution accidents, while one was about negligence of supervision and administration of environmental protection; there were 2 crimes of serious environmental pollution accidents and 2 crimes of negligence of supervision and administration of environmental protection in 2002; One serious environmental pollution crime took place in 2003.

Case: 40 tons of wastewater from Wujiang City pollutes the Grand Canal[11]

For example, in the Wujiang City Grand Canal pollution case, the defendant Zhu has committed the crime of causing severe environmental pollution incident. On June 21st, 2005, the anaerobic cylinder of the wastewater treatment facility in Wujiang Hengxiang Alcohol Manufacturing company exploded. 40 tons of ferment liquid was leaked from the explosion and was accumulated in the rainwater tanker. At around 4 PM, the manager of Hengxiang Alcohol Manufacturing company Zhu noticed the situation and released the water into the Grand Canal without permission. Because of the high COD and BOD in the wastewater far exceeded national standard, the water bodies of the Grand Canal were severely polluted. The river ran black, and the nearby Xinteng Water company in Jiaxing City, Zhejiang Province was forced to stop water supply. Direct economic loss amounted to 613,000 Yuan. The People's Court ruled that the defendant Zhu had violated national regulation, and released hazardous wastes into water bodies, causing severe environmental pollution and severe loss to public and private properties. The People's Court ruled that Zhu had committed the crime of causing severe environmental pollution. Zhu received a sentence of one year in jail, and a fine of 100,000 Yuan.

7 Another example would the pollution case in Yixing City, Wanshi Town, July 2002 that damaged 3000 mu of rice paddy. This severe environmental case was investigated as a

[11] Suzhou News Net, Qiang Zou: "40 tons of wastewater was discharged into the Grand Canal. The responsible individual was punished," http://www.subaonet.com Dec. 29th, 2005

criminal case. The manager of the chemical company that caused the pollution was arrested.

(2) Civil Liability Regime

8 According to Article 124 of the *General Rules on Civil Law* (of 1989) and Article 41 (1) of the *Environmental Protection Act* (of 1989), in regard to environmental pollution tort acts, China has established the tort liability system with non-fault responsibility as the basis. All organizations or individuals that pollute or damage the environment, as long as their acts cause damage to other organizations or individuals objectively, should assume civil liability, even if they have no subjective fault. Therefore, if victims' physical well being or property is damaged due to environmental pollution tort acts, they can bring lawsuits to the People's Courts according to the provisions of Article 41 of the *Environmental Protection Law* and *Civil Procedural Law*, and request the polluters to assume liabilities for damage compensation or damage remediation. In addition, the *Interpretations on Several Issues of Law Application of Hearing Physical Damage Compensation Cases* issued by the Supreme Court on December 26, 2003, further regulates clearly the law application issues related to physical damage compensation cases. It also becomes the legal basis, upon which pollution victims could request damage compensation remedies.

Transboundary Pollution Case in Zhejiang and Anhui Provinces[12]

The transboundary pollution case in Zhejiang and Anhui Provinces was settled through litigation. The dispute was between fishermen from Si'an Reservoir in Changxing County of Zhejiang Province and the Organic Synthetic Chemicals Company in Guangde County of Anhui Province. Si'an Reservoir is located on the border of Changxing County and Guangde County. Although the reservoir is in the jurisdiction of Changxin County, 90% of the reservoir's watershed is in Guangde County.

In 2001, the farmers of Si'an County discovered that the reservoir was polluted. The contacted Changxing County environmental protection bureau investigated the reservoir and sampled the water body in the afternoon. The results showed that the level of sulfide and aniline substances were higher than the standards. Afterwards, they tracked the pollution upstream and located the source of the pollution: the Organic Synthetic Chemicals Company in Guangde County.

From May 1st, 2000, the fish in the reservoir has been decimated by the pollution. Local agency calculated that pollution caused 617.5 thousands Yuan of direct economic loss to the fishermen, and 574.5 thousands Yuan of loss to the fish stock. It was the second time that Si'an Reservoir suffered from pollutions of the upstream. In mid-July of 1997, due to the discharge of wastewater from the Organic Synthetic Chemicals Company in Guangde County, 3000 mu of water body in the reservoir was polluted. Fishermen lost over 250 thousands Yuan in that incident. In 2000, when Si'an Reservoir was polluted again. The local government of Changxing County was still trying to get compensation for the 1997 pollution case. The local government was appealing

[12] New China Net, Lijing Cui & Jiabao Jing "Transboundary Polluter Shielded by Local Protectionism, Watershed Law Needed" April 15th, 2002. New China Net

the court in Guangde Court to enforce the ruling against the Organic Synthetic Chemicals Company in Guangde County.

In Sept. 2000, SEPA issued an injunction to the company, and recommend the company to relocate. SEPA requested Anhui Province to enforce the injunction before Sept. 30th of 2000, and report to SEPA on Oct. 1st. But until May, 2001, the company had not yet stopped production.

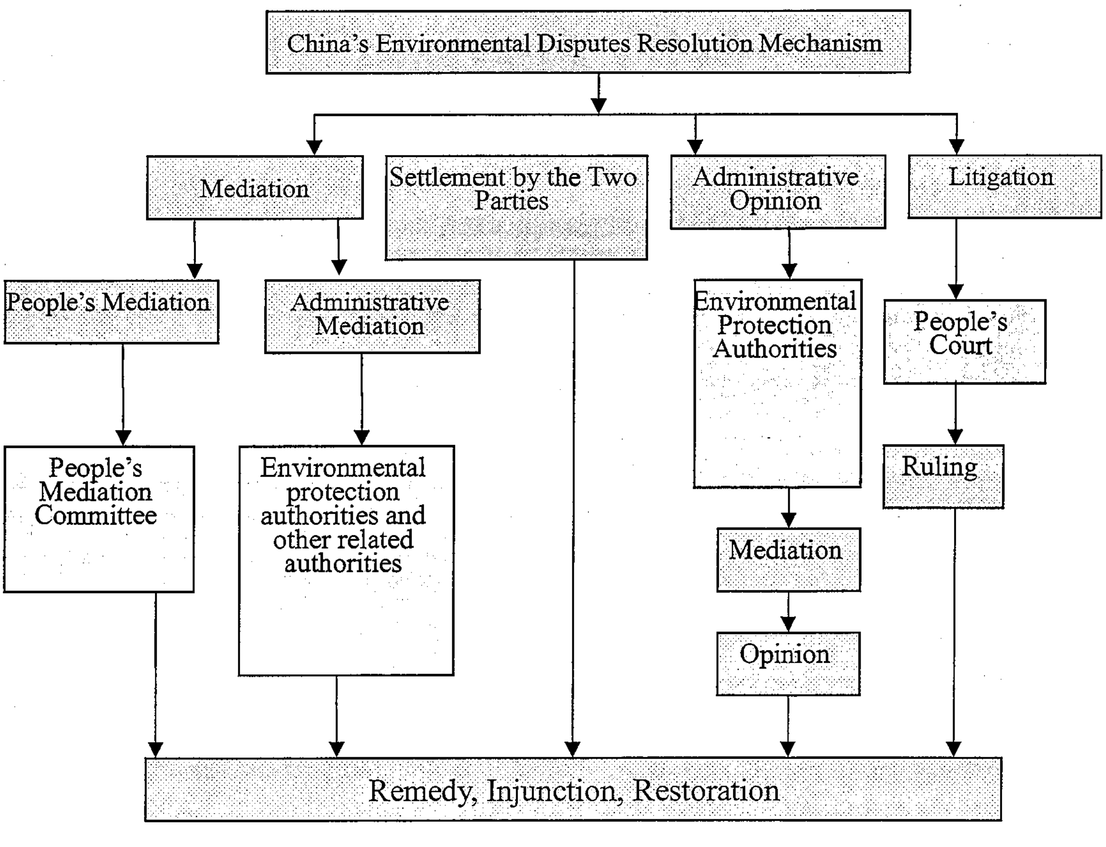
The lawyer of the plaintiffs showed that, the defendant is a major taxpayer of Guangde County. Because of the current environmental protection system, the EPB of Zhejiang Province had no jurisdiction over Anhui's company. Even after the pollution accident happened, the Zhejiang EPB was refused by the EPB of Guangde County in Anhui to investigate the case for the lack of jurisdiction.

On March 22nd, 2002, Zhejiang Changxing County Court ruled that the plaintiff, fishermen from Si'an Reservoir should receive 617.5 thousands of compensation.

9 The ruling in this transboundary pollution case shows that environmental litigation may play a significant role in solving transboundary water pollution disputes. Currently, most transboundary pollution disputes are still solved through negotiations between governments. However, administrative settlements are often not enforced. Judicial remedy would be an important means to solve transboundary pollution disputes.

10 Figure 6.3.1.3-1 exhibits the disputes resolution mechanism.

Figure 6.3.1.3-1China's Environmental Disputes Resolution Mechanism



6.3.2 Causes for Transjurisdictional Disputes

1 Different from the usual disputes, transjurisdictional water pollution disputes are often related to the regional socioeconomic, geographical, and environmental features.

(1) Causes for the TLB Water Pollution[13]

Table 6.3.2-1 Causes for the TLB Water Pollution

The Causes for TLB water pollution	Descriptions
1, water shortage Tai Lake Basin is the world's 19th largest economic zone. The per capita GDP in 2004 over nearly 5000 USD, almost 5 times of the nation's average.	However, the water resource per capita in TLB is only 1/5 of nation's average. The tension between development and environment preservation runs high. TLB has the nation's most severe water pollution cases and earth subsidence.
2, water pollution due to industrialization The Suxichang area of Jiangsu Province and Hangjiahu Area of Zhejiang Province are the most industrialized part of the Southeastern Coastal China.	Hangjiahu Area and Jiangsu's Shengze County is world famous for their textile and leather products. The rinsing and dyeing process consume more than 20 tons of water for each ton of textile products, not including the domestic water use of the employees. The tanneries require even more water. An average enterprise with common techniques consumes around 80 tons of water for each ton of hog hide processed, which is around 6 to 8 times of that in the European Union. Besides, tannery is one of the major sources of pollution.
3, serious pollution due to industrial development After the Reform and Open-Up Policy, the TLB became one of the nation's fastest developing areas with the highest urban density. Industrial wastewater and urban domestic wastewater increase rapidly. Besides, fertilizers are widely used in large-scale farms. Because of all these, the TLB area has very critical water pollution problem. The contradictions between upper and down streams also become increasingly acute.	Since 2004, the industrial outputs of Jiangsu Province have exceeded 1 trillion Yuan. Each 10,000 Yuan of industrial outputs consume several dozens to over 100 cubic meters of water. But the per capita water resource in Jiangsu Province is only 470 cubic meters, about one sixth of the nation's average. Water consumptions also produce wastewater. Nevertheless, the pollutant discharge to the Tai Lake has exceeded 3 times of the water environment capacity, just as in that of the Yangtze River. Each person produces more than 100 tons of wastewater per year.
4, water shortage leads to water pollution disputes	"Water disputes between Wu and Yue" is not only manifested in the water disputes on fresh water resources, but also on the water disputes caused by water pollution.
5, serious water shortage due to deteriorating water quality	The TLB and neighboring area, which should not worry for water, has become the nation's most typical area with serious water shortage due to deteriorating water quality.

(2) Forms of transjurisdictional water resource disputes

1 Frequently a large watershed will cross several counties, prefectures, or even provinces in its scope; therefore, water pollution disputes of an transjurisdictional

[13] New China News Agency, Libing Wang: "Water Competition between Wu & Yue, the Pain of Yangtze Delta" 2005-01-15 10:37:07 www.china5e.com/news/water/200501/2005011... 33K 2006-12-31

watershed present a variety of forms.

Table 6.3.2-2 Major Forms of Transjurisdictional Water Disputes

Major forms of transjurisdictional water disputes	Descriptions
1, Disputes incurred due to ambiguous water resource titles.	Often triggered by the conflicts between the over exploitation in upper streams and the downstream water shortages.
2, Disputes caused by undefined environmental liabilities.	Such as disputes incurred by unclear water pollution liabilities or disputes in aquaculture.
3, Water pollution disputes triggered by water pollution or resource damaging incidents.	Including water resource disputes triggered by incidents in certain jurisdiction among individuals or entities of the same or different jurisdictions.
4, Water pollution disputes incurred by the regular business operation of certain entities.	For example, the water environment dispute between certain urban chemical plant and its neighbors regarding the pollutants discharge.
5, Water pollution disputes caused by regular pollution sources.	Disputes between upper and down-stream cities on the long-term, massive quantity pollutants discharge that deteriorate the downstream water quality.

(3) Major causes of transjurisdiction water resource disputes

- Characteristics of environmental pollution torts

2 Different from ordinary torts, certain characteristics of environmental pollution torts – its latency, indirectness, sustainability, inequality between parties, breadth, and concomitancy – makes it difficult to ascertain the damages, tortfeasor, and the causality of the torts. Such characteristics sometimes encourage the tortfeasors to make excuses and shift liabilities onto others and delay or impede the resolution of the transjurisdiction environmental disputes.

a) Inadequate transjurisdiction environmental monitoring

3 Currently the responsibilities of environmental protection are spread to multiple government agencies at various levels. According to the *Environmental Protection Act*, currently China's environmental protection adopts the multi-level environmental supervisory, regulatory, and consultations settlement mechanism. Article 7 of the *Environmental Protection Act* further specifies that "SEPA under the State Council directs and supervises the nation-wide environmental protection. Local EPBs of county level or above direct and supervise the environmental protection of their jurisdictions. National oceanic, port monitoring, fishery management and monitoring, and military environmental protection authorities exercise environmental pollution prevention and control by the related environmental laws. The administrative authorities of land, mines, forestry, agricultural, and water resources of county-level or above exercise resource protection, monitoring, and management according to the related laws. Article 15 spells out that "environmental pollution prevention and control transjurisdiction should be resolved through consultation among the related local governments or by the government of higher levels." Therefore, transjurisdictional environmental pollution is subject to the administration and inter-consultation of the related local governments or government of

higher level. Such mechanism often gets caught among the various agencies and delays the process of environmental dispute resolution.

- Local Economic Interests

2 Local governments are overly focused on short-term economic benefits and willing to sacrifice the environment and even shield illegal pollution discharge cases to achieve economic goals. This is the root cause of why transboundary water pollution can not be effectively controlled.

- Local Protectionism in Transboundary Conflicts

3 All local People's governments at various administrative levels have their own interests. When facing transboundary environmental pollution and damage cases, local government are often restrained by their narrow local protectionism that hampers the orderly solution of environmental problems, and eventually influence the settlement of transboundary environmental conflicts.

- The Incoherence and Inconsistency in Environmental Pollution Prevention

4 Although Article 15 of Chinese Environmental Protection Law, and Article 26 of Water Pollution Prevention Law have specified the settlement mechanism of Chinese transboundary environmental pollution and damage cases, in practice, because of the separation of management responsibilities in different jurisdictions and various agencies such as environmental protection, forestry, agricultural, fishery, and water resources, it is extremely difficult to reach consensus among all relevant agencies and governments. Even with the mediation of high level government, it is difficult to reach prompt settlements on transboundary environmental cases that meet every party's needs.

6.3.3 Measures to Settle Transboundary Environmental Cases

(1) Improve Transboundary Environmental Protection Inspection Mechanism

1 The current multi-level environmental inspection mechanism is not conducive to prompt and effective solution to environmental pollution disputes. Therefore, China should improve its transboundary environmental protection inspection mechanism, such as integrated transboundary watershed water quality inspection mechanisms. The central government should set up agencies with responsibilities to inspect, and manage transboundary watersheds, and to ensure the implementation of environmental protection works. Such agencies would also be more effective in the settlement of transboundary watershed environmental pollution disputes.

2 According to the news report of China News on July 31st, 2006, in order to strengthen the enforcement of environmental laws, SEPA has initiated the organization of 11 national environmental protection inspection and supervisory centers, including 5 environmental protection supervisory centers in Eastern China, Southern China, Northwestern China, Southwestern China and Northeastern China, and 6 nuclear and radioactive safety inspection center in Shanghai, Guangdong, Sichuan, Northern China, Northeastern China,

and Northwestern China. Eastern China's inspection center is in charge of Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong. Therefore, the environmental law enforcement inspection activities in Huai River, and the Tai Lake Basin are to be carried out under the Eastern China Inspection Center. The Northern China Inspection Center is still to be approved. More detailed responsibilities for the centers are showed in the following table. If these inspection centers can fully carry out their supervisory duties, it would be a significant boost to the nation's environmental protection effort.

Table 6.3.3-1 Administrative Responsibilities of the Five Environmental Protection Inspection Center (Eastern China, Southern China, Northwestern China, Southwestern China, and Northeastern China)

Responsibilities	Supervise local implementation of national environmental policies, statutes, and standards
	Investigate severe environmental pollution and ecological damage cases
	Participate in the emergency response to severe environmental disasters and supervision of remedies
	Coordinate the mediation of transprovincial and transwatershed environmental conflicts
	Inspect the enforcement of environmental laws
	Inspect major sources of pollution
	Inspect state natural preservation zones and state major ecological protection zones
	Supervise transprovincial and transwatershed environmental pollution ecological damage petitioning cases and letters-and-visits reception.

Table 6.3.3-2 Administrative Responsibilities of the Six Nuclear and Radioactive Safety Inspection Center

Responsibilitie	Regular inspection of civil nuclear facility
	Regular inspection of nuclear facility directly supervised by SEPA
	Regular inspection of military nuclear facility radioactive environment
	Response to emergencies in nuclear facilities directly supervised by SEPA (including terrorist attacks)
	Onsite response to emergencies

(2) Implement Regional & Watershed Integrated Management

3 Because of the limitations in Chinese current environmental management system, as well as local protectionism, local governments often illegally interfere with the enforcement of environmental regulations, which results in obstacles in solving transboundary environmental problems. Therefore, China should establish regional & watershed integrated management system. Since the 11^{th} Five Years Plan, China should incorporate watershed integrated management into the next comprehensive Five Years Plan of land management, environmental protection, ecological construction, and water resources management, and specific plans on environmental protection, and water resources management. China should enact comprehensive transboundary water environment management laws. Also, China should include watershed management laws in the national legislative plans, and revise current laws and regulations related to watershed management.

(3) Improve the Litigation System and Settlement Mechanism for Environmental Pollution and Damage Disputes

4 The current settlement mechanism for transboundary environmental pollution and damage disputes are usually based on the Article 15^{th} of *Environmental Protection Law* and related regulations. Disputes are settled through negotiations between concerned governments or high level governments. In theory, this settlement mechanism should be able to help solve such disputes, however, in practice, due to local protectionism and the separation of responsibilities between regulatory agencies, such disputes become extremely difficult to solve through the current settlement mechanism. Therefore, it is feasible and constructive to improve Chinese civil procedure, follow the nature of transboundary environmental disputes, and through the means of environmental public interest litigation and class litigation to achieve fair and swift solution of environment disputes.

6.3.4 Case Studies of the TLB Water Pollution Litigations

1 Although the current Chinese environmental torts system has positive effects in controlling environmental problems, it is obvious that traditionally China has focused on administrative penalties made by administrative agencies as the remedy, but has neglected the positive effects of civil remedies and criminal penalties. More specifically, as applied in the cases we discussed before, we discover that the following insufficiencies in the current environmental torts system.

(1) Setting up an Administrative Settlement Mechanism

2 According to the relevant provisions of environmental administrative procedure legislations, the administrative measures to handle environmental conflicts include: administrative penalties to the person who violates environmental protection regulations, fine the individuals and units that are directly responsible.

3 Although Article 41 of the Environmental Protection Law stipulates the damage remedy for the tortfeasors, the Article also reads that compensation responsibility and the amount of compensation may be set by the environmental protection administration or other legally designated environmental administrative bodies if requested by the victims. If the victims are not satisfied with the settlement, they may appeal in the court. Therefore, the Article is clear that the administrative settlements made by Chinese environmental protection administration are non-binding.

4 Therefore, the "settlement opinion" issued by the administrative body can not solve the environmental pollution damage compensation disputes. Moreover, it is an ineffective mechanism that wastes resources. To fill in this gap in Chinese environmental law, and to avoid the embarrassing situations when the victims appeal against the environmental administrative agency in administrative litigations, the following environmental laws in China, such as the Solid Waste Pollution Prevention Law issued on Oct. 30^{th}, 1995, Environmental Noise Pollution Prevention Law in 1996, and Air Pollution Prevention Law in 2000 revised the "settlement" provision to "mediation & settlement." Therefore, it is clear that the "settlement opinions" issued by the environmental administrative agencies are non-binding mediation opinions.

5 This legislative approach shows that the major purpose for Chinese environmental protection administrations in solving environmental torts cases is to contain the conflicts between tortfeasors and victims and punish the polluters through administrative penalties. Remedies to the victims are usually neglected. And this is the major reason why Chinese current environmental administrative system is not effective in solving environmental pollution remedy disputes.

6 Under this situation, when environmental torts disputes happen, both the victims and the environmental administrative enforcers usually pay more attention to how to punish the polluters through administrative measures and stop the pollution. These measures are certainly meaningful in punishing, containing, or preventing pollution torts. However, these administrative penalties often replace compensations to the victims and civil liabilities, and the victims and administrative agencies often believe that disputes are solved when the tortfeasors are punished by the environmental administrative agencies. "Punishment but no compensation" becomes a prevalent mistake. Therefore, in most cases, the victims and even the judiciary often neglect the effects of the tortfeasors' civil liability in protecting the victims' rights. In some cases, even when the victims request compensations to environmental administrative agencies in environmental disputes, eventually the uncertainties and other obstacles in the administrative settlement procedure, method, compensation rules, and other relevant factors in calculating compensations would prevent the victims from obtaining their remedies. Under such legislations, even when there are hundreds of thousands environmental torts cases in China, only a few dozens received remedies through environmental administrative measures. Therefore, more importance should be attached to the administrative function of the government. Establishing a timely and efficient administrative settlement mechanism that can provide remedies to environmental torts plaintiffs is one of the most significant issues in Chinese environmental protection legislation. As a promising progress, the Property Law unequivocally protects prospecting right, mining right, water right, and the right to aquaculture and fishing of property owners. The Property Law also stipulates that "when these property rights are infringed, the property owners may request compensations and request the infringer to bear other liabilities." This provision is significant in protecting the property owners' water rights and their rights to aquaculture and fishing, and thus helps solve related disputes.

(2) The Lack of Criminal Liability in Practice

7 Although the *Criminal Law Code* revised in 1997 added a provision on the crime of "undermining environmental resources protection" to meet the needs of environmental protection under market economy, in reality, this provision of the Criminal Law Code has not been strictly enforced. The major reasons are: (1) this legislation needs to be refined. For example, the definition of "crime of severe environmental pollution accident" is still too abstract. Only those who actually caused the accidents are punished, and the punished targets are only limited to hazardous wastes cases. The summary legislation leads to inconsistencies in understanding among judges and academics. It is neither conducive to the strict enforcement of the provision, nor to achieve the legislative purpose of the

provision as in the criminal code; (2) administrative liability replaces criminal liability. For a long period of time, China has overemphasized the effects of environmental administrative liability. Most of the "severe environmental pollution incidents caused by illegal disposal of radioactive or pathogen contaminated, toxic, or other hazardous wastes to the land, water bodies, and air with serious consequences of public or private properties and individual health" are only punished for those administrative liability. For examples, the published results of "Undermining Environmental & Resources Protection Crime" cases show that the sentences are usually relatively light. The longest sentence period is 5 years; the shortest is mere 6 months. Besides, the compensation is usually too low to fully compensate the aggrieved party. Article 408 of the *Criminal Law Code* also clearly stipulates "offense of misconduct in office of environmental management." However, in practice, the People's Court often delivers probative sentence to officers who committed offense of misconduct that leads to severe loss to public or private property, or death or injury to individuals. The sentence is light and often limited to one year. Therefore, it is safe to conclude that the good legislative purpose of "Undermining Environmental & Resources Protection Crime" has not been realized. Besides, offenses of general misconduct in office usually receive up to 3 years of imprisonment. Under particularly severe circumstances, the sentence can be up to seven years. In comparison, offenses of misconduct in office of environmental management, and especially when the serious pollution incidents with serious consequences of public or private properties and individual health receive up to three years of imprisonment. Such regulations are neither conducive to the punishment of the responsible officer, nor to the deterrence of future environmental pollution accidents.

(3) The Gaps in the Civil Liability of Environmental Torts System

8 Chinese current regulations on environmental torts remedies have not provided specified provisions based on the special situations of environmental torts. In practice, compensation for environmental torts follows the general provisions on civil torts liability in the Civil Law Code.

9 These cases are mainly solved through administrative procedures. Victims' request for civil compensation are usually dismissed or failed. Through analysis of the aforementioned cases, we discover several major gaps in Chinese environmental torts remedy system.

10 First, there are several procedural requirements that are disadvantageous to the victims as in the following aspects:

11 a. difficulty in placing a case on file. According to the requirements in the *Civil Procedural Law*, those who seek remedies have the burden of proof. Therefore, the victims should present sufficient evidence of their injury. On the proof of injury, the Chinese court requires an appraisal of the injury caused by specific environmental pollutions from an official appraisal agency. Without an appraisal, the court would usually dismiss the case. However, such an appraisal is often very difficult to obtain given the financial and human resources limitations of the victims. Besides, the proof of causation in

environmental torts is different from ordinary torts cases and difficult to verify. Normally, environmental pollution are generated through air, water, and other natural media, or accumulated and synergized by various causes. Environmental pollutions are characterized by their extensiveness, indirectness, and latency. In addition, the polluters often have the advantage of asymmetric information, and may refuse to provide the information to the public under the excuse of business secret. Therefore, it is extremely difficult to scientifically and closely prove the causation between hazardous substances and injury for an ordinary citizen. Furthermore, the proof of causation between the action and injury is influenced by the development of science and technology. The hazards of environmental pollution are not only generated with high-tech and high-hazardous industries; the development level of advanced technology also limits the proof of causation, especially when environmental torts caused unknown diseases in the aggrieved party. In some cases, with current science and technology, it is impossible to directly prove causations. Even when the hazardous substances can be identified, it is complicated to specify the pollution sources, the pollution routes, and the correlation between pollution and injury. Even though Chinese legislature has made some efforts to alleviate the burden of proof on causation in environmental torts cases, the situation is still disadvantageous to the aggrieved party.

12 b. The difficulty in determining liabilities of the defendants. Although the Chinese *General Rules of Civil Law* have stipulated some regulations on environmental torts civil liability, such regulations are not specific enough. It causes divergence of views on how to determine liabilities, and is not conducive to enforcement. In addition, although some judicial interpretations have stipulated that the burden of proof should shift to the defendant when proving the causation of environmental torts, in practice, the provision is still ill-defined.

13 For example, in the case "Zhang Rongbao of Yixing City Fangqiao Village v. Fangqiao Oriental Chemical Co., Junda Chemical Co., Xingda Chemical Co., and Hexing Chemical Co.", the trial court and the appeal court both reasoned that the causation between the injury to Zhang's duck and the discharge of wastewater from the chemical companies can not be proved. Therefore, the case was dismissed and the plaintiff did not receive any remedy.

14 Second, on the issue of remedy

15 Due to the influence of traditional civil law theory, the calculation of remedy for environmental torts in China includes the factors such as the plaintiffs and the defendants' economic situation; therefore, it tends to undercompensate the aggrieved party. Even when the victims suffer grave loss, the compensations are often meager.

16 Third, on the calculation of remedy

17 In China, the remedy for environmental torts still includes direct loss and indirect loss according to the traditional method.

18 a. On property loss. China has long followed the traditional method in calculating

environmental torts remedy, which includes property loss and other non-property losses. Property loss is further divided into direct loss and indirect loss. When determining the monetary value of remedy, the property loss is calculated through individual appraisal and accumulative calculation. On the other hand, other non-property losses are calculated through a combination of factors such as the fault of tortfeasors, the specific condition of the injury, the actual consequences of the injury, the profit of the tortfeasors, the economic situation of the tortfeasors, and other relevant regulations. However, such individual appraisal and accumulative calculation method and partial compensation is questionable in terms of its theoretical underpinning and practical effects. In addition, environmental torts are different from other torts. The traditional method of remedy calculation may be inappropriate in the case of environmental torts.

19 b. On the scope of personal injury.

20 China currently adopts the same method of calculating general torts cases in environmental torts with personal injuries. The method is specified in Article 119 of the General Rules of Civil Law and the legal interpretation on personal injury compensation issued by the Supreme People's Court on Dec. 26th of 2003

21 On the calculation of compensation to victims who are handicapped or dead, Chinese judiciary system adopts the theory of "lost parenting." The compensation is mainly for the dependents of the handicapped or the dead victims. Though the "lost parenting" theory is reasonable and widely adopted by England, United States and France, there are a few defects in the Chinese system when the "lost parenting" theory is applied to calculate the damage of the victims. First, the length of the dependants parenting period is too short. For example, according to the Provision 1 of Article 28 of the *Legal Interpretation on Personal Injury Compensation.* If the dependents are juveniles, the parenting period ends at age 18. If the dependents can not work and have no other legal guardian, the parenting period ends at age 20. Besides, for dependents older than 60, the period is subtracted for each year over 60. For dependents older than 75, the period is set at 5 years. This provision tends to undercompensate the victims. In addition, the definition for "dependants" is too narrow. According to the Provision 2 of Article 28 of the *Legal Interpretation on Personal Injury Compensation*, dependants are limited to the juveniles to whom the victim has legal responsibility and other adult relatives who can not work and with no other legal guardian. When the dependants have other sources of income, the defendant only shoulders the portion legally required of the victim. Such a provision in fact rules out defendants who are willingly raised by the victims. Furthermore, according the Provision 2 of Article 28 of the *Legal Interpretation on Personal Injury Compensation,* "when there are several dependants, the annual compensation should not exceed the annual per capita consumption." Each dependant can not receive amounts exceeding the annual per capita consumption of the year before. The limitations on the amount that can be received by the dependants is inconsistent with the principle of full compensation and can not achieve the purpose of providing remedy to the victim.

22 Fourth, the Application of Injunctive Relief. Remedies for environmental torts are not

limited to compensation, and should also include injunctive relieves. Since environmental torts often come with legal industrial production, the court often faces a dilemma in these cases. Whether the court should protect the victims' lives, health, protection and environmental rights, and stop the socially beneficial industrial production? Or should the court stands by the side of industrial production and sacrifice the local residents' lives, health, property and environmental rights?

23 Fifth, Obstacles in Enforcement. China has not established a mandatory insurance system for environmental torts. When the tortfeasor causes severe damage to the victims' property and health, the victims will not be properly compensated if the tortfeasor lacks a deep pocket to cover all the compensation.

7. Policy Review and Evaluation

7.1 Environmental Policies

1 In a broad sense, water environment policies refer to all decisions and actions by the state and local governments in water environment protection.

2 Major policies referring the TLB water pollution control are listed in Table 7.1.1-1.

Table 7.1.1-1 TLB Water Pollution Control Policies

Level	Type	Name
National	Laws and Acts	Environmental protection act of the PRC (1989)
		PRC Water Act (1988)
		PRC water pollution control and prevention law (1996)
		PRC Soil conservation law (1991)
		PRC clean production promotion law (2003)
		PRC EIA law (2003)
		PRC administrative litigation law (1989)
		PRC administrative punishment law (1996)
		PRC administrative reconsideration law (1999)
		PRC administrative license law, (2004)
	Regulations	Regulation on the construction project environmental protection management (1998)
		Implementation detailed rules of the PRC water pollution control and prevention law (2000)
		Management regulation on the collection of pollutants discharge tariff (2003)
		Investigation and clampdown measures on the non-license operation (2003)
		Regulation on the public suggestion management (2005)
		Regulation on the control and prevention of the water pollution from the watercraft (2006)
	Department regulation	Measures on the management of water pollutants discharge permits (1988)
		Regulation on the management of pollutants discharge application and registration (1992)
		Code of the regulation and circular making for the environmental protection department (1999)
		Livestock and poultry breeding pollution control and prevention measures (2001)
		Management measures on the HRB and TLB water pollutants discharge permits (2001)
		Construction project completion environmental protection reception measures (2002)
		Classification and management of the construction project environmental protection (2003)
		Approval regulation of the construction project EIA report (2003)
		Management measures of the pollutants discharge tariff standard (2003)
		Management measures of the pollutants discharge tariff collection and use (2003)
		EIA report examination experts database management (2003)
		New chemicals environment management measures (2003)
		Regulation on the planning EIA report examination and approval (2003)
		Environmental protection field administrative punishment measures (1999)
		Environmental protection administrative license public hearing regulation (2004)
		Measures on the clean production audit (2004)
		Management measures on the license of environmental pollution control facility operation (2004)
		Management measures on the pollution sources automatic monitoring (2005)
		Punishment code on the illegal behavior in environmental protection field (2006)
Local	Jiangsu	Jiangsu province environmental protection regulation
		Jiangsu province ecological construction planning program
		Jiangsu province cyclic economy development plan
		Jiangsu province Tai Lake water pollution control and prevention regulation

Level	Type	Name
		Jiangsu province lake protection regulation
		Jiangsu province agricultural ecological environment protection regulation
		Jiangsu province municipal water supply and water resource management regulation
		Jiangsu province city environment and sanitation management regulation
		Jiangsu province environmental and economic harmonized development demonstration township construction plan
		Jiangsu province management measures of environmental protection science and technology development fund and environmental monitoring station standardized construction fund
		Jiangsu province environmental function classification management measures of surface water
		Jiangsu province environmental monitoring modernization implementation plan
		Jiangsu province key pollution sources pollutants discharge TML monitoring and report system
		Jiangsu province pollutants discharge TML monitoring and report system
	Zhejiang	PRC water pollution control and prevention law implementation measures of Zhejiang province (1996)
		Zhejiang province construction project environmental protection management (2003)
		Zhejiang province environmental monitoring regulation (1999)
		Hangzhou-Jiaxing-Huzhou area water pollution control and prevention 10th FYP(2001)
		Zhejiang province demonstrative ecological village standard and management regulation (2002)
		Zhejiang province classification management measures of environmental protection (2002)
		Program of Zhejiang province ecological construction plan (2003)
		Ecological construction objectives responsibility pledges for the governor and mayors during 2003-2007 (2003)
		Ecological province construction objectives and responsibility-audit measures (2003)
		Tasks of cities in 2003on ecological province construction (2003)
		Zhejiang province construction project environmental protection management measures (2003)
		Management measures on the authorization of construction project environmental protection approval, Zhejiang province (2003)
		Zhejiang province construction project environmental protection audit and check records measures (2003)
		Zhejiang province construction project "Three Synchronous" management (2003)
		Regulation on the environmental protection approval of Zhejiang province construction project (2003)
		Zhejiang province circulation economic development program (2005)
		Provincial monitoring area pollution control projects reception process
		Zhejiang province pollutant discharge tariff collection and usage management
		Zhejiang province environmental pollution and ecological damage emergency reaction plan
	Shanghai	Shanghai environmental protection 9th FYP and 2010long term plan
		Shanghai environmental protection 10th FYP
		Shanghai water environmental pollution control and prevention plan - 10th FYP
		Regulation on the public suggestion management - Shanghai (2003)
		Shanghai environmental protection regulation (1994, 1997, 2005, 2006)
		Shanghai food service industry environmental pollution control and prevention management measures (2004)
		Shanghai livestock and poultry breeding management measures (2004)
		Measures on the implementation of *PRC EIA law* - Shanghai (2004)
		Shanghai administrative permit regulation (2005)
		Operation process on implementation of administrative permit - Shanghai EPB (2006)
		Management measures of Shanghai water pollution sources control with time limit
		Clean production audit regulation (2004)

3 Except the *Interim Regulations on HRB and TLB Water Pollution Control and Prevention*, no policies have been specifically prescribed for the Tai Lake, and therefore there is no regulations specifically designed to address the watershed water pollution control and prevention objectives, pollutants discharge TMLL targeting, time-limited compliance, pollutants discharge permits issuing, pollutants discharge fee collection and management, industrial restructuring, coordinated water quality and quantity management, environmental emergency response, and water pollution disputes.

4 Although touching all major aspects of water pollution control and prevention, the current policies have the following issues:

a) "Principle" rather than concrete – there is no implementation guideline for the operation at various implementation level;

b) Raising the "hopes" without telling "how";

c) Lacking of specific result evaluation methods;

d) Lack of service-oriented but highly professional implementation guidelines to fill the details of the policies and regulations with plain but accurate and professional language to support and serve the implementers of the policies at provincial, prefecture, and county levels.

e) Possible conflicts of interest, inefficiency and ineffectiveness in the monitoring system lead to inefficiency, ineffectiveness, and weak enforcement.

f) Inadequate preparation before launching the policies, which in turn leads to unsatisfactory policy implementation.

7.1.2 Implementation

1 During the 9^{th} and 10^{th} FYPs, the TLB pollution control project was implemented in Jiangsu Province, Zhejiang Province and Shanghai Municipality. In the TLB areas, based on each jurisdiction's water pollution control policy, certain approaches were implemented, including industrial pollution prevention, urban domestic pollution control, pollution cleaning, construction of protection area, and rehabilitation of zoology, agricultural non-point source pollution prevention, shipping pollution control, aquaculture pollution prevention, and environmental management.

2 According the *Tai Lake Water Pollution Prevention during the 9^{th} FYP and 2010 Plan*, by the end of 1998, in the Tai Lake areas, the discharge of wastewater of all the industrial sources of pollution and livestock raising and husbandry, restaurants along the Tai Lake had reached the standard. In 2000, centralized drinking water use sources and major rivers had achieved standard class III. The Tai Lake water bodies became clean. According the *Report of Environmental Status of China in 1998*, until Dec 31, 1998, the discharge of wastewater from industries, centralized livestock raising and husbandry, restaurants along the lake, and other polluters had achieved State's or local standards. Among the 1035 polluters which discharge over 100 tons wastewater or COD 30 kg per day, 863 (83%) of them had passed the

inspection. Among the remaining 17%, 29 plants were improving their facilities or shut down, 42 had been closed, and 101 had run out of business. Therefore, the overall compliance rate has reached 97.3%. Besides, 70% of the 1052 "non-key" polluters discharging less than 100 tons wastewater or 30 kg COD per day had complied. Two urban WWTPs had been built, and another 3 were under construction, accounting for 33.2% of the entire plan. Ecological agriculture demonstration projects, silt cleaning, drinking water source protection, restriction of phosphorus-containing detergent sales, the scale of boxed aquaculture, and pollution from river course shipping had been controlled in a certain extent.

3 But according to the *Report of Environmental Status of China in 2000*, the TLB areas have been eutrophied in 2000. Major rivers around the lake were severely polluted. The situation was far from the objective of the 9th FYP. Accelerated urbanization and industrial pollution, excessively fertilizing, abundance of livestock rising and husbandry complicated the pollution control. Non-compliant wastewater discharge resurfaced. And inappropriate exploitation reduced the self-purification capability of the Tai Lake. The water body pollution is also severe, and the TP and NH_3-N were used exceed.

4 In the *10th FYP of Tai Lake Water Pollution Control*, the objectives have been adjusted from pure industrial point sources pollution control to a combined industrial point source control with agricultural non-point source control, from pure urban pollution control to a combined urban and rural pollution control. During the 10th FYP, based on the industrial reconstruction, industrial pollution control, clean production, urban WWTPs construction, decreasing the usage of fertilizers and pesticides, reinforcing the livestock rising and husbandry, and ecological dredging and shelter belt construction, the objectives of the 10th FYP had been generally accomplished. And the trend of degradation of water quality had been controlled.

5 However, the water quality objectives of 9th and 10th FYPs had not been achieved, and the water body pollution was still severe and far from the level at the beginning of the 9th FYP, let alone the situation before 9th FYP.

6 The implementation results of the policies indicate the suitability of the policies. The results mentioned above reveal further issues in the policies and their implementation:

a) The water policy-making does not adequately match or try to match the economic development level.

b) Economic decisions do not fully incorporate the environmental issues. Although the central government has taken the environmental issues as an important factor during the decision-making, at the local and corporate levels the environment issues have not been put to a proper position in their decision making.

c) Insufficient preparation of the long time span and complexity of river/lake water quality restoration in the water pollution control policy-making, epically in meeting the targets.

d) Insufficient financial and human resources in the EPBs to successfully enforce the

environmental policies, laws, and regulations.

e) Unsustainable execution of enforcement efforts: the often adopted "flare" style takes highly concentrated human resources and financial inputs and has been proved to have only short-lived results.

f) Insufficient funding – although pollution control policies and plans require for matching budgets, the funding was always not in place, in time.

7.2 Regional Development Policy

1 Policies of building ecological provinces are implemented widely in the TLB. The construction results are as below, but no data appeals any concrete effects of the TLB pollution control due to this policy.

2 Policies for building ecological provinces are carried out widely in provinces along the HRB, and are regarded as important develop guidelines. According to SEPA's *Interim Construction Indicators of Ecological County, City, and Province*, the construction index includes the following three sorts: economic development, environmental protection and social advancement. The second index defines that the water environment quality must reach functional use standards. It also defines the COD discharge intensity, urban domestic wastewater centralized treatment rate pollution control index. The following are the result of construction implementation:

3 The government of Jiangsu province issued the *Notification of Promoting Environment Renovation and Development* in 1999. In 2001, the People's Congress of Jiangsu province authorized the *Decision of Enhancing Environment Renovation and Promoting Ecological Province Construction*. The government issued the *Notions of Enhancing Ecological Environment Protection* in 2003, and 'Regulations for Building Ecological Jiangsu Province' in 2004, which was authorized and implemented by people's congress in that December.

4 All the towns and cities in the TLB area in Zhejiang Province have begun the construction of ecological demonstration areas. At the present time, *Lin'an, Anji, Pinghu, Tongxiang, Haining*, and *Deqing* have been named as the "state ecological demonstration cities" by SEPA. *Deqing* has even been named as the "state ecological and agricultural excellent county." 16 towns were named as "provincial-level ecological town" and some other areas are searching for mechanism of ecological compensation. *Anji*, *Deqing*, and *Lin'an* created policies to regulate the corporations which will enter these areas. The taxes will be all returned to the local government for prompting the enthusiasm of environmental protection.

5 Through the process of building ecological province, cities, counties, towns, and villages, all the provinces and cities in the TLB now consider environment influence more systematically, and have learned to balance regional development and environmental protection.

7.3 Industrial Development Policy

1 Recent industrial development policies are mostly guiding environmental policies, which are listed as follows.

(1) Industrial distribution and structural regulation

2 A number of characteristics feature this policy: adjust the improper industry distribution based on the overall urban planning and the environmental protection planning; for the old industrial cities, relocate certain industries to alleviate the concentrated pressure from pollution; and replace heavily polluting industries with those of lighter pollution. In 1996, a policy favorable of moving polluting industry came out. This policy enabled economic compensation to the industries relocated, and therefore partially resolved the financial shortage in urban industrial pollution restructuring. The industrial restructuring would focus on restricting heavily polluting and energy consuming industries and regulating the technologies.

(2) Technological advancement and the cleaning production policy

1 This policy adds environmental protection requirements to the industrial technological advancements and imposes pollution reduction requirements for new technologies generally through two approaches: technological advancement which updates the originally heavily polluting techniques to lightly polluting or zero discharging ones and comprehensive utilization, which recycles the wastes back to production.

(3) The "Closing, Ceasing, Combination, and Conversion" Policy

2 The "Closing, Ceasing, Combination, and Conversion" Policy has been a strict environmental protection policy. It is generally implemented according to two scales: the situation of pollution and the industrial size. The former one targets at the heavily polluting industries unable to comply, and the latter forbids the existence of miniature enterprises in certain sectors. The 1996 *Decision on Several Issues in Environmental Protection* by the State Council required local governments to close off all miniature enterprises of 15 heavily polluting industries. The policy was enforced as administration order.

3 According to the *9th FYP and 2010 Plan of Tai Lake Pollution Control,* the government must get down to adjust industrial structure, implement clean production, forbid new chemical papermaking factories in the TLB, close off and forbid new small papermaking, sulfur, plumbum, pesticide, dyeing, plating, and brewing factories of capacities below 5000 ton; It also strictly restrict the founding of new large-scale projects in chemicals, plating, brewing or others with severe pollution, and thoroughly ban the "small fifteen" types of factories. Up to the end of 1998, the *TLB Wastewater Renovation Plan for 1998* had been accomplished. However, according to the *10th FYP of TLB Water Pollution Control*, as a result of incentive-based economic policies, lax implementation and ineffective management, and local protectionism, there were nearly 10% of the factories remained to discharge over the standard, even discharge surreptitiously after the renovation, which led to the failure of the water clean-out plan in 2000.

4 The *TLB Water Pollution Control Plan for the. 10^{th} FYP* adjusted the direction of pollution control from pure industrial point-source to the combined industrial point sources and agricultural non-point source pollution control. All industrial enterprises in the drainage area have been obliged to observe the all-around standard; Industrial enterprises that could not fulfill the standard were obliged to reform in a limited time. Industrial enterprises with severe pollution were charged to close off or move out. All enterprises were required to look into clean production so that TLB would be built as nation-level clean production base. Meanwhile, agricultural non-point source pollution control will be enhanced. By building agricultural ecological demonstration regions and cultivating green farms, pollution from the plantation industry would be significantly reduced.

5 According to the planned objectives, both Jiangsu and Zhejiang provinces have adjusted their industrial structures, and enhanced the control of agricultural non-point source pollution. In Jiangsu province, all the 62 pollution control projects for N- and P-reduction, and 8 out of the total 10 non-point source pollution control projects have been accomplished. In Zhejiang province, all the 7 enterprises planned to be free from P and the 18 enterprises planned to be free with N had fulfilled their targets. Moreover, 4 ecological demonstration projects were basically established.

6 During the 10^{th} FYP, Jiangsu province issued local standard for textile, printing and dyeing industries[14], which defines that all factories of printing and dyeing should abide by Class I discharge amount since 2005. By the end of 2005, nearly 1000 printing and dyeing factories in Jiangsu along the TLB accomplished to adjust their discharge amount to new standard. Moreover, chemical industry renovation in the TLB were implemented during which pollutants discharge standard was heightened, so that enterprise non-complying the industrial policies or failed to meet the standard would be closed off; There were 738 enterprises finished the checkup for clean production.

7 During the 10^{th} FYP, over 200 projects with significant economic benefit were disapproved due to their high pollution levels. *Xiuzhou* District of *Jiaxing* City attempted to establish the mechanism of pollutants discharge fee mechanism for industrial enterprises, which would facilitate industry restructuring and pollution control. Concerning agricultural restructuring, Hangzhou, Jiaxing and Huzhou defined "husbandry prohibited area" and "limited husbandry area", and issued environment evaluation regulations for new husbandry areas. By the end of 2005, all husbandry areas in the "husbandry prohibited area" had been closed. A total of 23 excreta treatment and organic fertilizer factories, 2 earthworm farms, and over 4000 biogas and purification pools have been built. The overall excreta utilization rates of the three cities have reached 87%, 65%, and 88.5% respectively. Pollution control from livestock wastes has become more resource- and market oriented.

8 In sum, the above industrial policies in the TLB have promoted industrial restructuring, optimized the industrial outputs structure, enhanced the pollution control, and reduced pollutants discharge.

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[14] The evaluation report of water pollution control implementation in the 10th FYP in Jiangsu province

7.4 Finance Policy

1 The two FYPs of the Tai Lake water pollution prevention have consistently adopted the principle of "polluters pay." The investments have to a large extent depended on the investment by the local governments and supplemented by state subsidies.

2 The TLB provinces initially filled the planned investment by establishing a multi-facet investment and financing system, which is mainly composed of government investment and supplemented by private investments. This system is progressively attracting foreign direct investment. The details are presented in the following paragraphs.

(1) Comprehensive control of watershed

3 According to the statistics of the *10th FYP of Tai Lake Water Pollution Prevention*, during the 9th FYP, the planned investment in the Tai Lake pollution prevention was 129.5×10^8 yuan, and the actual investment reached about 100×10^8 yuan, 77.2% of planned level; the capital shortfall was 30×10^8 yuan, which can be largely attributed to the shortfall in construction capital for municipal WWTPs. The investment for the 10th FYP water pollution prevention plan of the Tai Lake totaled 220.1×10^8 yuan, and the actual investment reached 164.7×10^8 yuan, accounting for 77.8% of planned level.

4 As water pollution control and prevention investment relates to various public and private organizations, the current institutions have proved inadequate as a comprehensive supervisory, management, monitoring, and reporting system on water pollution control and prevention investment. No comprehensive information on investment in the 9th and 10th FYPs water pollution control and prevention is available at present. The available patch of data, the TLB water pollution control and prevention project investment during the 10th FYP, has been tabulated in Table 7.4-1.

Table 7.4-1 Water Pollution Control and Prevention Investment in TLB during 10th FYP

Unit: $\times10^4$ yuan

Program classification	Jiangsu		Zhejiang		Shanghai		Total	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Municipal WWTP	548755	558617	484900	495535	28500	14303	1062155	1068455
Waste disposal	30500	11800	96425	93287	0	0	126925	105087
Industrial pollution control	8616	12307	2644	1322	0	0	11260	13629
Ecological rehabilitation	208000	65579	0	0	0	0	208000	65579
Dredging	239948	50628	86300	106335	0	0	326248	156963
Non-point source pollution control	220933	139121	8760	9070	0	0	229693	148191
Drinking water source protection	61000	9512	78500	53500	0	0	139500	63012
Special industrial pollution control	3000	8470	4200	0	0	0	7200	8470
Environmental management capacity building	3500	15206	1800	1910	500	300	5800	17416
Total	1324252	871241	763529	760959	29000	14603	2116781	1646803
Ratio of actual investment to planned (%)	65.79		99.66		50.36		77.80	

Data Source(s): Provinces in TLB 10th FYP achievement evaluation report

5 The above table indicates that pollution control and prevention investment did not reach the target level during the two FYPs. During the 9th FYP, the shortfall of pollution control and prevention capital is mainly shown in the lack of construction capital for municipal WWTPs. The 10th FYP, nevertheless, saw general completion in financing for the WWTPs, solid waste treatment plants, industrial point sources control, special industries pollution control, capacity building projects on environment management but large shortfalls in project capital for ecological rehabilitation, silt cleaning, non-point source control, and water source protection. Since no steady investment channel exists for environmental projects, the processes and effects of pollution control depend on the funding availability and the time length of financing. These factors have posed severe restrictions on the control progress of the Tai Lake.

Case on Benevolent Cycles of Environmental Investment

During the process of controlling Wuli Lake, the Wuxi government has taken the position of "the environment is resources, assets and capitals" and has combined pollution control with urban planning. The Wuxi government invested over 6×10^8 yuan to systematically restore the Wuli Lake through bank loans or other channels, implemented comprehensive projects as returning fishing areas to lake areas, dredging, and afforestation. Through the execution of these projects, water environment of Wuli Lake has been ameliorated visibly, and the environment improved. In turn, the improved environment elevates the comprehensive functions and resource prices in the surrounding areas. In turn, favorable economic returns further facilitate comprehensive pollution control, forming a benevolent cycle between the environment and the economy.

6 A major reason for the shortfall in investment is that the pollution control budget is not fully included in the fiscal budgets of either the state or the local governments. Certain commonweal projects such as dredging, wetland construction, and building of automatic water quality monitoring stations cannot be financed through the financial markets, thus impeding the progress of comprehensive control of watershed. A benevolent cycle of environmental capital utilization, to multiple financing channels for comprehensive environment improvement projects, and finally the establishment of a better environment with accrued environmental assets needs to be established by improving environment quality and the comprehensive function of the planned area, market-oriented environment protection investment, healthy revolving of environmental capitals.

(2) WWTPs

7 During the 9th FYP, lack of construction capital of WWTPs and the delayed injection of capitals have been the major reasons of the unfinished investment tasks. According to the analysis of the *Tai Lake Water Pollution Control and Prevention in the 10th FYP*, total investment required for constructing WWTPs was 69×10^8 yuan, accomplished investment was about 40×10^8 yuan, and the shortfall was near 30×10^8 yuan, accounted for 45% of the total investment. In the specific program "Three River Three Lake" of national debt project, state approved 26 WWTP construction projects around the Tai Lake during 1998-2000, amongst specific project capital in central budget was 4.61×10^8 yuan, local government loan

totaled 6.14×10^8 yuan. According to the statistics by the MOC, by the end of 2000, completion rate of local complementary capital was just 41.3% of the planned volume, and the majority was invested successively in 1999 and 2000. Urban WWT tariffs were low. For instance, the WWT tariff of Jiangsu Province was 0.6 yuan/ton in 2000.

8 During the 10th FYP, planned investment of TLB WWTP construction was 106.22×10^8 yuan, and the actual investment, 106.85×10^8 yuan, exceeded the planned volume. According to the national policies of the 10th FYP, urban WWTP construction projects would usually receive 17% of the total investment from the state, and the WWT tariff should be set to ensure operational cost recovery, while a reasonable level of profit is allowed. From the survey, all provinces and cities in watershed had adjusted their WWT and water resource tariffs. On March 1st 2002, four TLB cities of Jiangsu Province took lead in increasing the WWT tariff from an average of 0.6 yuan/ton to 1.1-1.15yuan/ton, and made themselves the area with the highest urban WWT tariff in the country. During the tariff increase, these jurisdictions fully considered the social affordability and restricted the fee increase for poor individuals and plants. For most discharging enterprises, although the WWT fees have increased, the total cost for centralized treatment at the WWTPs is still lower than the cost of on-site treatment. Thus, the tariff increase was carried out smoothly. The increase in WWT tariff has increased the WWT profitability as a business and attracted private investment. A number of BOT, TOT and other operation models have settled in in the TLB and expedited the construction of pollution prevention infrastructure.

(3) Comprehensive treatment of industrial enterprise

9 According to the principle of "polluters pay", industrial enterprises are supposed to fund their own capitals for pollution control with certain aid from the local technical reconstruction capital. During the 10th FYP, the TLB industrial point sources control investment was 1.13×10^8 yuan, and the actual investment, 1.36×10^8 yuan, has exceeded the planned volume. The data on actual enterprise comprehensive control capital in the 9th FYP and the capital sources of the two FYPs were not available.

10 Although the policies has tried to establish a multi-channel investment and financing mechanism for water pollution control, the mechanism has yet to be full grown or effective as expected. In the existing mechanism, pollution control mainly depends on direct investment from the government. Existing policy can not lead other capitals into pollution control and get profits effectively.

11 Pollution control capital will be very limited if it just depends on financial support from the government planning, the deficiency of the pollution control capital is the chief factor, which affects the implement rate of progress of the TLB water pollution control and prevention project. Although the existing policy try to develop the channel to the social, civilian, enterprise and foreign capital, and made a great progress in urban WWTPs, but the benefit mechanism of pollution control which is based on the government finance, enterprise capital, credit capital, social capital, foreign capital has not been established.

12 Form a multi-pattern of environment protection investment financing among government,

banks, enterprise and individual etc, is an international custom to absorb diffusely capitals like fiscal capital, business capital, social public and enterprise unit and other social capitals into environment protection objectives, but it still need some policies to construct the benefit relationships on the retails of different capitals. Only under the drive of advantaged benefit instead of control order, each capital could enter the pollution control domain on their own initiative.

7.5 Technical Policy

1 In November 1986, the State Council Environment Protection Committee published *Regulations of Technical Policies of Preventing Water Pollution.* The Regulations made comprehensive requirements of controlling and preventing water pollution by technical policies of watershed, urban, industrial and mine enterprise and villages and towns enterprise, including: technical policies of water pollution according to the watershed, district comprehensive prevention; disposal technical policy of urban wastewater; control and prevention technical policies of water pollution of industrial and mine enterprise and villages and towns enterprise.

2 since the 9th FYP, according to the requirements of Chinese water pollution control, central government published many technical policies of water pollution control, including:

a) Light industry resource comprehensive utilization technical policy (1997)
b) Straw pulp industrial wastewater pollution control and prevention technical policy (1999-11-29)
c) Municipal WWT and pollution control technical policy (2000-05-29)
d) Domestic waste treatment and pollution control technical policy (2000-05-29)
e) Dying industrial wastewater pollution control technical policy(2001-08-08)
f) Lake and reservoir eutrophication control technical policy (2004-05-10)
g) Tanning industry pollution control technical policy (2006-02-21)

3 The local governments attach great importance to the technical policy of water pollution control and prevention. For instance, Article 21 of the *Tai Lake Water Pollution Control and Prevention Regulation of Jiangsu Province* requires that the TLB develop the science research of the Tai Lake water pollution control and prevention, adjust programming and industry structure in reason, optimize resource collocation, develop low pollution low consumption industries and products; accelerate technical alteration in enterprise, push clean production.

4 These technical policies, especially the industry technical policies, take the advance of clean production as guidance, put forward a collective technical principal, technical course and technical measure of pollution control and prevention during each producing process, and put forward both elimination and encouragement for industrial crafts and equipment at the same time, made an important effect on the water pollution control and prevention of HRB area which has serious structural pollution.

Case of pushing clean production by technical policy

During the execution process of clean production by Jiangsu the Tai Lake Juhao Artificial Board Ltd., Co, the company realized the clean production was the necessary choice to reduce consumption, decrease pollution, improve effect. On the basis of figuring the comprehensive utilization level of the actual resource of unit product, major comprehensive technical economic indicators and major pollution discharge indicators, the company invested 1.35 million yuan to execute 23 low/no fee projects, 3 middle/high fee projects, obtained 5.873 million yuan economical benefit annually, saved electricity 1.30 million degree, saved oil 15 ton, saved coal 3770 ton, reclaimed dust 250 ton, reduced dust discharge 250ton annually, reduced wastewater discharge 0.182 million ton, obtained well economical benefit, environment benefit and social benefit.

Source: website of Jiangsu EPB, June 21st 2006 "Jiangsu Tai Lake Juhao Artificial Board Ltd., Co. passed the check and acceptance of clean production"

5 Chinese environment pollution control and prevention technical policy is the technical guidance formulated by environment protection department, according to the pollution characters of economical technical level and different industries in a certain term, aim to prevent environment pollution. The technical policy advanced requirements of technical principal, technical courses and technical measure of pollution control and prevention, exerted as an important guidance in the HRB water pollution control and prevention project: at first, as the foundation of environment protection control in all levels to formulate the control policy of environment protection, avoid the control mistake or confusion of disharmony between environment control policy and the current economical technical level; secondly, guide pollutants discharge enterprise and environment protection enterprise choose the best technical way and technical measure in pollution control and prevention process, avoid go crossroad on pollution control and make improper decision, or suffer economical loss; thirdly, provide technical foundation for formulating the environment standards, make sure the environment standards and economical technical level can be on speaking term.

6 But due to the non-compulsion of these technical policies, they have not been absorbed into the process of environment control institutions by local governmental departments on all levels, and can not be performed as stated requests.

8. Institutional Review and Evaluation

8.1 Institutional Settings and Responsibilities

1 Water resource utilization and conservation encompass water supply, use, drainage and WWT. It naturally follows that the water environment management will have to incorporate all those aspects. However, those aspects of water environmental management are in the hands of various agencies according to the current administrative institutions.

2 The water environment management relates to: specialized agencies including MWR, SEPA, MOC, MOA, MLR, MOT, and SFA and their local bureaus; and comprehensive agencies including State Development Planning Commission (SDPC), MOF, State Economic and Trade Commission (related functions have been moved to NDRC) and their corresponding local agencies. By the authorization of the State Council, SEPA is responsible for the water pollution control and management; MWR is responsible for water resource planning, management and the construction of new projects; MOC is responsible for municipal wastewater network, water supply and sanitation and WWTP investment. MLR is responsible for management of national land and natural resources (water is resource); MOA is responsible for agricultural production, thus influences agricultural water use; MOT is responsible for transportation and impacts on water quality from river way shipping. Although the comprehensive agencies do not have direct impacts on water, but they still indirectly influence the water environment management. MOF is responsible for the investment and management of the state hydraulic engineering and pollution control projects, and participates in various fee policies and fee management relating to the water environment (water resources fee, over discharge fee and WWT fee); NDRC is responsible for state investment program planning and approval and participate in various policy-making in water environment; SDPC administers industrial enterprises, is responsible for the state industrial development policy-making, and has indirect impact on industrial pollution prevention and control (Table 8.1-1). The State Council and the local governments have exerted impacts on watershed environmental management, but they also can be the best coordinating body among various authorities. Table 8.1-1 tabulates responsibilities of different authorities.

Figure 8.1-1 Administrative Organization Chart

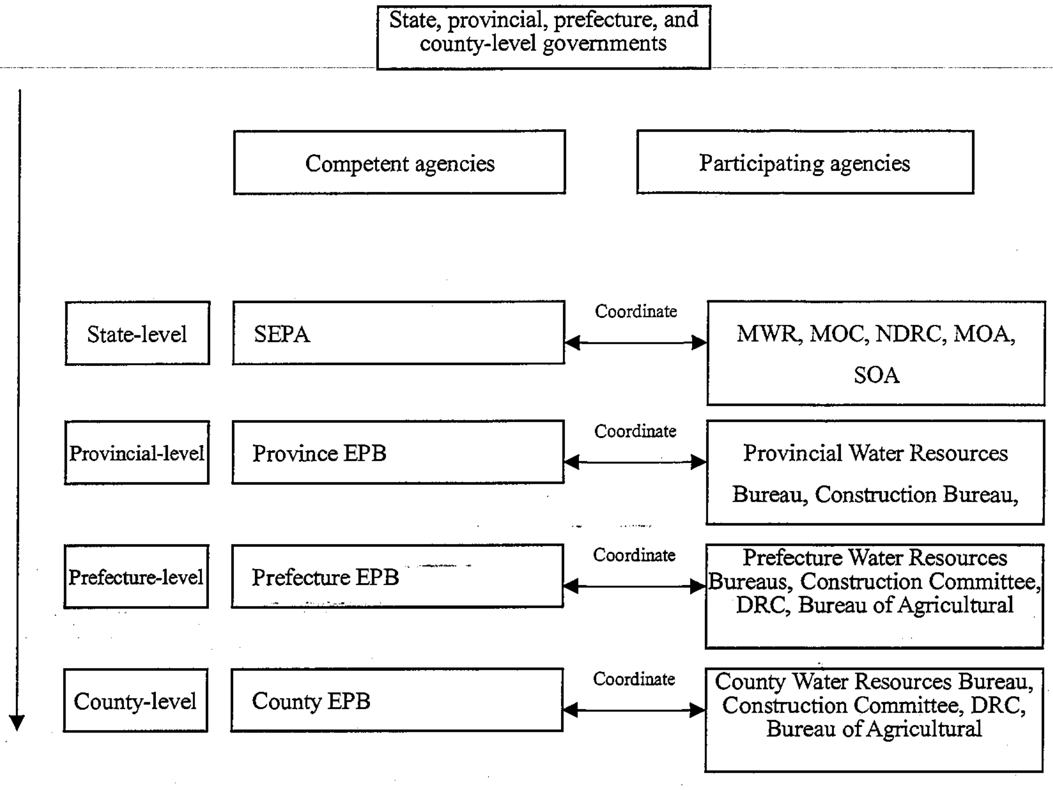

Table 8.1-1 Interrelated Responsibilities of Various Authorities for Water Environment Protection in the TLB

Ministry	Water resource protection			Water resource exploitation and development		
	Water resource and water environment management	WWT		Water extraction	Water supply	Water conservation
		Industrial	Domestic			
MWR	Unified water resource management, set water resource protection plans, monitor water quantities and quality in rivers and lakes, issue national water resource communiqué	Outlets to rivers, setting pollutants carrying capacities of water systems and the TMLL	Pollutants absorbing rivers and outlets to rivers, validate water system pollutants carrying capacity, advise TMLL	Implement water use permits institutions; establish water resource fee collection institutions, water distribution	Engineering water supply, organize and manage key hydraulic engineering	Water conservation policy, set water conservation plans and the relevant standards; organize, supervise and monitor water conservation projects.
SEPA	Water quality management; Pollution management	Monitor pollutants discharge outlets; manage; collect pollutants discharge fees	Issuing WWTPs fee policy			
MOC	Drinking water	Industrial wastewater entering into urban wastewater network	Urban WWPT planning, construction and operation	Water use permits	Urban water use and supply	Urban water conservation
MOA	Agricultural source water protection; Non-point sources pollution control	Wastewater discharge of agricultural products processing		Manage agricultural water supply and use	Agricultural water use	Conservation of agricultural water use
MLR	Water resource management					
SFA	Water conservation forests protection	Wastewater discharge from chemical industry				
MOT	Waterway shipping environmental management	Waterway shipping pollution				
SDPC		Sectoral policy		Management of industrial water supply and usage	Industrial water use	Industrial water conservation
MOF		Pollutants discharge fee policy and fund management	WWT fee policy	Participation in setting water resource tariff	Water tariffs	
NDRC		Pollutants discharge fee policy	WWTP fee policy		Water tariffs	
NPC	Laws, regulations, and statutes; monitoring					
State Council	State Council statutes; coordination					

8.2 Water Environmental Managerial and Organizational Functions

1 The table below tabulates the allocation of responsibilities among various authorities and presents their differences.

Table 8.2-1 Responsibilities of Various Authorities

	Management responsibilities	Competent agencies	Remarks
Water resource use and management	Urban industrial and domestic water supply and use management	Local WRBs, construction committee, EPBs, and hygiene departments	With basically complete functional coverage and smooth operation, but the tariffs for water resource, water supply, and WWT are relatively too low
	Groundwater resource management	Local WRBs, construction committee, and EPBs	With complete functional coverage but the partial overlap responsibilities results in no bureaus to bear the responsibilities.
	Agricultural irrigation water use and supply management	Local WRBs, agricultural bureaus, and other local agricultural economic organizations	Management mechanism suited to the locale-specific, small scale production of agriculture but lacking strict water use permitting system. Low water tariff. The decentralization of the management rights of water use may cause the agricultural operations exceed the governmental water allocation.
	Rural domestic water use management	Local WRBs	Lacking of defined management responsibilities. Only management practice is to register a portion of the rural groundwater users. In general, the government management remains weak.
	Management of functional water zones	EPBs and WRBs at various levels; also involving local urban construction, tourism, land resources, fishery, hygiene, and agricultural agencies	The most important "functional zones of water quality" (by EPBs) and "functional zones of water resource" (by WRBs) overlap in contents and management responsibilities but both refer to water demands. The undefined responsibility allocation leads to management conflicts and increases management costs.
	Water resource management and dam construction	WRBs	With basically complete functional coverage and defined responsibilities. However, the water direction and dam construction by the WRBs often excludes ecological considerations and deteriorates water qualities. (WRBs disagree with this point.)
Water quality management and pollution control	Plantation and agriculture non-point sources pollution control	Agricultural bureaus and EPBs of various levels	The ecological agricultural extensions by the agricultural bureaus do not incorporate watershed (regional) water pollution control and prevention. The scope and progress of the extensions do not coordinate with the non-point sources pollution control of plantation.
	Livestock raising and husbandry pollution control	EPBs (for livestock raising and husbandry point sources pollution control); EPBs and agriculture bureaus (for non-point sources pollution control)	No clearly defined responsibilities of livestock raising and husbandry (especially small scaled family husbandry) non-point sources pollution control; agricultural bureaus do not incorporate the comprehensive utilization of the livestock excreta in the ecological agricultural extension.

	Management responsibilities	Competent agencies	Remarks
water quality management and pollution control	Aquacultural non-point sources pollution control	Null	Responsibilities unassigned. The fishery bureaus only manage the production side of fishery. Fishery resource protection fee should be added and non-point sources pollution should be considered in aquacultural permits management.
	Urban and county surface runoff non-point sources pollution control	EPBs at various levels	The management offices do not have the even most basic control and management mechanism. The solution is to have the construction committees enhance management of municipal solid waste and incorporate urban uncontrolled surface runoff into the urban wastewater collection and treatment system.
	Solid waste landfill (dumps) wastewater leachate control	Construction committees and EPBs of various levels	Solid waste landfill site selection and construction is decided by the construction committee together with the EPBs; solid waste landfill is supervised by the construction committee; wastewater leachate control standard has been issued but no management authorities have been assigned. As solid waste treatment plants are mostly run by state enterprises under the government, pollution control by the EPBs remains weak.
	Industrial wastewater discharge and treatment	EPBs of various levels	With basically complete functional coverage and smooth operation, but the pollutants discharge fee and WWT tariff are relatively too low. The industrial WWT rate through municipal WWTPs should be increased.
	Urban domestic wastewater discharge and treatment	Construction committees of various levels	Mis-allocated responsibilities. In WWTP construction, often the local interests overshadow the watershed-wide (or regional) planning.
	Ship pollution control	Local transportation bureaus	Relatively good short-term results, but the utilization rate of on-board pollution control facilities remains low, which is an inevitable result from unsound management institutions.
	Sediment pollution control	*De jure*: local EPBs; *de facto*: null	The sediment management responsibilities are with the constructors. The sediment pollution prevention and control have not been clearly assigned to particular departments.

2 The analysis above indicates that multiple administrative agencies are presiding over the water environmental management. Water resource management encompasses treatment, protection, and utilization of surface and groundwater. Water environmental management is in the hands of the water resources, electricity, communication, urban construction, land & mining, and agricultural authorities (Qi Jiayin, etc., 2000). Sometimes the agencies set single-facet policy conducive to their own work, without considering the overall water environmental management. As a result, the "spill-over" from the single-facet policies and measures often harm watershed environmental management. Water environmental management requires comprehensive decision-making, but the existing decision-making mechanism cannot serve comprehensive water resource management, utilization and protection, even though certain coordinating mechanism – watershed management leading group and conference – has been working to improve the situation. This is caused by the

absence of coordination and communication between management system by function and that by appanage, which leads to conflict of interests among various agencies.

8.3 Watershed Management Institutions

1 At the dawn of PRC, the Chinese Government established seven Watershed Management Committees. However, at that time, fighting a flood, preventing water-logging, building water conservancy and managing water supply projects were their main responsibilities, and the management of water quality was not required.

2 Afterwards water quality management also became an important function of watershed management. In 1975, the national hydrology working meeting put forward that the MWR need to manage not only water quantity, sand quantity, but also water equality due to the need of water resources development and protection. At the same year the State Council environmental protection leadership group explicated that the MWR is responsible for water quality protection, and watershed water resource protection organizations for the 7 major Chinese water systems have been agreed by the State Council Environmental Protection Leading Group and approved by the Ministry of Hydraulic Power.

3 Owing to the inseparability of water quality protection and water pollution control, in order to strengthen national and water environment protection and management, in 1983, the Ministry of Urban and Rural Construction and Environmental Protection and MWR and Electric ruled six tasks of watershed water resource protection at publicity, planning, supervision, management, monitoring, and research, explicitly request all the EPBs and WRBs to strongly support the work of watershed management organization.

4 The TLB Management Bureau is a dispatched organization of MWR in TLB, Qiantangjiang watershed, Zhejiang province and Fujian province (excluding Hanjiang watershed), it represents the MWR and implement main function of water matters, and it is an institution which has administrative function.

- Based on responsibility confirmed by The State Council, the TLB Management Bureau takes charge of watershed water resources protection, organizes function division of water environment and controls waste water discharge to drinking water source protection areas; examines watershed pollution receiving capacity, puts forward suggestion on pollution carrying capacity, takes charge of water quantity and water quality monitoring of transboundary, important, or directly managed rivers, lakes and reservoirs, or inter-watershed transfer water bodies.
- The Management Bureau is also responsible for organizing or participating in making watershed flood control operation plan, and taking charge of supervising implementation, conforming to provision or authorization to flood control and drought resistance for important hydraulic engineering, guiding, coordinating and supervising work of flood control and drought resistance, guiding and supervising work of flood storage and detention area management and compensation, organizing and guiding flood control demonstration for fatal construction project, taking charge of work of watershed flood control headquarter.

- The Bureau supervises and manages the state-owned hydraulic assets, draws out project proposals and adjusts plans about water and electricity prices and other expenses correlated to the projects. It also takes charge of usage, investigation, inspection and supervision of fund of central hydraulic projects in watershed.

9. Investment and Financing

9.1 Key Issues

1 Stable and sustained funding is necessary for the investment plans. Therefore, sustainable fund raising channels are needed. Based on the features of pollution control investment in HRB and TLB drainage area, the logic model is applied to analyze the logical relationship between the factors affecting the establishment of the investment and financing channels. An objective tree is also set up. The analysis found out that stable and reliable fund resources, proper fund utilization, and good fund utilization results are the ultimately needed for a sustainable investment and financing channel. All these factors need the support from economic methods and policy, including special-purposed investment policy to the watershed, fund examine and approve policy, fund supervising and management policy, pollutants charging policy, finance policy, exchange management policy and policy of fund raising based on market principle. In this chapter, the fund resource, utilization and effect of HRB are analyzed and followed by an analysis on the economic methods and policies. Based on these analyses, an overall conclusion on the investment and financing in TLB is drawn, and the main problems identified.

9.2 Funding Sources

1 During the planned economy era[15], the funding for pollution control was not secured in the budget plans as infrastructure construction and industrial reconstruction were. Pollution control was considered inferior than the economic development in state investment. Till the 10^{th} FYP the power of market has been valued in policy-making. But, dictated by a narrow understanding of the "polluters pay" principle, the ideology that the funds for pollutants treatment should be 100% paid by the polluters persisted.

2 As a result, pollution control funds were considered of much lower priority than those for infrastructure construction and industrial reconstruction for either industrial and agricultural organizations or cities and towns. The discharged pollutants were not treated adequately. In later years during the market economy, the accumulated pollution problems from early years have proved too heavy a burden for the current funding to cover, and the reversed insensitive still persists, since the cost of non-compliance was much lower than the cost of compliance. In a word, the "Polluter Pay" policy was *de facto* not carried out, and the pollution control funds in the end were not all paid by the polluters.

3 It remains difficult to obtain reliable and comprehensive information of scale and composition of fund from different resources due to the lack of special-proposed statistical system for TLB pollution control investment. According to currently acquired materials, in the last decade a variety of fund channels for pollution control in TLB was set up, mainly including funds from central government, local government (so called local complementary funds), enterprises itself, bank loans and foreign investment. Favorable conditions or guarantee from government was

[15] The year 2002 can be used as a threshold, as in 2002 the National development and Planning Commission, originally renamed from the National Planning Commission in 1998, was renamed for a second time to the National Development and Reform Commission. Since then, the word "planning" has been eliminated.

involved in the bank loan and foreign investment process.

1, Hangzhou, Jiaxing and Huzhou City

These 3 cities employed a market-based professional management mode to raise fund and construct environment protection facilities. All the WWTPs in operation are running according market requirement, of which 8 WWTPs was contracted using private investment. According to local conditions, Xiuzhou District employed trade of pollutant discharge rights. Totally 53 enterprises purchased wastewater discharged rights, resulting in 6 million trade amount. Before 2005 the old enterprises uses wastewater discharge rights for free will undergo the pollutant discharge right reform. Along with the 30% added value, there will be more funds for WWTPs construction.

Source: Zhejiang Provincial Government. Water pollution review in Hangzhou, Jiaxing and Huzhou, TLB. May 2004

2, TLB in Jiangsu Province

In all the cities and some counties in Jiangsu, the WWT tariff has been raised to 1.1-1.15 yuan/ton, which is the highest in China. With the secured funding sources, a large amount of loans, social and private capital has been poured into the urban WWTP construction. Eleven WWTPs have been contracted with foreign investments worthy of US$0.21 billion. Bank loans have added in too. Since 2002, more and more social capitals have entered the environment protection fields for WWTPs construction.

Source: New mechanism activate the waste treatment market, water pollution in TLB review, Environment News, China, 12th, May, 2004

9.3 Fund utilization

1 An analysis of the fund utilization of projects in TLB during the 9th FRP is not included due to the unavailability of comprehensive and reliable data.

2 Fund utilization of projects in surrounding Province during the 10th FYP is shown in Table 9.3-1.

Table 9.3-1 Composing of the Investment for the TLB 10th FYP in Provinces

Type of the program	Jiangsu (%)	Zhejiang (%)	Shanghai (%)
Municipal WWTP	64.12	65.12	97.95
Garbage disposal	1.35	12.26	-
Industrial pollution control	1.41	0.17	-
Ecological system rehabilitation	7.53	-	-
Dredging	5.81	13.97	-
Non-Point source pollution control	15.97	1.19	-
Drinking water resource protection	1.09	7.03	-
Special industrial pollution control	0.97	0	-
Environmental management capacity building	1.75	0.25	2.05
Total	100	100	100

Note:
1."-" in the table indicate that this item was not include to 10th FYP.
2. Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

3 Generally speaking, most investment for TLB plan in the 10th FYP has been spent on waste water treatment project construction. Besides the investment scale of the planned projects, such types of project were favorably funded due to that they can significantly contribute to the local pollution control. What need special clarification is that all the project of which the investment proportion is shown as 0, except fro some special industry sectors with no investment, is due to that they weren't listed in the plan.

4 Fund utilization of projects in surrounding cities in TLB during the 10th FYP is shown in Table 9.3-2.

Table 9.3-2 Capital Use of 10th FYP in Cities of TLB

City	Municipal WWTP (%)	Garbage disposal (%)	Dredging (%)	Drinking water resource protection (%)	Special industrial pollution control (%)
Wuxi	89.54%	1.82%	3.63%	3.45%	1.56%
Changzhou	73.57%	-	23.88%	-	2.55%
Suzhou	93.01%	3.26%	2.99%	0.36%	0.37%
Zhenjiang	100%	-	-	-	-
Shanghai Qingpu	100%	-	-	-	-
Hangzhou	69.14%	30.86%	-	-	-
Jiaxing	82.52%	3.89%	6.95%	6.64%	-
Huzhou	39.38%	5.30%	39.83%	15.49%	-

Note:

1."-" in the table indicates that this item was not include to 10th FYP.

2. Data Source(s): The Jiangsu TLB water pollution control and prevention 10th FYP performance evaluation report, The Hangzhou-Jiaxing-Huzhou TLB water pollution control and prevention 10th FYP performance evaluation report, The Shanghai TLB water pollution control and prevention 10th FYP performance evaluation report.

5 As shown in the table above, most investment has been spent on waste water treatment facilities construction. In Changzhou and Huzhou city, funds for bottom mud removal from lakes and rivers also comprise a major proportion of the total investment, which is closely linked with local environment and economy development characteristics.

9.4 Investment Benefit

1 Investment needs rewards. Benefits from pollution control investment include socio-economic and environmental benefits.

2 Direct economic benefit comes from urban WWTPs, recycling or reuse of "pollutants" after WWT. To enterprises or organizations, indirect economic benefits include reduction of production costs by reducing pollutants discharge fees, obtaining green reputation, fulfilling enterprises' social responsibility after satisfying environment standards. However, under the current circumstance, enterprises obtain little economic benefit through reducing pollutants discharge or penalty, as the cost of compliance is universally is higher than the cost of non-compliance, and in the current China social responsibility is not an important factor for elevating profitability. Therefore, the indirect economic benefits are very limited.

In July 2005, Zhejiang EPB together with the Zhejiang Province Development and Reform Commission, Province Economic and Trade Commission, Province Administrative Supervision Department, Province Trade and Industry Bureau, Province Justice Department, and Safety Supervision Bureau organized an investigation and law enforcement action focusing on the environmental pollution and ecological destruction that violated the EIA law and "3S" of the construction projects in the key river basins, regions and key polluting industries.

In the first phase of this special action, the EPB investigated the pollution of textile industry and seized 11 textile and dyeing enterprises that severely violated the pollutants discharge regulation. Among them, the Nanfeng Dye Houses in Nanhu District Jiaxing City stored the untreated wastewater in ponds and then waited until chances emerge to discharge the wastewater to the nearby river; Shuangqiao Dye Houses in Jiaxing City directly discharged untreated wastewater into the river; Changxing Silk, Ltd. in Huzhou City, Hangzhou Silk Spinning, Ltd., Topstar Dyeing Company and Xinwang Textile Company in Yuhang District did not operate its WWT facilities regularly; Huzhou Zhongjiang Dyeing Company and Jinnengda Dyeing Company discharged their non-compliant wastewater or surreptitiously; Hangzhou Yong Zhu Er Textile Co. Ltd. in Xiaoshan District and Hangzhou Fuchun Plastics Co. violated environmental protection 3S principle; City Xinchang Chengguan Fidelity Knitting Factory in Shaoxing increased their dyeing processes without environmental department approval. The provincial EPB had punished these enterprises by penalty from 5,000 to 100,000 RMB according to the seriousness of the case, and setting deadline for the enterprises to complete their pollution control facilities or enen stop their operation if not in compliance within a limited period.

Source: Zhejiang Government. Provincial Environmental Protection Bureau exposed 11 textile and dyeing enterprises serious violations of wastewater discharge. August 5, 2005

3 Due to the absence of statistics, the effectiveness and direct economic benefit of urban WWTPs will be illustrated through a typical case.

4 Built during the 9th FYP, the Huzhou city Bilang WWTP is located in the Bilang District of Huzhou city with a treatment scale of 10000m^3/day. The district has adopted a separated sewage system and the domestic wastewater collected from pipeline is discharged into the WWT plant.

5 The plant has adopted the Cyclic Activated Sludge System, it has not only a simple, reliable, and flexible operation method but also a function of N and P removal to meet the needs of small towns and ensure the effluent water quality. It is featured that the compartmented CASS pools with different dominant microbes and densities of pollutants to serve different major functions. Although every single cell works separately, the entire process serves as a cascaded sequence of successive anaerobic, anoxic and aerobic stages and therefore has a better N and P removal result. The concentration of COD in the influent water is 200 mg/l, while that in the effluent will only be 20-30 mg/l. Ammonia removal rate is 40-50%.Operation cost is 0.6 yuan/m^3 if depreciation and network construction costs are excluded.

6 The total investment of plant construction is 14 million yuan (network construction costs

excluded) with financial resources from the government bonds, corporate funds, loans, and government interest subsidy. Land for construction allocated by the government is about 100,000 yuan/mu, compensation to the original residents for relocation is 20,000 yuan/mu. Construction of the networks and pumping stations was completed after the completion of the plant with a total investment of 90 million.

7 The operating costs of the plant rely on the WWT fees collected by the water supply company. The WWT fees had been collected since November, 1988 in order to guarantee the effective operation and easing shortage of funds. With WWT continuously expanding and sewer projects build-up and put into operation, and WWT fees is lower than the operational costs. Therefore, new WWT tariffs have become effective since July 2005: domestic wastewater at 0.5 yuan/m^3, non-business users at 1.05 yuan/m^3, business users and special services at 1.30 yuan/m^3.

8 The following table tabulates the operational costs and revenues of the WWTP with an investment payback period of 10 years.

Table 9.4-1 Cost and Revenue of Bilang WWTP

Item	Details	Total (yuan/ton water)
Cost	Depreciation	0.38
	Sewer network	0.17
	Cost of O&M	0.55
	Total	1.05
Revenue	WWT tariff	0.50
	Total	0.50

9 Costs and benefits of the plant have basically broken even in terms of cash flow, with depreciation and network costs excluded. The plant operates with a net loss if depreciation and network costs are considered.

10 The environmental and social benefits can be reflected in a number of ways. In this study, they are evaluated through evaluating the effects of the major pollutants discharge on the environment.

Table 9.4-2 COD, Ammonia Discharge in the End of 10th FYP and Investment during 10th FYP

Item	COD Discharge (ton /year)	NH3-N Discharge (ton /year)	Investment in 10th FYP (x108 yuan)
Target	378100	99100	220.1481
Actual	358753.7	42672.4	164.6803
Difference (%)	-5.12	-56.94	25.2

11 According to the table above, during the 10th FYP, the actual investment showed a 25.2% gap with the planned objectives, COD and NH_3-N discharge, however, had a gap of 5.12% and 56.94% respectively from their planned objectives. The result seems to indicate that the completed investment had been effective, if considering the underestimated economic and population growth.

12 The most direct benefit of the investments can be reflected through the reduction of total annual COD and NH_3-N discharge from 2000 to 2005. So investment effectiveness can be reflected through the gap between the expected discharge reduction per unit investment and

that of actual unit investment.

Table 9.4-3 Reduction of Pollutant by Unit investment in 10th FYP

Item		2000 ($x10^4$ ton)	2005 ($x10^4$ ton)	Reduction ($x10^4$ ton)	Total investment ($x10^8$ yuan)	Pollutant reduction of unit investment ($x10^4$ ton/10^8 yuan)
Objectives in the plan	COD	49.15	37.81	11.34	220.15	0.0515
	NH3-N	13.00	9.91	3.09		0.0140
Actual value	COD	49.15	21.62	27.53	164.68	0.1672
	NH3-N	13.00	1.99	11.01		0.0669

Notes: The investment was the value in that year happened, the little price change in the 5 years was not take into consideration.

13 The above analysis indicates that the actual COD and NH_3-N discharge reduction per unit investment is far above the expected level, 3.2 times for COD and 4.8 times for NH_3-N. Assuming proper planning, it can be concluded that the actual investment effect has been satisfactory for the main pollutants of TLB.

14 The above discussion indicates that the newly launched urban WWT market provides little information on whether its economic effect is satisfactory. But international experiences and cases of the HRB suggest that the prospect of urban WWT is bright. If the market experiences in urban WWT can be introduced to other water pollution control fields such as the industrial WWT and agricultural non-point sources by introducing profitability to the industrial WWT and agricultural non-point sources control projects through policy innovations, one could expect satisfactory economic return.

15 Indirect economic benefits of pollution control investment remain minor in China. Innovating in policy instruments will be necessarily to increase indirect economic benefits of pollution control investors.

16 Environment and social benefits of pollution control investment are obvious. But neither the water quality objectives nor the reduction effectiveness per unit investment have not met the design requirements. It is necessary to further study the pollution control investment effectiveness.

9.5 Economic Measures

9.5.1 Preferential Policy

1 Preferential policies are an incentive measure to promote investment. To promote the HRB pollution control, the Shanghai municipal government has launched a number of preferential policies including the 2005 subsidy plan for suburban wastewater network construction.

2 Zhejiang Province has established nine environmental management and protection special grants including the "Ecological Agriculture and Rural Development", "Ecological Forest Construction". The total provincial financial aid amounted to 561.61 million yuan in 2003. Beyond the state bonds, another 30 million yuan of interest subsidies has been added at the province level for environmental infrastructure construction.

3 Jiangsu province promulgated the *Policy Measures to Accelerate Industrial Pollution Control and Achieve Discharge Standards* to promote enterprise investment as much as possible from taxes, prices, electricity supply, and funding.

4 The above-mentioned preferential policies have to some extent encouraged enterprises to control pollution and the private capitals' entry to pollution control. But the high incidence of unlawful discharge through hidden tunnels, the slow progress of WWTPs construction, and problems during WWTPs operation suggest that incentives provided by these preferential policies are limited.

9.5.2 Pollutants Discharge Fee

1 Any water discharge facilities, including entities and persons discharging wastewater to municipal WWTPs, must pay the municipal WWT fee.

2 For example, Jiangsu province has increased WWT tariff and pioneered the market-oriented environmental resources utilization. Currently, most of the cities and counties in the Jiangsu TLB region have elevated the WWT tariffs to 1.1-1.15 yuan/ton, the highest nationwide.

3 Zhejiang Commodity Price Regulative Bureau's *Notice on Accelerating the Implementation of the WWT System* required that starting 2005, urban WWT fee will be integrated into the ecological province construction with annual performance evaluation. The implementation of urban WWT projects will be tied to the provincial financial assistance.

4 The policy requirement of profitability of WWTPs has created incentives for the private sector's entry to the construction, operation, and management of urban WWTPs. For example, the 5 WWTPs in Huishan District of Jiangyin City mainly constructed with private investment. Another 10+ WWTPs are under negotiation of franchising with domestic and foreign investors. At present, six have signed the contract, among which the Wenzhou Xishan District Anzhen WWTP will with a 250 million yuan private investment will start construction immediately.[16]

9.6 Sustainability Evaluation

1 As watershed pollution control is a long-term and arduous task, and only a sustainable financing mechanism to ensure stable and sustainable funding. But such a sustainable financing mechanism and not been established.

2 Taking the urban WWTP as an example, the main funding sources of WWTPs in the TLB include government bonds, corporate raised funds, bank loans, government interest subsidy, and a few foreign investments. Although the local governments have been actively push the construction and operation of public facilities such as the WWTPs to the market by promoting BOT and TOT models, the conditions for application of these models is not fully ready. Conflicts between the tariff collection system and management system still exist. For instance, wastewater to be accepted by the WWTPs will need to meet the following

[16] Jiangsu Provincial EPB. Exploring successful water pollution control in Wuxi TLB area. October 31, 2006.

conditions: enterprises must have their own pretreatment facilities and the corresponding EIA has to have been approved by the government environmental protection department; enterprises should obtain licence from the construction bureau or municipal department for discharging wastewater to municipal sewerage network; the WWTP should prove its capacity of handling the industrial wastewater according to the national standards. With these conditions met, the WWTP and the enterprise could then sign a WWT agreement with clear influent water quality and flow rate. Further more, during compliant discharge the enterprises will pay only WWT fees; once the discharge exceeding the standars, the enterprise needs pay non-compliance fee, the treatment fees and fines. For example, by this way the Phoenix WWTP in Huzhou accept 60-70% domestic wastewater and 30-40% industrial wastewater.

3 In addition, since the faster economic development in TLB in recent years, a large number of industrial and economic development zones have been established. In order to attract foreign investment certain development zones have promised that wastewater discharge fee will be paid by the development zone government as preferential condition. This promise obstructed the mechanism of enforcing the the environmental law and standards at enterprise level. This is particularly acute for the development zones involving electronics, chemical, printing and dyeing, and machinery industries. Once the enterprises discharge wastewater is not in compliance with the standards, the wastewater will bring a huge threat to the stable treatment of the WWTP.

4 In sum, obstacles for the establishing sustainable investment and financing channels include:

5 a. The investment, financing policy and supporting measures are to be perfected; clear rules for the foreign and private funds entering water pollution control field is still lacking, which may prove problematic and adds risks to the investment. For example, in the implementation process of BOT projects, due to the lack of corresponding laws and regulations and mismatching between projects approval and BOT projects implementation, the progress of BOT projects cannot be implemented on schedule. Especially, regulations and policies of various government departments are mismatched, which brings difficulty to the bid winner of the BOT project. For instance, the bidder with foreign investment needs the approval of foreign trade authorities after the project was approved by the construction department, while construction department needs the approval from foreign trade authorities first. This catch-22 situation reveals lack of coordination between the project approval authorities and the BOT project implementation.

6 b. Although the financing channels under the government planning system, such as public budget and bonds, played a leading role, the capital input is not sufficient.

7 c. Policies that absorb investor other than government and polluters into the field of ecological rehabilitation and non-point pollution control are still absent.

8 d. The commercial financing mechanism to raise social funding is almost absence.

9 e. The tariff levels of domestic wastewater discharge and garbage disposal from urban residents have increased significantly, while how to ensure the collection of the tariff is still a

problem.

10 The limitation of investment and financing mechanisms mentioned above is the main reason for the undercapitalization in water pollution control.

10. Management Review and Evaluation

10.1 Environmental Management Settings

1 The major environmental management systems launched during the 9th and 10th FYPs in the HRB include: environmental impact assessment, the "Three Synchronousness," pollutant discharge permits system, pollutants TMLL, environmental accountability, pollutant discharge fees, time-limited pollution control, and urban comprehensive pollution control quantitative evaluation.

10.1.1 Environmental Impact Assessment and the "Three Synchronousness"

10. Management Review and Evaluation

10.1 Environmental Management Settings

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10.1.1 Environmental Impact Assessment and the "Three Synchronousness"

1 The 9th FYP Plan of water pollution control in Tai Lake requires that all new construction, rebuilding, and expansion projects must strictly enforce the EIA and the 3S. The 10th FYP requires that any projects failed to meet the water pollution control requirements in Tai Lake in the EIAs will not be approved, and the leadership will be held responsible for the violations; no new outlets are allowed to be add to the Tai Lake; discharging of wastewater to the level-one protection zone for domestic drinking water is prohibited; new construction and expansion of the polluting projects in the level-two protection zone for domestic drinking water are prohibited; reconstruction of projects in the level-two protection zone for domestic drinking water must reduce their current pollutants discharges.

2 The survey results suggest growing attention to the EIA and "3S" in the implementation of the 9th and 10th FYPs in the TLB. Due to incomplete data, building a complete time series data set for the rate of implementation for both EIA and "3S" throughout the 9th and 10th FYPs turned out impossible. However, data for 2004 has been tabulated in Table 10.1.1-1 to illustrate the implementations.

Table 10.1.1-1 Performance of Three Synchronous and EIA in the Provinces of TLB (2004)

Province	Jiangsu	Zhejiang	Total	Nationwide
# of new construction projects	62659	27445	90104	323264
# of projects conducted EIA	62133	27283	89416	320997
Ratio of EIA conduct (%)	99.2	98.9	99.2	99.3
# of project that should conduct 3S	9057	12741	21798	79456
# of projects that conducted 3S	7841	12655	20496	76038
Ratio of 3S practice (%)	86.6	99.6	94.0	95.7

Source(s): China Annals Environmental Statistics 2004.

3 The table above suggests that rate of practice of the Environmental Impact Assessment has been relatively high and reached 99.2%, 98.9%, and 100% for Jiangsu, Zhejiang, and Shanghai respectively in 2004. Zhejiang and Shanghai have been above the national average in the implementation of the "3S", while Jiangsu Province has a relatively low rate of 86.6%.

4 Provinces in the system implementation process have its own characteristics. Among them, Jiangsu Province has launched the environmental protection examination and inspection of the 3S implementation for construction projects and taken the lead in strategic environmental assessment and EIA hearings for sensitive construction projects. Zhejiang Province has begun to require EIA for new husbandry projects. Shanghai, building upon the experiences in EIA, has launched regional development EIA (or strategic environmental assessment at regional level), thereby promoting the construction of environmental infrastructure. Currently the Qingpu Development Park and other city- and district-level development zones have been carrying out regional environmental impact assessments.

5 EIA and 3S during the project feasibility study phase have been important mechanisms to implement "head-of-the-pipe" prevention.

10.1.2 TMLL

1 The TMLL of the major water pollutants is an important management tool of the TLB water pollution control. In many TLB areas pollutants discharge has significantly exceeded the carrying capacity of the environment. If no decisive measures are taken, the pollutants discharge will further increase and aggravate pollution. The 9th FYP of water pollution control in Tai Lake proposed the TMLL as a countermeasure. Starting from January 1, 1999, TMLL has been enforced universally. According to the 10th FYP Summary of the Tai Lake, during the 9th FYP, the TMLLs of industrial pollution of Jiangsu and Zhejiang are: COD total discharge at 175,500 tons/year, TP at 4019 tons/year. The actual total discharge of COD in 2000 was 161,700 tons/year, and the figure for TP was 3490 tons/year; the reduction objective has been achieved.

2 One of key objectives of the 10th FYP of the Tai Lake is to improve for the TMLL based on TP, NH_3-N, and COD TMLL targets. The TMLL targets will be allocated to the boarder control sections, key control sections, and river/lake entry point sections. Generally speaking, the provinces have not fully achieved their objectives. According to reports by Jiangsu Province, in 2004 the province the TLB pollutants discharge were 236671 tons for COD and 20193 tons of NH_3-N. Measuring against the 10th FYP control objectives, NH_3-N has reached the TMLL target, but COD exceeded the target by 11.8%. The results of monthly water quantity and flow of 2005 in the TLB show that the total COD entering the lake from the 9 major rivers was 71800 ton/year, TP 630 ton/year, and NH_3-N 6217 ton/year. Measuring against the TMLLs of the 10th FYP, the NH_3-N has met the target, while COD and TP have exceeded the targets by 21.6% and 6.6% respectively. According to reports of Zhejiang Province, the COD discharge of the Hangzhou-Jiaxing-Huzhou Region totaled 16.87 tons in 2005, indicating a 22% reduction from the 2000 level. However, it still exceeded the target by 16.65 tons. The total discharges of TP and NH_3-N, nevertheless, are still increasing.

3 The gap between the TMLL objectives and their actual levels are the unexpected rapid

economic growth in the region. Even when the pollutants discharge intensities have dropped in absolute values, the pollutants discharge will also rise. Therefore, the future TMLL targets will need to consider not only the requirement of environment by scientifically allocating the TML among the watershed using environmental quality models but also the dynamics of regional growth and development, and adjust the industrial structural accordingly.

10.1.3 Permitting System

1 The implementation of the permitting system is basis of implementing the TMLL. In order to control the HRB and TLB key water pollutants discharge and strengthen the supervision and control of water pollution management, the state developed, China has enacted the *Management Provisions of the HRB and TLB Key Water Pollutant Discharge Permitting System (Trial)* on October 1, 2001.

2 The provinces within the watershed show different levels of progress in the implementation of the permits. Zhejiang's situation is more optimistic. Currently, the province has fully implemented the major pollutants discharged permits and issued more than 4,000 permits. Among them, Huzhou City in 1999 has implemented, on a pilot basis according to the relevant state regulations to the city level, the registration pollutants permits to 100 key water pollution enterprises, and explored the full implementation of the pollutants discharge license management. In 2001 to further strengthen the supervision and management of pollution sources and the implementation of TMLL, Hangzhou city government promulgated the *Management Method of Huzhou City Pollutants Discharge Registration and Licensing Regulations* to standardize the regulation of the sewage and waste discharge permits. The permits of a total of 1002 enterprises have fallen under its regime. By allocating the permits to the key polluting enterprises, the permits become legalized documentation of the environmental rights and responsibilities of the enterprises and the basis of management by law.

3 Jiangsu Province, on the contrary, is lacking a comprehensive management and an effective follow-up post-issuance institute, and thee implementation of the permits is still hindered. To address this issue, a few approaches are recommended: strengthen reforms in environmental policy instruments, issue management provisions of the permits, legitimize the permits; establish a practical management approach of the TMLLs to properly allocate the permits and effectively monitor its implementation.

10.1.4 Other Management Systems

1 During the 10th FYP, in order to promote the TLB water pollution control, the cities in the basin gradually established and improved the environmental protection objectives responsibility system for environmental protection.

2 In the Jiangsu Province, has signed the environmental protection objectives letter by governor with various cities mayor, formulated *Jiangsu Provinces and Cities County Party politics Mainly Leading cadre Environmental protection Work Actual accomplishments Inspection Tentative method*", the TLB water pollution preventing and controlling took the important content, included the inspection scope. The provincial government prints and distributes the TLB water pollution

preventing and controlling year work plan to at the beginning of every year, carries out the goal duty decomposition various cities people's government with the province department concerned. The province two level the Tai Lake water pollution preventing and controlling committee has organized a special inspection conducted regularly to the members of the Committee informed units comprehensive harnessing water and the progress of work, and make sure municipalities and departments carry out their tasks. Each quarter through the Xinhua Daily, Jiangsu Province television and other media to announces the watershed key point work the progress to the social, to borrow the power of the public to further promote the Tai Lake pollution prevention work.

3 In Zhejiang Province, the provincial government and cities in the Hangzhou-Jiaxing-Huzhou area have established their water pollution preventing and controlling leading groups, which regularly hold the meetings to work on Tai Lake management. The provincial government issues every year Hangzhou-Jiaxing-Huzhou area water pollution preventing and controlling work plan to ensure the assignment of Tai Lake management responsibilities. The Hangzhou-Jiaxing-Huzhou area took the lead in entire province to implement the monthly reporting of the transboundary water monitoring system and the air quality daily reporting system. All levels of the government have also frequently invite the members of the National People's Congress, commissars of the Chinese People's Political Consultative Conference, and reporters to supervise the inspection the Tai Lake management progress, and through reporting of violations promotes society-wide monitoring.

4 Due to the lack of data, statistics on the implementation of the various systems in the TLB is difficult to find. In 2004 the partial environment management system in the TLB as well as the national implementation situation have been tabulated in Table 10.1.4-1

Table 10.1.4-1 Performance of Environmental Management Requirement in the Provinces of TLB (2004)

Province		Jiangsu	Zhejiang	Total	Nationwide
Total discharge tariff (x10^4yuan)		87222	69783	157005	941846
Ratio of increasing (2003 to 2004)		11.1	85.4	35.2	32.8
Pollution control project with time limit	Number of projects	1277	2703	3980	22649
	Investment (x10^4yuan)	67548	117832	185380	1464070
Number of enterprises that were enforced CSCM[1]		562	2416	2978	13348

Note:

1. CSCM-To close the enterprise, stop the operation of enterprise, change the production of enterprise or move the plant to other place because of the pollution of the enterprise.

2. Source(s): China Environmental Statistic Annals 2004

5 The table suggests effectiveness of the discharge fee collection and time-limited pollution control enforcement. The total collected pollutant discharge fee has grown in 2004. Compared to 2003, the 2004 levels of the two provinces have increased by 35.2%, higher than the national average. The investment for the time-limited pollution control projects covered 3980 projects, 17.6% of the total projects nationwide; the investment reached 18.5×10^8 yuan, 12.7% of the national total; the number of enterprises that were closed, shut down, merged, or moved out was 2978, accounting for 22.3% of the national total.

10.2 Monitoring System

10.2.1 Monitoring System of Water Environment

(1) Monitoring of the water pollution sources

1 According to the *Environmental Protection Act*[17], SEPA is responsible for establishing the monitoring institutions, setting the monitoring regulations, organizing monitoring networks, and conducting environmental monitoring.

2 By the *National Environmental Monitoring Guideline* (1983), the national environmental monitoring system has been established to include the 4 levels of environmental monitoring stations:

- Headquarter Station: CNEMC.
- Level-One Station: provincial-level central environmental monitoring stations at the provinces, autonomous regions, and municipalities.
- Level-Two Station: city environmental monitoring station (or central stations) at the prefecture-level cities.
- Level-Three Station: environmental monitoring stations at counties, county-level cities and the districts in large metropolis

2 The environmental monitoring stations at all levels are subordinate to the EPBs of the same level administratively and supervised professionally by the environmental monitoring station of the higher level. As state-owned institutions and public service organizations, the environmental monitoring stations conduct environmental monitoring and inspection within the authorities given. The budgets of the environmental monitoring stations are covered in the local fiscal spending of the same level.

3 According to the SEPA's method of pollution source monitoring and management, in the process of monitoring pollution sources, environmental protection bureaus below provincial level are responsible for supervising monitoring the condition of pollution sources discharge and establishing pollution sources monitoring net in their administrative boundary, leading the work of pollution sources monitoring.

4 In terms of the frequency of monitoring, for the key sources of pollution, the monitoring is conducted 1-2 times per quarter; for usual sources, the monitoring is conducted once per 6 months.

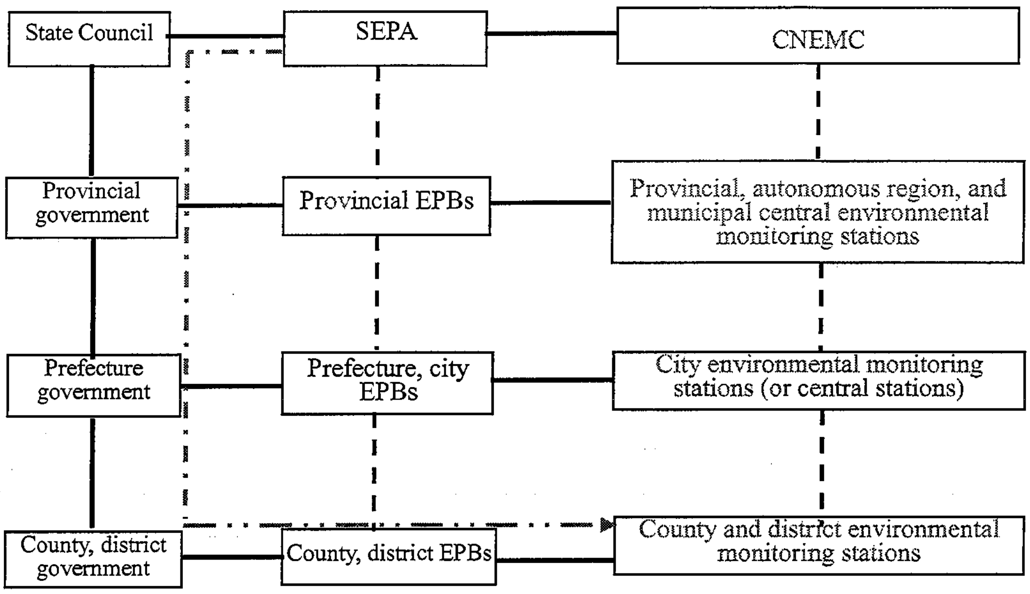
5 The water pollution source monitoring has established a system from the central to local government, which is summarized in Figure 10.2.1-1.

6 This system has shaped such a situation that environmental monitoring is managed by every level of local governments, SEPA and environmental monitoring general station only

[17] Article 11 in Chapter 2 "Environmental Monitoring" of the *Environmental Protection Acts* defines that the SEPA should establish the monitoring institutions, set monitoring regulations, organize monitoring network in collaboration with other related agencies, and enhance the management of environmental monitoring.

draw institutions and make technological instructions. Technologically, for the sake of environmental management, if SEPA want to carry out environmental monitoring in some counties, firstly, they should report to the state council, and only when the command is sent to the local EPB, the monitoring activities can go ahead.

Figure 10.2.1-1 Structure of Environmental Monitoring System at SEPA



Notes:

(1) Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

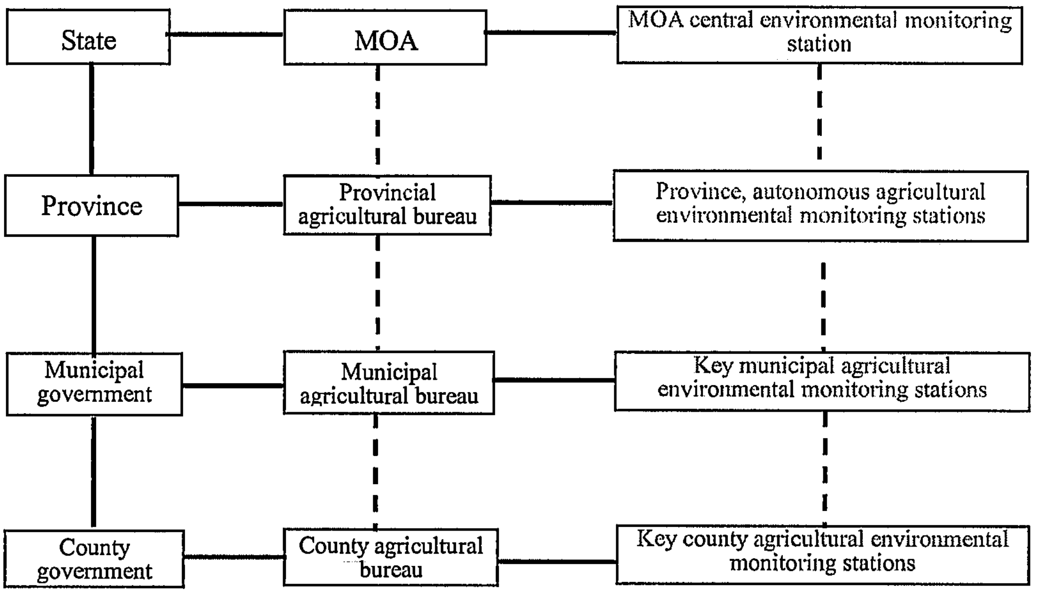
(2) Red, arrowed dash line indicates the management path of SEPA to county-level environmental monitoring stations.

3 An important attribute of environmental monitoring is its independence or neutrality. The environmental monitoring station of this system is under the leadership of local governments, when monitoring the pollution sources of economic organization which is closely connected to local government's political achievements, the independent of this monitoring will be doubted.

4 This system should includes urban and agricultural none point pollution monitoring, but now, most of the pollution sources monitoring of this system is mainly aimed at industrial pollution sources, the monitoring of agricultural none point pollution has not been carried out. In 1984, the MOA initiated the working regulation of natural agricultural environment monitoring, and established an agricultural environment monitoring system based on it, which is responsible for continuously monitoring the pollution entering into agricultural environment, including soil, irrigating water, underground water, agricultural none point sources pollution, agricultural ecology, and so on. Except Zhejiang and Jiangsu province, the monitoring of agricultural none point sources pollution hasn't been carried out. The figure of 10.2.1-2 shows the agricultural environment monitoring system structure of MOA. The monitoring system is resemble to that of environmental protection bureau, but monitoring

stations of the level of urban and county aren't comprehensive, only several important urban and county establish monitoring station.

Figure 10.2.1-2 Structure of Environmental Monitoring System in MOA



Notes: Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

1 The above review and analysis reveal further problems in the water pollution monitoring system.

2 From the environmental management perspective, the 23-year-old *Management Regulations on Environmental Monitoring* can no longer guide the current environmental monitoring and management in the current-day China, which has undergone significant development and changes in the government structures, the economic level and the society.

3 From the perspective of professional government agencies, pollution monitoring of water resource is managed by the two ministries, SEPA and MOA, separately. MOA takes charge of agricultural pollution sources, and the SEPA takes charge of other pollution sources. SEPA does not manage the monitoring of pollution sources by the environmental protection laws. When the agricultural none point sources pollution become the main pollution sources of water pollution, its management and monitoring become more important but the loopholes in the legislation and practice still persist.

4 From the perspective of SEPA's admnistration, except the CNEMC, SEPA has no actual administrative authority over other environmental monitoring stations. In fact, the local governments directly manage environmental monitoring. According to the *Environmental Protection Act,* the local governments carry out environmental protection management of their jurisdictions. This weak vertical leadership between the environmental protection offices impedes the independence of environmental monitoring.

5 In terms of monitoring frequency, in the past ten years, the frequency of monitoring is so low that it cannot reflect the actual condition of pollution sources nor to sufficiently supervise and manage the pollution sources.

(2) Water Body Environment Monitoring

6 According to the definition given by the *Environment Protection Act*, the monitoring system of environmental protection bureau should carry out monitoring water quality, but because of other laws' different provisions, environmental protection bureau, ministry of water resource and resource department actually jointly take part in monitoring water quality.

7 Water body quality monitoring of environmental protection system includes ground water monitoring net set by environmental protection general bureau and every local province and urban these monitoring nets basically cover main water quality control sections of the TLB and the HRB. From 1999, SEPA began to construct automatic monitoring system of water body sections, thirteen automatic water quality monitoring stations have established in the Tai Lake, and seven automatic water quality monitoring stations have established in the HRB, these help to understand the condition of water quality in time. But the water quality monitoring nets of environmental protection system don't include the monitoring the underground water quality. The groundwater monitoring net of national land resource department is responsible for monitoring underground water quality monitoring. But according to Chinese environmental quality announcement, this net is divided into units based on big region, the two regions of east and south China include not only Huai River and the Tai Lake, but also the watershed of the Yangtze River, the Pearl River, and so on. In addition, environmental monitoring system of MOA also monitory water quality of rural wells.

8 According to the *Water Pollution Prevention Act*[18], the TLB of water resource protection work, it is responsible for monitoring the watershed's water bodies giving the water quality environmental conditions and monitoring results to SEPA and MWM. According to the *Water Act*[19], the Huai River and the TLB of MWR/WRBs be responsible for the water bodies for water quality monitoring. Therefore, the MWR by law in the Huai River and the TLB of water bodies to establish water quality monitoring systems. Moreover, the MWR/WRBS also enter the water bodies of all outfalls of water quality and water quantity monitoring. In order to regulate the river outfall management oversight, MWR in 2004 on the 22nd orders issued in the form of the *River Outfall Supervision and Management Approach* to the January 1,

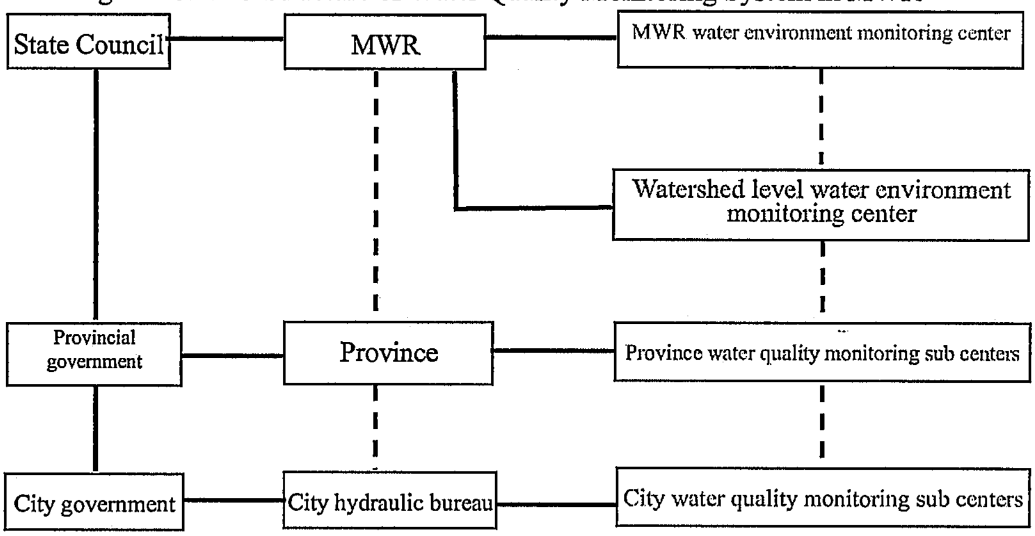
[18] The *Water Pollution Prevention Act*, Chapter III "supervision" of the 18th: the state's major river watershed's water resource protection work, it is responsible for monitoring the watershed's water bodies giving the water quality environmental conditions and monitoring results and the Times, the State Council environmental protection departments and the State Council hydraulic management; by the State Council approved the establishment of the watershed leading water resource protection agencies, the monitoring results should be promptly reported to watershed water resource protection leadership.

[19] Article 16 of the Water Act: the people's governments above the county level should be enhanced hydrology, water resource information systems. The people's governments above the county level administrative departments in charge of water and watershed management should strengthen the dynamic water resource monitoring. Article 32: The local people's governments of county level and above water administrative departments and watershed management of water bodies should function of water quality monitoring the situation ....

2005 introduction. The management approach provides a clear, water administration departments responsible for the sewage outfall pipe into water bodies supervision Jimmy work.

9 In the 1980s, MWR has carried out water environmental monitoring by adding water quality monitoring institution. In 1984, water quality Experiment and Research Center of MWR has been established, and the water quality monitoring standards have been issued. After twenty years' development, MWR has established a four-level water quality monitoring system.

Figure 10.2.1-3 Structure of Water Quality Monitoring System in MWR



Notes: Solid lines indicate direct supervision and subordinating relation in personnel, financial management, and administration; dashed lines indicate technical advisory relations.

10 The monitoring of water quality of MWR emphasizes on the service to the water resources development and management. The setting of the monitoring stations considers watershed as whole, and has combined with the WRB stations. The design of the monitoring items, considers the nature chemical characteristic of the river and its pollution. However the the setting of the monitoring station can not fully and comprehensively reflect the water supply, pollutants discharge control and water body function characteristic and not so suitable for the water pollution control.

11 The organization under MWR responsible for the TLB water environment monitoring are TLB Water Environment Monitoring Center and the WRBs of Zhejiang, Jiangsu and Shanghai. They carry out the water quality monitoring for the water body function zones and the provincial boundary sections.

12 The MWR is responsible for water body monitoring, and SEPA is responsible for the water monitoring on land. But in fact, SEPA has conducted the water quality monitoring of water bodies, and the MWR has monitored the water pollution sources "ashore". This shows in a special way that it is necessary to connect the pollution source monitoring and water quality monitoring of water bodies.

13 In addition, the MOC system also carries out water quality monitoring which focus on the drinking water resources.

Difference between the Water Quality Monitoring Systems of SEPA and MRW

According to the Weekly Water Quality Automatical Monitoring News Press of Key Sections of Major Watersheds Nationwide by the SEPA, starting from January 1, 2004, the weekly updates of the water quality automatic monitoring results of the 73 (later increased to 82 since June 5, 2004) authomatic monitoring sections will be publicized to the public.

According to the report by the minister of the MWR on December 27, 2004 at the 13th Meeting by the Standing Committee of the 10th National People's Congress, the national water environment quality monitoring network is consisted of a total of over 760 monitoring sections and 117 water quality automatic monitoring stations, which have enabled the dynamic monitoring.

5 The above review and analysis reveals a number of issues in the water environmental monitoring institutions:

6 a. The SEPA/EPBs and MWR/WRBs have overlap responsibilities in the water environment monitoring, which has led to the waste of the limited, if not insufficient, monitoring resources. The segregated institutional arrangement has led to the lack of coordinated, synchronized, and unified arrangements in the set-up of the monitoring systems, selection of the monitoring indicators, locations, time, and frequency. No single agency is designated to summarize, collate, and use the monitoring data from various sources. Actually, under such segregated environmental monitoring system, even if the data were available from those agencies, they tend to be inconsistent and prove difficult to use.

7 b. Coordination between the *Environmental Protection Act*, the *Water Pollution Prevention Act*, and the *Water Act* in water quality monitoring is still lacking. The standards, management, and institutions in water quality monitoring remain ambiguous.

8 c. The segregated institutional arrangement resulted that there is no unified planning on the water environmental monitoring, such as monitoring equipment, indicators, locations, time, and frequency.

14 d. The lack of a watershed-based groundwater monitoring network leads to the lack of understanding of the watershed groundwater conditions.

10.2.2 Reporting System of the Water Environment Monitoring Data

1 The mechanism of water environment monitoring determines the data reporting system. The structure figures 10.2.1-1, 10.2.1-2, 10.2.1-3 show the water environment monitoring system of environmental protection, hydraulic and agricultural department, they also reflect the water environmental data reporting process. The environmental monitoring station of Environmental protection, hydraulic, MOA separately report data to their own higher department, these professional departments report to the same level governments, or to higher governmental professional departments. Environmental monitoring station may directly report to higher level environmental monitoring station.

2 The main problem of the data reporting system of water environment monitoring is that

none of departments summarize all monitoring data, and carry out instructing and using these. In fact, under the separate environment monitoring mechanism, even though some departments summarize all the data, because the data of different departments lack unification it's still hard to make use of them.

10.2.3 Installation of the Monitoring System

1 Under the on-site survey, three city of Hangzhou, Zhejiang Province respectively completed the online information platform and install water-line monitoring devices for monitoring the 145 water pollution enterprises. The portion of Shanghai in the TLB within the building Shongpu Bridge and Daliu water port two automatic water quality monitoring stations, more than 3 million yuan investment, the SEPA has been in the acute water port (Su-Hu junction section), construction of the automatic monitoring stations, three automatic monitoring stations operate normally, the initial formation of the automatic water quality monitoring network, meeting the basic needs of the city TLB within the scope of water quality monitoring; ratification of the TLB the 10th FYP on automatic water quality monitoring project has been completed.

10.3 Small Watershed Pollution Control Plan

1 The integrated pollution control in small watershed should integrate the water quality, total water quantity, projects and investment for every watershed and consolidate the treatment of water pollution, wastewater reuse, ecological restoration and watershed protection through a combined means of economical, legal, technical and administrative. The intergarted small watershed management will also pull in the forces of social groups, market mechanism, public monitoring, and macroscopic management to facilitate the industry restructuring, environment facilities construction, clean production, and pollution control.

2 Small watershed pollution control plan of the TLB has been implemented in Jiangsu and Zhejiang province with overall satisfactory results.

3 In order to ensure COD_{Mn} of the main river into lake and joint administrative area's section achieve environmental quality three standard for surface water, During the 10th FYP, small watershed comprehensive prevention plan was roundly run in eleven river including Liangxi river and Xiaoxi harbor in Wuxi city Jiangsu province.

4 During the 10th FYP, comprehensive treatment of four rivers including Nanxi River, Nanshaoxi River, Jinxi River and Baixi River were carried out in Lin'an city Zhejiang province. Small watershed comprehensive control engineering invested 660 million yuan, at present, it has been basically completed, and it has obvious effect on improving flood control ability and improving watershed water environmental quality, etc. The first and second phase of Nanshaoxi river treatment in the city zone has comprehensive carried out, and it improved ecological environment of water bodies in urban river, and new urban landscape which has function of recreation, amusement, tour and sightseeing is in a bit scale. Jinxi river treatment run by marketing operation, at present, seventy-eight percent of the work has been completed, 6150 million yuan has been invested. Five hundred meters of Nanxi watershed comprehensive treatment has been achieved.

5 During the 10th FYP, "Urban agricultural development plan in Jiaxing province" was constituted, and in the plan it is prescribed that persisting in the fundamental of comprehensive planning and management, farther strengthening water-soil synthesize father, applying engineering approach combined with non-engineering approach and tillage management, uniform planning hills, rivers, fields, forests and roads, taking flexible strategies based on different locations, speeding up small watershed management.

6 Integrated small watershed management represents the successful international planning and developing model that combines economy, urban construction, industrial production, water conservancy, pollution controlling and ecological conservation of a small watershed. As a small river watershed usually does not involve big jurisdictions, its management could be accommodated within the authorities of local governments at the county (city) level, and the watershed comprehensive plan can be easily connected to local plans. Hence a better result can be acquired in the TLB. Although no specific monitoring data can be cited to quantify the contribution of integrated small watershed pollution control on the water quality improvement, past international experiences has proved it an effective measure to improve environment quality with little investment.

7 Based on the conditions in each province, the provinces can work out general plans on water environmental pollution control in small watersheds and bring them into the local plans for national economic and social development to ensure the objectives of water environmental pollution control achieved.

11. Public Participation

1 China has a relatively found legal foundation for environmental protection public participation. The *Constitute* of PRC clearly specifies that "The people are entitled by law to manage the state, economic, cultural, and social affairs by various channels." This is the constitutional basis for any Chinese citizen to participate in environmental management. Article 6 in the *Environmental Protection Act* further specifies that "all entities and individuals are obliged to protect the environment and are entitled to reveal to the higher authority or prosecute any entity and individual who pollutes the environment." The state has already confirmed the rights and duties of public participation for environmental protection in statutes, which has served as the legal foundation of the public participation. However, the statutes remain in principle and abstract. The lack of practicality and concrete implementation rules prohibits the further deepening of public participation in China.

11.1 Forms of Public Participation

1 In recent years, some provinces and cities have pioneered in public participation and established certain institutional arrangements. For example, *Fuyang, Hangzhou* and *Dongyang* of Zhejiang Province have started public hearings for public participation in environmental management, monitoring and Environmental Impact Assessment. Jiangsu Province has experimented public participation of comprehensive environmental and development decision-making and the environmental management and enterprise environmental information disclosure (in *Zhenjiang* City). However, in general, the current forms of public participation are still largely limited to:

(1) Raise Environmental Proposals through the People's Congress, CPPCC, and the democratic parties

2 The public could raise congressional proposal on the environment to the government during the legislative period of the People's Congress raise environmental legislative issues through deputies to the People's Congress at various levels. Meanwhile, deputies to the People's Congress can monitor the government's environmental actions through inquiries to the government, debrief government environmental reports, and inspect environmental law enforcement.

3 The *Constitute* specifies the CPPCC's (National Committee of the Chinese People's Political Consultative Conference) function as participation in state administration. The government is required to earnestly listen to its views and provide responses upon careful study. Members of various levels of CPPCC often pay high attention to the environmental protection and proactively organize environmental studies and provide valuable recommendations and advices.

4 Members at the democratic parties generally have advanced educational backgrounds and have access the central government through channels such as the CPPCC and influence the decision-making by providing influential reports and recommendations.

(2) Monitoring through Media

5 The media can help publicize environmental conditions and the evaluation results of the urban comprehensive pollution control programs. The media can establish columns or feasured programs for the public opinions on environmental protection. The public participate in China's environmental management through appraising the organizations and individuals contributing to environmental protection and exposing and criticizing polluting and environmental destructing activities. The *China Century Environment Protection Campaign*, a nation-wide environmental protection public education program, is one of the examples.

(3) Environmental Petition Complaint

6 The public can pursuit environmental law suits through the EPBs to safeguard their own interests and benefits. Most of the EPBs in China have opened the environmental protection hotline and the petition office. In order to standardize petition responses, the government at different levels has issued procedures and guidelines. For example, SEPA has issued the *Environmental Protection Petition Management Guidelines*. Those efforts have to a certain degree facilitated public participation.

(4) Through Environmental Protection Public Education Activities Organized by Government, Civil Societies, and Other Organizations

7 The government promotes the public participation in environmental protection through organizing various specialized pollution control activities, the *China Century Environment Protection Campaign*, and various environmental protection memory day activities. Other environmental protection civil society organizations such as the Friends of Nature and the Global Village also promote the public participation in environmental protection.

(5) Environmental Impact Assessment

8 The *Environmental Impact Assessment Act* has specified that "the state encourages the proper participation in the environmental impact assessment by the related organizations, experts and public." Typical environmental impact assessment process will involve surveys, expert panel discussions, and public hearings. However, due to the lack of compulsory implementation guideline and monitoring, the current public participation often remains a mere formality.

(6) Expert Opinion

9 The government usually consults the opinions from the related institutes and experts during policy- and decision-making, and the experts usually conduct surveys at the place of study/interest when preparing the study reports. This process represents one of the forms of the public participation in China.

11.2 Effects and Issues of Public Participation

1 Although in the past 10 more years public awareness of environmental protection has been significantly improved, the public participation is just been started. Forms of public participation are limited; sound institutional support is yet to be built. The public participation

at the current level is still mainly "end-of-the-pipe" and passive. NGO development, an important proxy of public participation is still lagged.

2 Our survey results indicate that: The sound public participation mechanism is still to come. Existing environmental protection regulations concerning public participation in China are still to be perfected and have already impeded the effects and development of public participation. A number of key concerns have been noted below:

(1) Lack of sound information disclosure institutions and the missing public environmental right to know.

3 The public cannot participate without knowing. Currently it is the government sectors and enterprises that have the environmental information. This has determined that the government and enterprises are the obliged to disclose the information in public participation for environmental protection. Whether the public will be informed thus depends on whether the obligor will proactively disclose the environmental information they have. To a certain degree, the issue of public's environmental right to know is the issue of environmental information disclosure. Sound environmental information disclosure institutions thus become the key to public environmental right to know.

4 Although in recent years the government environmental information disclosure has been improved, the contents of disclosed information and the methods of disclosure are still limited. Untimely and education-oriented have been the features of most disclosed information. The use of the Internet is rather low. Using the HRB as an example, only when information such as the environmental monitoring data, pollutants discharge data, government inspection data, government law enforcement results have all been disclosed, will true public participation become possible. Particularly, information regarding the enterprises' behavior concerning the environment is not disclosed, leaving public participation and enterprises' environmental behavior monitoring on paper.

5 The fundamental cause for those issues is the lack of a set of sound institutions to clarify the subjects, methods, procedures, and contents of information disclosure.

(2) "End-of-pipe" and passive public participation

6 Using the public participation in Environmental Impact Assessment as an example, "public participation" takes place as the distribution of survey tables to the public by the constructers of development projects and collection of the responses afterwards. The public usually do not have much knowledge of the construction project prior to the survey; their knowledge will likely remain limited even during the survey. The effects of the public participation will almost for certain be limited as well. The public participation in real life tends to be the post participation posterior to the environmental pollution and ecological destruction. The public are often called to participate in the environmental affairs after the pollution and ecological damages have occurred, and the public interests have been infringed. The participation in the environmental legislation, policy-making, planning, and program preparation is almost absent.

(3) Lack of practicality of public participation principles

7 Specifications on public participation in China's environmental protection laws and regulations often have a flavor of advocacy. The principles do not specify the procedures, methods, time, rights and obligations of public participation, leaving its implementation to the mercy of the real life. The impractical legislations forms little binding force and provides little guiding to the public participation in practice. Till this moment, the state has not issued authoritative, detailed, and practical complementary technical specifications on public participation.

8 Within the entire Chinese legal system, articles regarding public participation could hardly be found. The mechanism for public participation in democratic decision-making and state administration is still lacking. The laws also have not clearly defined the legal status of the citizen and civil societies, nor the incentive mechanism of broad public participation or the legislative aid system for intrusion to the right to participate.

(4) Public lack of awareness and concept of public participation

9 This TA project would like to reflect the public opinion in the study results. The project team has designed questionnaires on the environmental economics and investment, institutions and policy, legal cases, and comprehensive watershed water pollution control and prevention policies and investment for the HRB and TLB. The questionnaires have been distributed to the stakeholders during on-site surveys. However, the project team discovered that a NIMBY (Not In My BackYard) attitude has dominated among the concerned organizations and individuals: This is not my business; I am not obliged to respond. The questionnaires have experienced an extremely low response rate (Table 11.2-1). The extremely low response rate indicates a number of problems:

Table 11.2-1 Questionnaire Survey of Water Pollution Control Environmental Policies and Investment Evaluation in the HRB and TLB

Questionnaire	# of distributed	Reply collected	Rate of reply (%)
Comprehensive questionnaire for evaluation of environmental policy and investment for water pollution control in the HRB and TLB	80	7	9
Investment and operation of the WWTPs	10	1	10
Enterprise pollution control survey questionnaire	7	1	14
Policy and institution survey questionnaire	65	32	49
Administrative effectiveness of the water pollution dispute	40	0	0
Judicial effectiveness of the resolving of the civil pollution cases judged by people's court	10	0	0
Judicial validity of the resolving of the environmental resource destroy cases transacted by people's court and procuratorate	10	0	0
Total	222	41	18

Most of the public have taken public participation as participation by individuals. In fact, public participation-in theory and in practice-involves the participation by all stakeholders. The stakeholders could be individuals, civil societies, enterprises, institutes, and even local governments. Before the law, all stakeholder groups are equal. Provided that the participant

has certain stakes-interests and benefits-related to the discussed matter, the participant is a stakeholder, and to protect his/her/its own rights and interests and express his/her/its opinions the stakeholder can and should voice his/her/its opinion.

10 The public awareness of participation is low. Often the public considers the questionnaire filling as a "pro-bono" service provided to the favor of the project team, which is not obliged or useful for the surveyed. This lukewarm attitude toward public participation, nevertheless, is a tragic consequence of lukewarm tradition of public participation in China. The infrequent public participation incidents whose fate seldom escapes "a case of mere formality" have disseminated the public confidence level in participation.

11 On the other hand, the low public environmental protection awareness topped with the lack of environmental knowledge is another important cause of low public participation.

12 In general, the following causes have led to the issues with the public participation in the TLB: (1) The "tradition" of economic development tends to under-evaluate environmental protection. In particular, the GDP-oriented cadre performance evaluation system creates incentives for the government officials to skew toward economic development and downplay environmental protection. (2) Practical legislative support for public participation is still missing. (3) High costs persist for information acquisition and participation. To resolve those issues, not only the environmental legislation need to be perfected, but also a sound supporting base has to be established from China's legal system. The true question is not that if the public could participate, but rather if the public could participate effectively, and how the procedures and methods of public participation could be improved.

Volume IV

INTERNATIONAL EXPERIENCES

Table of Contents

1. Evaluation Methods and the US Government Performance and *the Results Act*............. 1
1.1 Background 1
1.2 US Government Performance and Results Act of 1993 (the Results Act)................ 1
1.2.1 Objectives of the Result Act 1
1.2.2 Implementation Mechanisms.. 1
1.2.2.1 Strategic Planning.. 2
1.2.2.2 Performance Plan and Report 2
1.2.2.3 Managerial Accountability and Flexibility 3
1.2.2.4 Pilot Projects... 3
1.2.2.5 Training 3
1.2.2.6 Congressional Oversight and Legislation 3
1.3 Government Performance Logic Model 3
1.3.1 Logic Model for Government Performance 3
1.3.2 Application of the Logic Model 4
1.3.2.1 Performance-Based Budgeting (PBB).. 4
1.3.2.2 Performance-Based Contracting (PBC).. 4
1.3.2.3 Human Resources Management (HRM) 5
1.3.2.4 Information Technology/e-Government Measurement (IT/e-Gov) 5
1.3.2.5 Commercial Assistance/Software Packages for Implementing the Logic Model.. 5
2. Best Watershed Management Practices.. 6
2.1 Overview 6
2.2 Regulatory Background.. 6
2.2.1 Safe Drinking Water Act.. 7
2.2.1.1 SDWA Amendments 7
2.2.1.2 SDWA Implementation and Enforcement 8
2.2.2 Clean Water Act... 8
2.2.2.1 Major CWA Amendments.. 9
2.2.3 Types of Water Quality Standards under the CWA... 10
2.2.3.1 Technology-Based Standards... 10
2.2.3.2 Ambient or Water Quality-Based Standards.. 12
2.2.4 Clean Water Act Funding Mechanisms 12
2.2.4.1 Plant Construction Grant Program and States Revolving Fund............... 13
2.2.4.2 CWA Funding via Department of Agriculture and Land Grant System .. 13

2.2.4.3 Other Clean Water Act Funding Sources ... 14
2.3 USA Watershed Best Management Practices (BMPS) ... 14
2.3.1 USA Watershed BMPs – Non-Point Source Pollution ... 14
2.3.1.1 Total Maximum Daily Loads (TMDLs) ... 15
2.3.1.2 TMDL Implementation and Enforcement ... 15
2.3.1.3 Stormwater Discharge BMPs – Urban Stormwater ... 16
2.3.1.4 Stormwater Discharge BMPs – Agricultural Stormwater ... 16
2.3.1.5 Spill Prevention Control and Countermeasure Plan (SPCC) ... 17
2.3.1.6 Livestock Operations BMPs ... 17
2.3.1.7 Conservation Security Program (CSP) ... 17
2.3.1.8 Nutrient Trading ... 18
2.3.1.9 Federally Mandated Non-Point Source Pollution Control Plans ... 18
2.3.2 USA Watershed BMPs – Point Source Pollution ... 18
2.3.2.1 NPDES Permitting Program ... 19
2.3.2.2 NPDES Program Implementation and Enforcement ... 21
2.3.2.3 NPDES Program Administration – EPA versus State Authority ... 23
2.3.2.4 Pretreatment Program and Bio-solids Program ... 23
2.3.2.5 Sanitary Sewer Overflow (SSOs) Program ... 24
2.3.2.6 Combined Sewer Overflow (CSO) Program ... 24
2.4 Monitoring and Reporting ... 24
2.4.1 Water Quality Reporting Requirements ... 24
2.4.2 Section 106 Funding for Water Quality Reporting Requirements ... 25
2.5 Other CWA Permit Programs – Section 401 and Section 404 Permits ... 25
2.6 Applicability of International (USA) Watershed BMPs to China ... 26
2.6.1 Applicability of Non-Point Source Watershed BMPs ... 26
2.6.2 Applicability of Point Source Watershed BMPs ... 27
3. EU Water Resource Management Framework Directive and Watershed Management ... 28
3.1 Background ... 28
3.2 Brief Introduction of the Water Framework Directive ... 29
3.3 Implementation of the Water Framework Directive ... 30
3.4 Committed Key Actions by the EU Member States ... 31
3.6 River Basin Management Plan of the Water Framework ... 32
3.7 Monitoring Program of the Water Framework Directive ... 33
3.8 Public Participation in the Water Framework Directive ... 35
3.9 Priority Substances in the Water Framework Directive ... 36
4. International Environmental Planning ... 37
4.1 Environmental Planning of the US ... 37
4.1.1 Planning System ... 37
4.1.2 Strategic Environmental Plan ... 38
4.1.3 Features of the Environmental Plan ... 38
4.1.4 Applicability to China ... 39
4.2 Japan's Environmental Planning ... 40
4.2.1 Planning System ... 40
4.2.2 Basic Environmental Plan ... 40

4.2.3 Features of Japanese Environmental Planning 40
4.2.4 Applicability to China 41
4.3 Korea Environmental Planning 42
4.3.1 Planning System 42
4.3.2 Environmental Planning and Plans 43
4.3.3 Applicability to China 43
4.4 Dutch Environmental Policy Plan 44

1. Evaluation Methods and the US Government Performance and *the Results Act*

1.1 Background

1 Both the legislative and executive branches of government need evaluative information to help them determine whether, and in what important ways, if a government program is working well or poorly, and why. The US Government Performance and Results Act of 1993 (the Results Act) was a manifestation of the legislative branch's frustration with the fact that congressional and executive branch decision-making was often hampered by the lack of accurate information on the results of federal program activities. In an effort to promote improved federal management and increased efficiency and effectiveness of federal programs, the Results Act instituted a government-wide requirement for agencies to set goals and report annually on program performance. Many analytic approaches have been employed over the years by various agencies to assess the operations and results of federal programs, policies, activities, and organizations. One such approach is the Government Performance Logic Model, which is a methodological framework for planning, managing, measuring and evaluating government programs. The US Results Act and the Performance Logic Model are further described in the following sub-sections.

1.2 US Government Performance and Results Act of 1993 (the Results Act)

1.2.1 Objectives of the Result Act

1 In order to improve government program efficiency and effectiveness, the US Congress enacted the Government Performance and Results Act of 1993 with the following main objectives:

- Improve Federal program effectiveness and public accountability by promoting a new focus on results, service quality, and customer satisfaction;
- Help Federal managers improve service delivery, by requiring that they plan for meeting program objectives and by providing them with information about program results and service quality;
- Initiate program performance reform with a series of pilot projects in setting program goals, measuring program performance against those goals, and reporting publicly on their progress;
- Facilitate congressional decision making by providing more objective information on achieving statutory objectives, and on the relative effectiveness and efficiency of Federal programs and spending; and,
- Promote public confidence in the capability of the Federal Government by systematically holding Federal agencies accountable for achieving program results

1.2.2 Implementation Mechanisms

1 The US Congress amended/augmented relevant sections of the US Code to incorporate the following implementation mechanisms for achieving the objectives of the Government Performance and Results Act of 1993:

- Strategic planning;
- Annual Performance Plans and Reports;
- Managerial Accountability and Flexibility;
- Pilot Projects;
- Training; and
- Continuing Congressional Oversight and Legislation.

2 These implementation mechanisms are briefly described below.

1.2.2.1 Strategic Planning

1 A new section (Section 306, Strategic Plans) was added to Chapter 3, Title 5 of the US Code, requiring the head of each federal agency to submit to the Director of the Office of Management and Budget and to the Congress a strategic plan (generally of 5-year duration) for program activities. Such a plan shall contain:

- A comprehensive mission statement covering the major functions and operations of the agency;
- General goals and objectives, including outcome-related goals and objectives, for the major functions and operations of the agency;
- A description of how the goals and objectives are to be achieved, including a description of the operational processes, skills and technology, and the human, capital, information, and other resources required to meet those goals and objectives;
- A description of how the general goals and objectives in the strategic plan relates to the performance goals required by other relevant sections of the US Code;
- An identification of those key factors external to the agency and beyond its control that could significantly affect the achievement of the general goals and objectives; and,
- A description of the program evaluations used in establishing or revising general goals and objectives, with a schedule for future program evaluations.

2 The new Section 306 emphasizes that when developing a strategic plan, the agency shall consult with Congress, and shall solicit and consider the views and suggestions of those entities potentially affected by or interested in such a plan.

1.2.2.2 Performance Plan and Report

1 Two new sections (Section 1115 – Performance Plans, and Section 1116 – Program Performance Reports) were added to Chapter 11, Title 31 of the US Code. The Performance Plan for each program activity establishes program goals in quantitative and measurable terms, to the extent practicable. It also describes operational processes, resource needs, and performance indicators to be used for evaluating program effectiveness. The Performance Report for each fiscal year enumerates the performance indicators established in the Performance Plan, along with the actual program performance achieved compared with the performance goals expressed in the Plan for three preceding fiscal years (as applicable). The Performance Report also explains and describes, if a performance goal has not been met, why the goal was not met and what remedial actions are recommended.

1.2.2.3 Managerial Accountability and Flexibility

1 A new Section (Section 9703, Managerial accountability and flexibility) was added to Chapter 97, Title 31 of the US Code. Under this implementation mechanism, an agency may request from the Office of Management and Budget a waiver of the administrative procedural requirements and controls normally required in performance plans (including specification of personnel staffing levels, limitations on compensation or remuneration, and prohibitions or restrictions on funding transfers among budget items) in return for specific individual or organization accountability to achieve specified performance goals. Certain restrictions apply to such a waiver proposal.

1.2.2.4 Pilot Projects

2 Various Chapters/Sections of Title 31 of the US Code were amended to authorize the Office of Management and budget to designate several agencies as pilot projects to evaluate the costs/benefits and usefulness of:

- Performance Plans and Reports;
- Managerial Accountability and Flexibility; and
- Performance Budgeting.

1.2.2.5 Training

1 In order to provide managers with an orientation on the development and use of strategic planning and program performance measurement expertise, the Office of Personnel Management was authorized to develop a strategic planning and performance measurement training component for its management training program, in consultation with the Director of the Office of Management and Budget and the federal Comptroller General.

1.2.2.6 Congressional Oversight and Legislation

1 Congress reserved the right to establish, amend, suspend, or annul a performance goal, as necessary. Any such action shall have the effect of superseding that goal under any previously submitted performance plan.

1.3 Government Performance Logic Model

1.3.1 Logic Model for Government Performance

1 The Logic Model (developed by The Performance Institute, Arlington, Virginia, USA) is a structured methodology for connecting program activities to desired outcomes and enable agencies to accurately prioritize their activities and processes. It clarifies the process by which activities lead to expected results. The Logic Model:

- Ensures that activities that are conducted make a contribution to intended outcomes, i.e., that they are worth doing ;
- Ensures that intended results are supported by activities, i.e., that you are doing something to make results happen;

- Makes selection of performance measures more efficient, i.e., identifies what needs to be measured;
- Provides a basis for program evaluation and performance measurement; and,
- Guides planning and resource allocation, i.e., focuses activities and resources on strategic outcomes

2 The Logic Model can help identify key performance indicators, support and improve a variety of management processes, identify activities that are not contributing, and highlight gaps in services, such as desired outcomes that are not supported by input activities.

1.3.2 Application of the Logic Model

1 One of the main applications of the Logic Model is in program performance evaluation. By basing a program performance evaluation on the program logic model, program personnel can focus better on desired outcomes, and determine more easily whether the program is working as intended. Since the logic model expressly describes the linkage between inputs, activities/outputs and outcomes, it facilitates determination of answers to evaluation questions such as:

- Were specific inputs in terms of funding and material resources made as planned?
- Were specified activities and outputs produced?
- Were planned program participants fully engaged?
- To what extent were the specified short, medium and long-term outcomes realized?

2 In this manner, the logic model assists the program evaluation by providing the basis for pinpointing weak links in program operations, and hence, the opportunity for timely intervention.

3 Although the Logic Model has been used to develop implementation strategies and performance measures for various government management challenges, other applications of the Logic Model in the US include: Performance-Based Budgeting; Performance-Based Contracting; Human Resources Management; and, Information Technology/e-Government Measurement. These applications are briefly described below:

1.3.2.1 Performance-Based Budgeting (PBB)

1 The PBB Logic Model provides a concrete approach to linking resources to results through performance budgeting. It includes definitions of outcomes, intermediate outcomes for program strategies, and program outputs. The result is the alignment of performance and costs of a program in a formal budget justification. Typical PBB Deliverables include:

- Program Performance Measurements;
- Performance Justification for the Budget; and
- Activity-Based Costing Work Processes for Program Cost Alignment to Results

1.3.2.2 Performance-Based Contracting (PBC)

1 The PBC Logic Model is used to link contracting and acquisition functions to program

results. It includes selection of performance measures to use in the solicitation and the contract vehicle, and how to structure contract incentives. Typical PBC Deliverables include:

- Statement of Work;
- Statement of Objective;
- Performance Measurements Linking Contract to Program Results; and,
- Worksheet Applying Incentives to Contract Vehicle.

1.3.2.3 Human Resources Management (HRM)

1 The HRM Logic Model addresses workforce assessments, human capital plans, recruitment and retention, and employee evaluation initiatives in aligning workforce capacities to desired program results. Typical HRM Deliverables include:

- HR Performance Measures;
- Executive Performance Plans;
- Employee Performance Evaluation Plans;
- Human Capital Plans; and,
- Data Blueprint for Workforce Analysis.

1.3.2.4 Information Technology/e-Government Measurement (IT/e-Gov)

1 The IT/e-Gov Logic Model focuses on use of information technology to deliver program results. Typical IT/e-Gov Deliverables include:

- e-Gov Performance Measures;
- IT Performance Standards;
- IT Capital Plan; and,
- Budget Justification

1.3.2.5 Commercial Assistance/Software Packages for Implementing the Logic Model

1 Two options for assisting government agencies or other entities in the implementation of The Logic Model are described below:

(1) The Performance Institute's (PI) Training Sessions/Seminars

2 As the US' largest think tank dedicated exclusively to government performance, the Performance Institute works with government agencies to develop and use meaningful performance measures for nearly every operational function and every mission area in government. This is accomplished through training sessions that help government managers implement The Logic Model for specific government programs or challenges. Each Logic Model session begins with comprehensive training for program participants in the fundamentals of performance measurement. Then, specific application training is provided to bridge performance measurement with the specific management challenge being addressed by program participants.

3 Most Logic Model sessions require one to two days, depending on the complexity of the agency program and the intended use of the performance measures. Because the Performance Institute's facilitation approach emphasizes internal capacity-building, the agency can

continue refining its Logic Model outside of the Institute's facilitated Logic Model Sessions.

(2) PerformanceSoft's PBVIEWS Software Solution

4 PerformanceSoft, Inc.'s (Vienna, Virginia, USA) stated mission is to provide a total Performance Management solution that helps organizations measure their performance, manage all key areas, and outperform citizens' expectations through more effective decision making, efficient management reporting and increased accountability. PBVIEWS is a detailed software package developed specifically to address a variety of real life Performance Management situations.

2. Best Watershed Management Practices

2.1 Overview

1 This section describes the current US watershed protection BMPs including policies, statutes, and mechanisms. The European Union (EU) is a multinational organization comprised of independent states. Those states exhibit noticeable differences in geographic, climatic, social and economic conditions. Such differences pose significant challenges when defining pollution control policies that aim at leveled results in the different states. The BMPs described here mainly refer to the cases in the US, which poses many common attributes with China. The US watershed management system has come into being gradually by the enactment of various laws, acts, and statutes. The following paragraphs introduce the major acts concerning watershed management and selectively present the enactment and amending process of those laws and acts according to their relevance to China's situations. By referencing the past US socio-economic development curve and the making of its environmental laws, China could draw useful lessons for its own making and perfecting of the water basin based policies, laws, and institutions.

2 The main methods of watershed BMPs of non-point source pollution in the US include daily TML, precipitation pollution prevention and control, chemical spillover prevention and control, concentrated animal feeding, soil and water conservation and safety, nutrient trading, and the state non-point source pollution management entrusted by the federal government.

3 Main methods of watershed BMPs of point sources pollution control include state pollutants discharge elimination system (which is a pretreatment requirement to the municipal services and industrial waste discharge, industrial waste discharge), and the permitting system of domestic wastewater discharge overflow, and combined sewage 以及合流制下 water system overflow. This report also discusses the applicability of international watershed BMP experiences to China's conditions.

2.2 Regulatory Background

1 The Safe Drinking Water Act of 1974 (SDWA) and Clean Water Act of 1972 (CWA) are among the earliest statues enacted to preserve drinking water quality and to minimize pollution of water bodies.

2 The SDWA focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources. The Act authorized USEPA to establish

safe standards of purity and required all owners or operators of public water systems to comply with primary (health-related) standards. State governments, which assume this power from EPA, also encourage attainment of secondary standards (nuisance or aesthetic-related).

3 The CWA originally started as the Federal Water Pollution Control Act (FWPCA), which was originally enacted in 1948 with the stated goal to "enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution." Several amendments broadened the powers of the Federal Government to enforce the FWPCA law and also incorporated some state authority.

4 In 1972, the various amendments were consolidated and implementation authority vested in the USEPA. Pursuant to a subsequent amendment in 1977, the FWPCA became commonly known as the Clean Water Act (CWA). The CWA established the basic structure for regulating discharges of pollutants into the surface waters of the US. It gave EPA the authority to implement pollution control programs such as setting water quality standards for industrial and construction activities. It regulates a wide variety of toxic pollutants, including the "priority pollutants" (a list of 126 specific pollutants that includes heavy metals and specific organic chemicals), BOD, TSS, fecal coli-form, oil and grease, and pH.

5 Although both statues are important, the CWA outranks the SDWA due to its primary emphasis on regulating pollution discharges and protecting surface water quality. The following subsections briefly outline the salient features of the two statutes

2.2.1 Safe Drinking Water Act

1 The Safe Drinking Water Act (SDWA) was established in 1974 (as Public Law 93-523) and regulates public drinking water systems in the US. Under the SDWA, protection of public health is achieved through the identification of potential water contaminants, development of health-based maximum contaminant level goals (MCLGs), and ultimately, maximum contaminant levels (MCLs) for those contaminants.

2 An MCLG is the concentration of a contaminant below which there is no known or expected health risk. The MCLGs provide the basis for establishing MCLs, which are the highest concentrations of contaminants allowed in drinking water. The MCL for any particular contaminant is usually higher then the MCLG due to limitations in either available treatment technology or associated treatment costs that render meeting the MCLG infeasible. In cases where the USEPA determines that it is not economically or technically feasible to establish a MCL or in the absence of a reliable or economical method of detecting a particular contaminant, a required treatment technique for acceptable contaminant removal may be specified instead.

2.2.1.1 SDWA Amendments

1 In recognition of the limitation that the original SDWA of 1974 focused on "end of the pipe" solutions (i.e., treatment of water to meet specified standards prior to delivery) and did not address protection of the waters that are direct sources of the drinking supply, amendments were enacted in 1986 and 1996 to emphasize source water protection. The 1986 amendments expanded the list of drinking water contaminants to 83, including several

disease-causing microbial contaminants or pathogens.

2 The Surface Water Treatment Rule (SWTR), which originated from the 1986 amendments and became effective December 31, 1990, requires water systems to filter and disinfect surface waters used for public water supply in order to reduce the levels of viruses and other microbes that cause waterborne disease. The SWTR regulations (codified as 40 CFR141) allow a waiver from filtration for systems that meet specific criteria for source water quality and watershed conditions. One such criterion for the waiver is that the public water system demonstrates the ability to "control all human activities which may have an adverse impact on the microbial water quality of the source water". The public water system must also identify watershed characteristics or activities that may adversely affect source water quality.

3 The EPA further recognized that disinfection techniques to eliminate pathogens can create disinfection byproducts which may themselves pose health risks. As a result, it established the Interim Enhanced Surface Water Treatment Rule in 1998 and the Long Term 1 Enhanced Surface Water Treatment Rule in 2001. The 1988 rule required that unfiltered systems that serve 10,000 or more persons expand their watershed control requirements to include the pathogen cryptosporidium and that all public water supply systems, regardless of the size of the population served, conduct sanitary surveys. Sanitary surveys are a comprehensive inspection of a water system that includes identification of potential contamination of the surface water supply. The 2001 rule expanded the watershed control requirements to all systems regardless of the size of population served.

2.2.1.2 SDWA Implementation and Enforcement

1 USEPA has ultimate responsibility for implementing the SDWA, but states may apply for authority to administer the statute. Currently, a majority of the states in the USA have "state primacy" with respect to the SDWA (i.e., have been granted authority to administer the statute), but are all subject to USEPA oversight. Water supply systems or any individual, corporation, or governmental agency that violates SDWA regulations or whose actions threaten contamination of public water supplies are subject to enforcement actions that may include fines, administrative orders, or legal actions.

2 New York City water supply system is an example of how watershed protection measures can be implemented in order to waive the water filtration requirement and avoid SDWA enforcement action. The New York City watershed management strategy includes septic system upgrades and replacement, wastewater treatment plan upgrades, stream restoration, wetlands protection, stormwater control, and protective land acquisition.

2.2.2 Clean Water Act

4 The Federal Water Pollution Control Act (FWPCA) originally enacted in 1948 and subsequently amended and renamed the Clean Water Act (CWA) is the principal statue or law addressing pollution of US' surface waters. When the FWPCA was initially enacted in 1948, water pollution was viewed as primarily a state and local problem; hence, there were no federally required goals, objectives, limits, or guidelines. The federal role at this time was

merely to provide state and local governments with technical assistance funds to address water pollution problems, including research. Even for enforcement, federal involvement was strictly limited to matters involving interstate waters and only with the consent of the state in which the pollution originated.

5 During the latter half of the 1950s and the 1960s, the federal role and federal jurisdiction were gradually extended to include navigable intrastate, as well as interstate, waters. Amendments to the statute in 1956 and 1961 primarily provided funding for construction of local wastewater treatment plants (the funding program was later expanded in the 1972 Amendment).

6 A 1965 Amendment required states to develop water quality standards for interstate waters and determine appropriate pollutant loading that could be discharged to interstate waters without exceeding specified water quality standards.

7 Amendments in 1972 and 1977 expanded the treatment plant construction grant program, established specific water quality standards, permitting systems, Best Management Practices, and applicable treatment technologies. The 1987 Amendment fully addressed non-point source pollution for the first time. Key CWA Amendments are further discussed below.

2.2.2.1 Major CWA Amendments

1 The realization by the late 1960s that existing enforcement procedures were too time-consuming and that the water quality standards approach was flawed; because of difficulties in linking a particular discharger to violations of stream quality standards led to several amendments to strengthen the statute and improve enforcement.

2 **1970 Amendments**, cited as the Water Quality Improvement Act of 1970, further amended the prohibitions on discharges of oil to allow such discharges only when consistent with regulations to be issued by the President and where permitted by the 1954 International Convention for the Prevention of Pollution of the Sea by Oil. The President was also authorized to publish a National Contingency Plan to provide for efficient and coordinated action to minimize damage from oil discharges, including containment, dispersal, and removal.

3 The Reorganization Plan No. 3 of 1970 (December 2, 1970) created the Environmental Protection Agency (EPA), abolished the Federal Water Quality Administration in the Department of Interior, and transferred to EPA all functions formerly assigned to the Secretary of Interior and the Department of Interior which had been administered through the Federal Water Quality Administration.

4 **1972 Amendments**, also known as the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 marked the first step toward comprehensive Federal regulation of surface water quality. The FWPCA Amendments outlined specific goals for water quality in the US and established programs for permitting discharges of pollutants into surface waters. The Amendments included requirements that limitations be determined for point sources which are consistent with State water quality standards, procedures for State issuance of water quality standards, development of guidelines to identify and evaluate the extent of non-point

source pollution, water quality inventory requirements, as well as development of toxic and pretreatment effluent standards. Additional provisions further defined liability for discharges of oil and hazardous substances and the Federal role in clean-up operations, established the National Pollutant Discharge Elimination System (NPDES) to authorize EPA issuance of discharge permits, and authorized the Corps of Engineers to issue permits for the discharge of dredged or fill material into navigable waters at specified disposal sites.

5 NPDES permits are not required for a facility that discharges wastewater to a municipal sewer system for treatment at a publicly owned treatment works (POTW). However, such "indirect discharges" are regulated by pretreatment regulations for certain industry categories under the CWA. These pretreatment requirements are intended to control concentrations of specific industrial pollutants that may upset POTW treatment processes. The NPDES permit effluent limitation guidelines for each industrial category are based upon the degree of reduction of a pollutant that is achievable through the application of various levels of technology (Best Practicable Control Technology (BPT), Best Available Technology (BAT), Best Available Control Technology (BACT), and Best Conventional Control Technology (BCT)).

6 **1977 Amendments** addressed control of toxic pollutants more fully and renamed the entire law the "Clean Water Act" (CWA). Important components included development of Best Management Practices (BMPs) as part of the state area wide planning program, procedures for State assumption of the regulatory program, and authority for the Corps of Engineers to issue general permits on a state, regional, or national basis for appropriate categories of activities.

7 **1987 Amendment** expanded the CWA provisions for addressing non-point or diffuse sources of pollution. Key components of the Amendment included establishment of a $400 million program for States to develop and implement, on a watershed basis, non-point source management and control **programs** with EPA responsibility for grant administration, program approval, and periodic program evaluation. There was also the establishment of the Chesapeake Bay Program Office and Great Lakes National Program Office that required states to develop strategies for toxics cleanup in waters where the application of "Best Available Technology" (BAT) discharge standards is not sufficient to meet State water quality standards and support public health.

2.2.3 Types of Water Quality Standards under the CWA

1 The Clean Water Act (CWA) specifies three general types of water quality standards, namely technology-based standards, ambient or water quality-based standards, and, for a small number of toxic compounds, health-based effluent standards. These are briefly described below.

2.2.3.1 Technology-Based Standards

1 The CWA established four technology-based water pollution control standards. These standards consist of technology-based effluent limitations, which are numerical limitations, established by EPA for specific pollutants from specific sources, based on the degree of

pollutant reduction achievable through the use of recommended pollutant control technologies. The standards are:

2 **Best practicable control technology (BPT)** sets uniform, industry-wide effluent standards that reflect approximate amount of control achievable from existing technology for each specific industry. It is the first level of technology-based standards established by the CWA to control pollutants discharged to waters of the U.S.

3 BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants within each industrial category or subcategory. Effluent limitations from all point sources other than POTWs must be based on application of best practicable control technology. BPT sets the initial baseline applicable to all existing industrial sources of water pollution. Industries were given until July 1, 1977, to install best practicable control technology to clean up waste discharges. Municipal wastewater treatment plants were required to meet an equivalent goal, termed secondary treatment by that date. Municipalities unable to achieve secondary treatment by July 1, 1977 were allowed to apply for case-by-case extensions up to July 1, 1988.

4 USEPA estimates that 86% of all cities met the 1988 deadline; the remaining municipalities were subjected to judicial or administrative schedules requiring compliance as soon as possible. However, as at the present time, many cities are still building or upgrading facilities needed to achieve secondary treatment. In some cases, cities that discharge wastes into marine waters were eligible for case-by-case waivers of the secondary treatment requirement, where it could be sufficiently demonstrated that natural factors adequately eliminate traditional forms of pollution and that both balanced populations of fish, shellfish, and wildlife as well as water quality standards would be fully protected.

5 **Best conventional control technology (BCT)** is the technology-based standard for the discharge from existing industrial point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, oil and grease. The BCT is established based on a two-part cost-benefit analysis. The first part compares the cost for an industry to reduce its pollutant discharge with the cost to a POTW for similar levels of reduction of a pollutant loading. The second part examines the cost-effectiveness of additional industrial treatment to achieve effluent limits lower than required by BPT. EPA finds limits which are reasonable under both cost-benefit tests before establishing them as BCT.

6 **Best Available Technology Economically Achievable (BAT)** applies primarily to certain toxic pollutants specified in the statute, non-conventional pollutants, and thermal pollution as defined in the statute. If the source discharges into a POTW, it must comply with applicable pretreatment requirements. Regardless of any other provisions, the CWA makes it unlawful to discharge any radiological, chemical, or biological warfare agent, any high-level radioactive waste, or any medical waste into navigable waters of the US.

7 **Best Available Demonstrated Control Technology (BACT)** requires the greatest degree of effluent reduction achievable. BACT forms the basis for new source performance standards and is determined based on different categories of industrial and agricultural enterprises.

2.2.3.2 Ambient or Water Quality-Based Standards

1 Water quality standards (WQS) are standards for the overall quality of water. Water quality standards are usually composed of three components, namely (1) designated uses for the water body, (2) water quality criteria that specify quantitative or numerical measures of water quality, and (3) anti-degradation measures that specify policies to maintain the desired water quality.

2 The designated uses (DUs) of a water body can include recreation, water supply, industrial, or other uses determined by the state and federal government as appropriate for the surface water body. Water Quality Criteria (WQC) provides concentrations of specific pollutants, descriptions of water body conditions, or other water quality characteristics that ensure maintenance of designated uses.

3 Anti-degradation policies focus on maintaining the quality of waters meeting the requirements for a DU. According to USEPA, there are three levels or tiers of anti-degradation policies - Tier 1, which applies to all waters regardless of use, provides a baseline for water quality and requires that no existing designated use of a water body should be lost if avoidable. The intent of Tier 2 is to prevent a lowering of water quality from levels well above the Water Quality Standards (WQS) to levels that barely meet the WQS, except under mitigating circumstances such as application of pollutant controls or economic/ social considerations. Tier 3 is the most stringent policy, and applies only to waters designated as "Outstanding National Resource Waters" due to their location, ecological or recreational value.

4 The Clean Water Act requires each state to establish water quality standards for all bodies of water in the state. The standards supplement the federal technology-based standards by identifying where additional pollutant controls are needed to achieve the overall objectives of the statute. For waters where industrial and municipal dischargers have achieved technology-based effluent limitations consistent with BPT and BAT, and yet water quality standards have not been met, the dischargers would be required to meet additional pollution control requirements.

5 Control of toxic pollutant discharges has been a key focus of water quality programs. In addition, the CWA requires states to implement control strategies for waters expected to remain polluted by toxic chemicals even after industrial dischargers have installed the best available control technologies required under the law.

2.2.4 Clean Water Act Funding Mechanisms

1 The CWA originally established a municipal construction grants program to fund construction of sewage treatment plants under the construction grants program. Subsequent amendments in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund (SRF), more commonly known as the Clean Water State Revolving Fund (CWSRF).

2 A combination of Federal and State funds are used to provide long-term, low interest loans to local governments, community groups and individuals for approved projects such as

wastewater treatment upgrades, septic system repairs and agricultural best management practices (BMPs). Every State in the US has a SRF Loan Program, and some States (e.g., the Mid-Atlantic Region States) offer low interest loans for agricultural BMPs. CWA funding vehicles is further described below.

2.2.4.1 Plant Construction Grant Program and States Revolving Fund

1 The 1956 CWA Amendment authorized grants to fund the planning, design and construction of sewage treatment facilities. Under the Title II construction grants program established with the 1972 Amendment, the US Congress greatly expanded the construction grants program and has since appropriated over $70 billion in funding for wastewater treatment plant construction. The Title II grants program made federal grants available for several types of projects including secondary treatment and sewer systems, based on a priority list established by individual states. Federal grants were made available for up to 55% of total project costs, increasing up to 75% for projects using innovative or alternative technology. Grantees were not required to repay federal grants, but were responsible for providing the remainder of the project costs.

2 The increasing financial burden and its adverse impacts on federal budget deficits led Congress to modify its CWA funding commitments. In this regard, Title VI of the 1987 CWA Amendment replaced the Title II construction grant program with a grant program to capitalize a State Water Pollution Control Revolving Fund (SRF) or loan program beginning 1989. States contribute matching funds (equal to at least 20% of the federal contribution) to the federal capitalization funds, and under the revolving loan fund concept, funds borrowed by municipalities for wastewater treatment plant construction have to be repaid to the state fund. When it is repaid then the funds will be available for future plant construction or other watershed BMPs in other communities. In other words, free federal grant funds were no longer available beginning 1989; re-payable loans were established instead.

3 Although all states now have revolving fund loan programs as required by the CWA, some municipalities have difficulty repaying plant construction project loans, especially the smaller cities. Statutory authorization for federal grants to help capitalize state loan programs expired in 1994; hence capitalization of the revolving funds is now solely the responsibility of the states. However, Congress has continued to provide annual appropriations on an ad-hoc basis to help cities address incidental problems such as wet weather overflow discharges of inadequately treated wastes from municipal sewers and major environmental remediation projects.

2.2.4.2 CWA Funding via Department of Agriculture and Land Grant System

1 Besides the Clean Water State Revolving Fund, the US Department of Agriculture's (USDA) Cooperative State Research, Education and Extension System (CSREES) is a major resource and funding source for water pollution related activities. CSREES' main purpose is to advance knowledge for agriculture, the environment, human health and well-being, communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. CSREES doesn't perform actual research, education, and extension but rather helps fund it at the state and local level and provides program leadership in these areas.

2 A Land-Grant college or university is an institution that has been designated by its state legislature or Congress to receive certain statutory benefits such as federal lands and yearly financial appropriations (up to $50,000 annually per state). The Land Grant College system was originally created to provide practical agriculture and technology education to a broad spectrum of the population, including the working masses. In return for the federal benefits, the Land Grant institutions are mandated to provide technical input, research and community extension services in connection with agriculture and related public health issues including water pollution. There is now at least one Land Grant institution in every state and territory of the US, as well as the District of Columbia, and certain southern states have two Land Grant institutions.

2.2.4.3 Other Clean Water Act Funding Sources

1 Additionally, there are miscellaneous federal funds available under the CWA, including Section 319 funding for states to develop non-point source pollution management plans and Section 106 grants for states to monitor and report on water quality on an annual basis. These funding programs are further described in Sections 9.2.1.9 and 9.3.1.

2.3 USA Watershed Best Management Practices (BMPS)

1 All land uses within a watershed have the potential to adversely impact the water quality of down gradient receiving waters. Both point and non-point sources of pollution in a watershed contribute nutrients, bacteria, and chemical contaminants to waterways. Watershed management refers to all activities aimed at identifying contaminant sources and minimizing transport of contaminants to a water body from its watershed.

2 Effective watershed management is a continual, ongoing process that should be flexible enough to adapt to the specific characteristics of different watersheds as well as changing circumstances within each watershed. The net result should be a reduction of contaminants within the watersheds and overall improvements in water quality and aquatic ecosystem health. Watershed management BMPs may be categorized into BMPs that address non-point source pollution, and BMPs focusing on point sources. The two BMP categories are discussed in the subsections below.

2.3.1 USA Watershed BMPs – Non-Point Source Pollution

1 The successful point source pollution reduction efforts achieved by the US Clean Water Act NPDES program have resulted in significant improvements in surface water quality and greatly increased the number of water bodies meeting intended uses (e.g., fishing, swimming, potable supply, etc.). However, the issue of non-point source pollution continues to pose challenges for surface water quality. Non-point source pollution refers to pollution associated with stormwater runoff from urban areas, rural areas, agriculture, timber operations, mine drainage, and other sources for which there is no single point of discharge.

2 According to USEPA, non-point source pollution currently poses the greatest threat to water quality and is the most significant source of water quality impairment in the nation (Handbook for Developing Watershed Plans to Restore and Protect Our Waters, USEPA 2005). Non-point source pollutants include fertilizers and pesticides from agricultural and residential areas, oils and toxic chemicals from urban runoff, construction related stormwater runoff, bacteria and nutrients from

livestock feeds and wastes, etc. Control of non-point source pollution is achieved through regulatory and non-regulatory BMPs as well as application of the watershed approach to pollution control. Typical non-point source pollution BMPs are outlined below:

2.3.1.1 Total Maximum Daily Loads (TMDLs)

1 The TMDL Program is a watershed management process mandated by the CWA that integrates watershed planning with water quality assessment and protection. A TMDL may be regarded as a pollution "budget" (usually expressed in terms of mass per unit time, or other appropriate measures that relate to the water quality standard being violated) that is used to determine the maximum amount of pollution from both point and non-point sources that a water body can assimilate without violating water quality standards.

2 As stipulated in Section 303(d) of the CWA, states are required to provide lists of impaired waters within their territories that do not meet established water quality standards for the designated uses. Such waters must be given special attention and pollutant-specific TMDLs established for them. Since point source pollution is relatively easy to control, non-point sources usually present the more difficult challenge for the TMDL program. Development of a TMDL requires the identification of specific pollutants causing the water quality impairment, quantification of pollutant loads from various sources, and determination of load reductions required of each source to improve water quality.

3 Conceptually, a TMDL is the allocation of pollutant loads for an impaired water body such as to achieve the desired water quality and for each pollutant, is expressed as a summation of point source contributions, non-point sources including natural background levels, and a factor of safety to accommodate uncertainties in the load calculations.

4 In reality, estimation of each of the various variables in the TMDL equation is a complex task requiring collection and interpretation of water quality data, application of mathematical watershed models, and determination of the effectiveness of pollution control techniques.

5 Watershed models can be particularly useful in their ability to estimate current pollutant loads and at the same time, predict future loads based on projected future land use and economic scenarios.

6 Examples of public domain watershed models include USEPA's HSPF and SWMM models. A report by the National Research Council titled *Assessing the TMDL Approach to Water Quality Management* (2001) and an EPA report titled *The Twenty Needs Report: How Research Can Improve the TMDL Program* (EPA, 2002d) provide technical and scientific perspectives on the challenges of TMDL development.

2.3.1.2 TMDL Implementation and Enforcement

1 There have been problems associated with implementation and enforcement of the TMDL program. Under the CWA, USEPA requires each state to submit an updated list of impaired water bodies biennially, including a priority ranking for each impaired water body and details on the nature of the impairment, as well as a listing of water bodies slated for TMDL development within the next two years. It is also EPA's responsibility to approve all TMDLs prior to implementation.

As at 2004, EPA was reported to have approved approximately 10,000 TMDLs whereas approximately 49,000 TMDLs were estimated to be needed nationwide. If a state fails to meet its TMDL requirements, EPA is required to develop a priority list for that state and make its own TMDL determination.

2 Most states have lacked the resources to do TMDL analyses, which involve complex assessment of point and non-point sources and mathematical modeling, and EPA has been reluctant to override states in addition to lack of resources to do the analyses. Thus, the TMDL regulation has lagged in implementation, and has been the subject of lawsuits from national and local environmental groups against EPA and states for failure to fulfill the TMDL requirements of the Act. EPA has recently proposed criteria for states, territories, and authorized Indian tribes to identify impaired waters and establish all TMDLs within 15 years.

3 For point sources, enforcement of TMDL load allocations can be implemented through the NPDES permitting system. Enforcing the non-point source component of TMDLs is more difficult and relies more on watershed education as well as collaborative efforts among federal, state, local governments, and public stakeholders within each watershed. Funding for TMDL development and implementation can be obtainable through state allocation, local government or private organizational funding. The USDA, through the Land Grant universities is also a significant source of funding and technical expertise for TMDL activities.

2.3.1.3 Stormwater Discharge BMPs – Urban Stormwater

1 The CWA was amended in 1987 to require stormwater discharge permitting under the NPDES program. Both stormwater discharges associated with traditional industrial activities (manufacturing, materials handling and processing, etc.) and from construction related activities are covered under the NPDES stormwater permit program.

2 The stormwater permits usually require implementation of specific Best Management Practices (Soil Erosion and Sediment Control Plans, Stormwater Pollution Prevention and Control Plan, Oil Spill Prevention, Control and Countermeasure Program, etc) intended to prevent pollution at the source, before receiving waters are impacted. In addition to individual stormwater permits, EPA or delegated states often issue general permits covering categories of activities (e.g., traditional industrial, construction related, etc), to reduce associated permit administration bureaucracy.

3 Urban stormwater pollution sources also include excessive fertilizers/pesticides for lawns, careless disposal practices and incidental oil/product spills by the public, accumulating garbage and litter on streets and roadways, etc. BMPs for addressing these pollution sources focus primarily on education of the community on environmental stewardship behavior – judicious use of fertilizers/pesticides, recommended lawn mowing methods, proper disposal of waste/toxic materials, regular street cleaning and garbage disposal, etc.

2.3.1.4 Stormwater Discharge BMPs – Agricultural Stormwater

1 Excessive use of fertilizers, pesticides and herbicides, failure to maintain adequate vegetation cover to minimize soil erosion and sediment/pollutant transport, product leaks and spills from farm automotive equipment, poor septic tank maintenance and management, etc.,

are examples of pollution sources that might be associated with agricultural runoff.

2 Agricultural stormwater BMPs focus primarily on education of the farming community on the adverse impacts of excess nutrients on surface waters. Stormwater Pollution Prevention and Control Plans are used to minimize contact between stormwater and toxic materials, strategies for minimizing soil erosion and sediment transport to receiving waters, preventative septic system maintenance and technology upgrades, etc.

2.3.1.5 Spill Prevention Control and Countermeasure Plan (SPCC)

1 The Spill Prevention Control and Countermeasures Plan (SPCC) is a component of the federal Oil Pollution Prevention Regulation promulgated under authority of the Clean Water Act. An Oil SPCC plan is a plan prepared in accordance with good engineering practices to prevent and clean up accidental spills from oil storage tanks or facilities.

2 "Oil" as defined in the federal regulations includes petroleum oils such as gasoline, diesel and heating oil as well as non-petroleum oils such as animal or vegetable oils, synthetic oils, and mineral oils. The federal SPCC plan requirements apply specifically to oil storage facilities with an aggregate storage capacity greater than 1,320 gallons and where a discharge could reach a navigable water body, either directly or indirectly. Any oil storage container or tank that is 55 gallons or larger in size will count towards the total aggregate storage capacity. Federal regulations (40 CFR 112) specify the types of information to be included in the SPCC Plan.

2.3.1.6 Livestock Operations BMPs

1 An animal feeding operation (AFO) is an agricultural facility where animals are kept and raised in confined situations; where feed is brought to the animals and all elements of production, including feed, wastes and dead animals, are concentrated in one area. A Concentrated Animal Feeding Operation (CAFO) is usually defined as an AFO with 1000 animal units, where 1 animal unit = 1000 pounds or more.

2 Water bodies in areas where large numbers of livestock operations or CAFOs are located are often impaired due to animal waste matter and excess nutrients. Inadequate animal waste treatment systems, direct animal contact with surface water, insufficient manure storage lands, inappropriate animal grazing practices, etc., contribute pollutants to stormwater runoff and hence, receiving water bodies.

3 Under the NPDES program, all CAFOs that discharge to surface waters or allow animal contact with surface water require a discharge permit. The NPDES CAFO permit requirements include: Nutrient Management Plans (adequate manure storage, dead animal management, no direct animal contact with surface water, etc); BMPs for production area and land application areas (raw material storage, wastewater containment areas, application of process wastewaters or residuals to land, etc); and Poultry Operations BMPs.

2.3.1.7 Conservation Security Program (CSP)

1 The Conservation Security Program (CSP) is a watershed based (i.e. not restricted to municipal, county or state jurisdictions) program sponsored by the US Department of

Agriculture (USDA) that encourages and provides monetary rewards to farmers for practicing outstanding stewardship on working farmland. Farmers are grouped by watershed, since each watershed shares similar water quality and natural resource concerns. Qualifying practices might include nutrient application based on specific recommendations, integrated pest management, planting winter cover crops to minimize erosion and sediment transport, etc.

2.3.1.8 Nutrient Trading

1 Nutrient Trading is a market-based approach for addressing water quality goals by allowing one waste source (e.g., nitrogen, phosphorus or other waste substances) to meet its regulatory obligations by paying another source to reduce it's emissions beyond their own regulatory requirements. Thus, total nutrient emissions are reduced at lower pollution control costs.

2 USEPA established a *Water Quality Trading Policy* in 2003 to encourage states, interstate agencies and tribes to develop and implement trading programs for nutrients, sediments and other pollutants. USEPA nutrient trading policy encourages voluntary trading programs that facilitate the implementation of TMDLs, reduce the cost of Clean Water Act compliance and create incentives for voluntary discharge reductions (US EPA Trading Policy, 2003)

2.3.1.9 Federally Mandated Non-Point Source Pollution Control Plans

1 Section 319 – Non-point Source Management Program – was added to the Clean Water Act in the amendments of 1987 to provide for greater federal leadership in assisting state and local non-point source pollution prevention efforts. Previously, the Clean Water Act had largely focused on controlling point sources, while helping states and localities to plan for management of diverse non-point sources. However, as industrial and municipal sources have reduced pollution, it has become recognized that uncontrolled non-point sources present serious challenges for water pollution control. Section 319 contains three main strategies for addressing non-point source pollution:

- A requirement for states to prepare assessments of their current non-point source pollution problems
- A requirement for each state to develop management programs to address the problems identified in its assessments
- Establishment of a grant program under which states and Territories receive grant money from EPA to support a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific non-point source implementation projects. Federal grants can cover as much as 60% of the costs of implementing a state's management plan, but there is concern that insufficient funding remains a constraint.

2.3.2 USA Watershed BMPs – Point Source Pollution

1 A major component of the Clean Water Act implementation is the control of point source pollution (such as originating from city sewers, sewage treatment plant outfalls, and industrial waste discharges) through the National Pollutant Discharge Elimination System (NPDES).

The NPDES program requires the issuance of a permit for any activity that results in discharge of pollutants to navigable (surface) waters.[1]

2 The permits specify discharge limits for individual pollutants in a waste stream to minimize pollution of receiving waters. NPDES permits can be issued directly by USEPA to facilities regulated by USEPA or it can delegate to state agencies (such as State Departments of Environmental Protection) the authority to issue the permits. The NPDES permitting system and other non-point source pollution control BMPs are further described below.

2.3.2.1 NPDES Permitting Program

1 The Clean Water Act NPDES program was originally charged with control of wastewater discharges such as originating from publicly-owned sewage treatment works, industrial/commercial facilities, and large agricultural enterprises. Under the CWA, all discharges into the nation's waters are unlawful and subject to civil, criminal, and administrative enforcement provisions, unless specifically authorized by a permit.

2 An NPDES permit (authorized in section 402 of the CWA) obtainable through the EPA or delegated state requires the discharger to attain technology-based effluent discharge limits (such as BPT or BAT for industry, secondary treatment for municipalities, or more stringent standards if necessary for water quality protection). Permits generally specify the control technology applicable to each pollutant and the numerical effluent limits a discharger must meet. Sources are required to maintain records and to carry out periodic effluent monitoring activities to ensure continued compliance with permit requirements. Permits are usually issued for 5-year periods with provisions for renewal in order to be allowed to continue to discharge.

3 In addition to numerical effluent limits applicable to categories of industry (based on BPT, BAT, etc., as applicable), EPA has issued water quality criteria for a large number of pollutants, including 126 named classes or categories of toxic chemicals referred to as priority pollutants. These criteria recommend ambient, or overall, concentrations for the pollutants and provide guidance to states for establishing overall water quality standards consistent with the CWA objectives.

4 The CWA1987 Amendment expanded the NPDES program to include stormwater discharges, and specified a two-phased implementation of the stormwater rule. The Phase I rule was finalized by EPA in 1990 and regulated stormwater discharges from large- and medium-sized municipal (or other publicly owned or operated) separate storm sewer systems (MS4s) serving populations of 100,000 people or more, as well as eleven specific categories of industrial enterprise including construction activity that disturbs five or more acres of land. The Phase II Stormwater rule took effect in 1999 and expanded the regulation of MS4s to include certain small separate storm sewer systems (i.e., serving less than 100,000 populations) as well as tightened the construction activity regulation to those activities disturbing one to five acres.

[1] Note: Some states such as New Jersey also regulate discharges to groundwater, in addition to surface water discharges.

5 EPA defines small MS4s as all small MS4s located in "urbanized areas" (UAs) as defined by the Bureau of the Census, and those small MS4s located outside of a UA that are designated by NPDES permitting authorities. The Census Bureau defines a UA as a land area comprising one or more places and the adjacent densely settled surrounding area that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile.

6 Based on the foregoing, the three types of stormwater discharges regulated under the NPDES stormwater program are, discharge from industrial activities, discharge from construction activities and discharge from municipal separate storm sewer systems. These three categories are briefly described below.

(1) Stormwater Discharge from Industrial Facilities

7 Hazardous materials that are routinely processed, stored or otherwise handled at industrial facilities are often exposed to the weather and hence come in contact with stormwater runoff. As runoff from rain or snowmelt comes into contact with these materials, it picks up pollutants and transports them to nearby storm sewer systems, rivers, lakes, or coastal waters.

8 Stormwater pollution is a significant source of water quality problems and EPA estimates that of eleven pollution categories, urban runoff discharged through storm sewers or directly into surface waters is the fourth leading source of impairment in rivers, third in lakes, and second in estuaries. Therefore, to minimize the impact of stormwater discharges from industrial facilities, the NPDES program requires permit authorization from operators of industrial facilities included in any one of the 10 categories of stormwater discharges associated with industrial activity.

(2) Stormwater Discharge from Construction Activities

9 As stormwater flows over a construction site, it picks up sediment from disturbed soils, debris, chemicals and other pollutants. When discharged into surface waters, the polluted runoff can adversely affect fish and other wildlife, as well as degrade the quality of the receiving waters. Sedimentation or siltation also can destroy aquatic habitat and high volumes of runoff can cause stream bank erosion.

10 Therefore, the NPDES Phase II stormwater program requires operators of construction sites one acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge stormwater under an NPDES construction permit.

(3) Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s)

11 Under Phases I and II of the NPDES stormwater program, operators of large, medium and regulated small municipal separate storm sewer systems (MS4s) require authorization to discharge pollutants under an NPDES permit. Pollutants in this context refer to any type of municipal, industrial, or agricultural waste matter discharged into surface water, and may be generally grouped into three categories, namely conventional, toxic, and non-conventional

pollutants. Conventional pollutants include biochemical oxygen demand, total suspended solids, pH, fecal coliform, and oil and grease. Toxic pollutants or "priority pollutants" include 126 chemical substances that were selected by EPA for priority consideration in development of effluent limitations. Other substances that are neither conventional nor toxic pollutants are considered by EPA as non-conventional pollutants.

12 Medium and large MS4 operators are required to submit comprehensive permit applications and are issued individual permits. Regulated small MS4 operators have the option of choosing to be covered by an individual permit, a general permit, or a modification of an existing Phase I MS4's individual permit.

2.3.2.2 NPDES Program Implementation and Enforcement

1 The primary implementation mechanism for the NPDES program is via individual and general permits issued to regulated dischargers. While individual permits pertain to particular dischargers and contain permit conditions unique to the specified discharger, general permits cover categories or groups of similar dischargers and hence are more efficient administratively. Both individual and general NPDES permits either specify numeric effluent pollutant limits that may be discharged into waters of the US or require implementation of BMPs that prevent or minimize Stormwater pollution.

2 Effluent limits may be either technology-based or water quality-based. Technology-based effluent limits depend on the type of facility generating the discharge and reflect the levels of particular pollutants achievable using the most cost-effective pollution prevention and control techniques suitable for the type of facility. Technology-based effluent limits do not expressly specify the type of control techniques to be used, but they do require that existing discharges be treated using the Best Available Technology Economically Achievable (BAT). In contrast, new discharges have to comply with New Source Performance Standards (NSPS), which are more stringent and require use of Best Available Control Technology (BACT). Contrary to technology-based effluent limits, water quality-based limits do not take economics and availability of technology into as much consideration. Rather, water quality-based effluent limits focus on the designated uses of the receiving water body, and back-calculate appropriate effluent limits to protect those uses.

3 NPDES permits usually require monitoring and use of best management practices (BMPs) to ensure maintenance of permit stipulations. Monitoring requirements usually indicate the pollutants to be monitored, the frequency and type of monitoring or sampling, and specifications for monitoring reporting and record keeping. Discharges are monitored and, in some cases, receiving waters are required to be monitored as well. BMPs include structured activities and/or controls designed to prevent or minimize pollution of surface waters. Specifically, a stormwater Pollution Prevention Plan (SWPPP) is a standard requirement for compliance with NPDES BMP requirements. In the case of construction activity, a SWPPP is a plan for controlling pollutants and runoff from a site during and after construction activities. The stormwater General Permit (GP-02-01) requires a construction activity permit SWPPP typically has the following minimum components:

- Background information and Scope of Project

- Maps, including general location map/site map/construction drawings
- Site characterization, including a description of soils present at the site and contiguous receiving waters
- Construction phasing plan describing the intended sequence of construction activities
- Erosion and Sediment Control (ESC) plan for soil stabilization, runoff and sediment control, including post-construction runoff controls
- Description of on-site construction materials/debris storage and pollution prevention measures to minimize exposure to stormwater
- A maintenance schedule including regular inspections to ensure continuous and effective operation of the ESC practices
- Delineation of SWPPP implementation responsibilities
- Hydrologic and Hydraulic analysis to compare pre- and post-development runoff conditions
- Description of post-construction stormwater control practices, and a maintenance schedule to ensure effective operation of the stormwater controls

4 Regarding enforcement, failure to submit scheduled reports or report equipment malfunction or accidental release, exceed permit of effluent limits, and other permit violation are subject to enforcement action including administrative injunctions, monetary fines or imprisonment in the case of repeated willful violations.

5 In lieu of fines, EPA can occasionally offer a violator the Supplemental Environmental Projects (SEP) option. The SEP policy calls for performance of environmentally beneficial projects which the violator or defendant is not otherwise legally required to perform. A violator's willingness to implement a SEP is one of several factors taken into consideration by EPA when determining an appropriate settlement penalty. In addition, individuals may bring a citizen suit in U.S. district court against persons who violate a prescribed effluent standard or limitation, or against the EPA Administrator (or equivalent state official) for failure to carry out necessary enforcement action. In such cases, EPA or other relevant state agency must be notified 60 days prior to the legal action to give the regulatory agencies the opportunity to implement enforcement instead.

6 EPA's criminal enforcement program was established in 1982, and expanded with full law enforcement authority by enactment of the 1990 Pollution Prosecution Act. The criminal enforcement program is made up of well-trained, fully designated federal law enforcement agents, environmental forensic scientists and engineers, attorneys and training specialists. EPA's Criminal Investigation Division (EPA CID) Special Agents are fully authorized law enforcement officers empowered to enforce environmental laws as well as any other federal law in accordance with the guidelines established by the federal Attorney General. The criminal enforcement program prosecutes significant violations across all major environmental statutes, including: data fraud cases (e.g., private laboratories submitting false

environmental data to state and federal environmental agencies); indiscriminate hazardous waste dumping that result in serious injuries and death; industry-wide ocean dumping by cruise ships; oil spills that cause significant damage to waterways, wetlands and beaches; international smuggling of CFC refrigerants that damage the ozone layer and increase skin cancer risk; and illegal handling of hazardous substances such as pesticides and asbestos that expose children, the poor and other especially vulnerable groups to potentially serious illness.

2.3.2.3 NPDES Program Administration – EPA versus State Authority

1 USEPA can issue stormwater NPDES permits to facilities located in states regulated by the agency, or can delegate to state agencies the authority to issue general or individual stormwater NPDES permits for activities/ facilities located in their states under the State Pollutant Discharge Elimination System (SPDES). In order to reduce the bureaucratic effort associated with permit system administration, both the EPA and authorized states frequently issue General Permits or Multi-Sector Permits that cover specific sectors or activity categories regulated under the NPDES Program.

2 Under this dispensation, a prospective recipient can obtain coverage simply by satisfying specified requirements of the General Permit. New York is an example of a delegated state, and the New York SPDES is a NPDES-approved program with permits issued in accordance with the New York State Environmental Conservation Law. New York administers the SPDES through the New York State Department of Environmental Conservation (NYSDEC). To implement the NPDES Stormwater rule, NYSDEC has issued General Permits for stormwater discharges associated with Industrial Activity (except construction activity), stormwater discharges from Construction Activities, and stormwater discharges from Municipal Separate Stormwater Sewer Systems (MS4s).

3 Typically, in order to obtain coverage under a stormwater General Permit, a stormwater discharger must submit a Notice of Intent (NOI) to the NYSDEC. A SWPPP is required to have been prepared prior to submission of an NOI. Submission of the NOI is an affirmation that a SWPPP has been prepared and will be implemented. In states such as New York, if an applicant certifies that the SWPPP has been developed in conformance with NYSDEC's technical standards, coverage for the applied-for activity is deemed effective five (5) business days after the NYSDEC's receipt of the NOI, except if the applicant is informed otherwise. For construction activity General Permit coverage, cancellation of permit coverage is usually accomplished by submitting a Notice of Termination (NOT) after construction is completed as defined in the General Permit.

2.3.2.4 Pretreatment Program and Bio-solids Program

1 The Clean Water Act requires industrial dischargers to pre-treat waste streams to specified standards prior to discharge to publicly owned treatment works (POTWs) for additional treatment. The National Pretreatment Program is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality.

2 The objectives of the program are to 1) protect Publicly Owned Treatment Works (POTWs) from the introduction of highly toxic industrial pollutants that may interfere with

plant operation or that may pass through untreated and 2) to improve opportunities for the POTW to reuse wastewater and sewage sludge that are generated. The Bio-solids Program regulates the beneficial reuse (e.g., land application) of treated sewage sludge (or other wastewater residuals).

2.3.2.5 Sanitary Sewer Overflow (SSOs) Program

1 SSOs are overflows or releases from sanitary sewer systems. They are illegal under the Clean Water Act's NJPDES Program and subject to enforcement action. Municipal systems with separate sanitary sewers may have overflows due to inadequate capacity of the sewer lines and/or at the wastewater treatment plant, etc. SSOs pose a significant threat to public health and the environment, and can be a major cause of water quality impairment due to high concentrations of bacteria from fecal contamination as well as disease-causing pathogens and viruses.

2.3.2.6 Combined Sewer Overflow (CSO) Program

1 Pipes designed to convey both stormwater runoff and sewage are known as combined sewers. Combined sewers contain raw sewage and pose a significant public health concern because the capacity of combined sewers system might be exceeded during rainfall and a mixture of stormwater, untreated household sewage and industrial wastewater can overflow into receiving waters through the sewer outfalls. CSOs are illegal under the Clean Water Act's NJPDES Program and subject to enforcement action

2.4 Monitoring and Reporting

1 As in air pollution monitoring, water quality monitoring and reporting is an important tool for determining whether water quality control program goals such as compliance with pollution regulations or implementation of effective pollution control actions are being met. Monitoring is a critical component of any restoration or protection effort.

2 Monitoring assesses over time the success of management measures in reducing pollution loads and improving water quality. To be effective, water quality monitoring should include a combination of chemical, physical and biological components. The most common approach is to measure the chemical and physical constituents, as well as biological indicators in the water itself. The concentrations of these constituents are then compared to appropriate water quality and ecological standards to determine if the designated uses of the water body are supported or quantify progress toward attainment of that goal

2.4.1 Water Quality Reporting Requirements

1 States and local jurisdictions use their raw monitoring data to determine whether their waters meet water quality standards and attain designated uses. States report this information to USEPA every two years. USEPA, in turn, summarizes these state water quality assessment reports, required under Section 305(b) of the Clean Water Act Amendment of 1972, into a national Report to Congress called the National Water Inventory

2 In addition, EPA prepares a report referred to as "Index of Watershed Indicators" (formerly known as "Environmental Indicators of Water Quality in the US"), which describes

environmental indicators that USEPA and its state, federal, local and private partners use to measure progress toward national water quality objectives. Over time, the indicators described in this report provide consistent information on water quality trends.

2.4.2 Section 106 Funding for Water Quality Reporting Requirements

1 The Clean Water Act (CWA) gives States and Territories the primary day-to-day responsibility for implementing programs to protect and restore water quality, including monitoring and assessing the nation's waters and reporting on their quality. CWA Section 106(e)(1) requires EPA to determine that a State is monitoring the quality of navigable waters, compiling, and analyzing data on water quality and including it in the State's Section 305(b) report in order to qualify for award of Section 106 grant funds. The EPA provides guidance on the basic elements of a State water monitoring program and helps the States determine whether a monitoring program meets the prerequisites of CWA Section 106(e)(1) for funding eligibility.

2.5 Other CWA Permit Programs – Section 401 and Section 404 Permits

1 The Clean Water Act Section 401 Water Quality Certificate is a state water quality agency's certification that a project will not violate state water quality standards or that no applicable effluent or other water quality limitation exists for the project in question. Any un-exempt construction activity or facility operations which may result in any discharge into navigable waters is required to provide the project licensing or permitting agency the water quality certification from the state in which the discharge originates or will originate, and is a prerequisite for obtaining the federal Section 404 permit governing such discharges.

2 The CWA Section 404 Permit Program was established to regulate the discharge of dredged or fill material into waters of the US including wetlands. Activities regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the US, except for exempt activities such as certain farming and forestry activities. The purpose of the Section 404 Permit Program is to prevent irresponsible and unregulated discharges of dredged or fill material that could permanently impact or destroy valuable aquatic resources. In keeping with its basic premise, prospective Section 404 Permit applicants are required to show that they have:

- Taken steps to avoid wetland impacts and that no practicable alternatives exist that are less damaging to the aquatic environment
- Minimized potential impacts on wetlands
- Provided compensation for any remaining unavoidable impacts

3 The Section 404 Permit Program is administered by the U.S. Army Corps of Engineers, with environmental guidance from USEPA. Proposed activities are regulated through a permit review process. An individual permit is required for potentially significant impacts, and is usually rigorously reviewed by the U.S. Army Corps of Engineers prior to approval. However,

for a majority of discharges or routine activities (e.g., minor road activities, minor excavation, grading or backfill, etc.) that will have only minimal adverse effects, a General Permit will usually suffice.

4 General permits are issued on a nationwide, regional, or State basis for particular categories of activities. The general permit process eliminates individual review and allows certain activities to proceed with little or no delay, provided that the general or specific conditions for the General Permit are met. Although primary responsibility for implementation of Section 404 Program rests with the Army Corps and EPA, qualified states have been delegated certain Section 404 permitting responsibility, through state program general permits, water quality certification, or Section 404 Program assumption. New Jersey and Michigan are examples of delegated states.

2.6 Applicability of International (USA) Watershed BMPs to China

1 The US and China share similar experiences in several important aspects, including:

- Geographic size – both countries consist of geographically vast land areas, each with wide variations in geophysical and climate characteristics
- Political structure - both countries have a strong central government working cooperatively with a large number of states or provinces, which in turn consist of numerous local entities or counties/municipalities
- Environmental management structures comprising a central national agency (USEPA, SEPA) and provincial authorities (US State Departments of Environmental Protection, Chinese Environmental Protection Bureaus)
- Rapid economic growth – The US experienced rapid economic growth in the past, similar in many respects to the current economic boom occurring in China
- As a consequence of the rapid economic growth of previous decades, severe water pollution became widespread in the US. The country struggled to control pollution, starting with the Federal Water Pollution Control Act (FWPCA) of 1948, through several amendments culminating in the 1977 Clean Water Act and subsequent 1987 amendment that specifically addressed non-point source pollution. China is similarly grappling with worsening water pollution problems, through various evolving statues, policies and regulations

2 Applicability of the US experience with respect to specific watershed BMPs is briefly discussed below

2.6.1 Applicability of Non-Point Source Watershed BMPs

1 As in the US, China has recognized that non-point pollution originating from diverse urban, industrial, rural, and agricultural/livestock sources poses enormous challenges in the effort to control pollution. Although the US has had much success in control of point-source pollution, non-point pollution control is still a work in progress. By statute, the USEPA was vested with primary authority for environmental management, with the states playing

supplementary roles. Similarly strengthening SEPA (or other central agency) in China can also have positive benefits. US experiences in non-point source BMPs are potentially applicable to Chinese watersheds in the following respects:

- Total Maximum Daily Loads (TMDLs) – accurate determination of TMDLs for impaired water bodies using mathematical watershed models if necessary, is an important first step in evaluating baseline conditions as well as needed pollutant load reductions.
- Urban stormwater BMPs – The key to controlling non-point source pollution is to minimize contact between stormwater and pollutants. Regulations can be enacted or strengthened requiring SWPPP and SPCC plans for all industrial, commercial or government facilities or construction sites where the potential exists for stormwater contact with pollutants (petroleum products, toxic materials, hazardous wastes, etc). Environmental stewardship education (sparing use of fertilizers/pesticides, proper disposal of toxic wastes, etc) can be disseminated to the community in general
- Agricultural Stormwater BMPs – Farmers can be educated to refrain from excessive fertilizer and pesticide use. For major farming operations, BMPs can be required to minimize spills from automotive equipment and stormwater contact with miscellaneous pollutants and hazardous materials
- Livestock Operations – Regulations can be strengthened to minimize stormwater contact with animal material. Permitting systems can be instituted for CAFOs to ensure compliance with waste management rules.
- Incentive Programs – "Good farmers" can be rewarded for environmentally friendly farming practices
- Non-point Source Pollution Management Plans – As in the US, the provinces can be required to develop official plans specifically targeting non-point source pollution at the local levels

2.6.2 Applicability of Point Source Watershed BMPs

1 Important lessons can be learned from the US' successful efforts to control point source pollution.

2 Implementation and enforcement of the Clean Water Act's NPDES permitting program for domestic and industrial waste discharges has been instrumental in controlling point source pollution. For China, a similar permitting effort, with emphasis on compliance and enforcement can also have positive impacts.

3 By statute, the Clean Water Act provided adequate funding on a revolving basis to meet municipal sewage treatment plant construction needs. Similarly for China, if sufficient funds can be provided on a continuing basis not only for treatment plant construction, but also for sewer pipes to convey wastewater to the plants, a significant source of pollutant loading to surface waters would have been essentially neutralized.

4 Besides NPDES and treatment plant funding, other point source BMPs with potential

applicability to China include:

- Industrial waste pretreatment – strengthening and enforcement of pre-treatment regulations to minimize the risk of shock loading and disruption of municipal treatment plant operations
- Wet weather flows – regulation and enforcement regarding sanitary sewer overflows and combined sewer overflows, which result from inadequate plant/sewerage capacity
- Beneficial reuse of treated wastewater and sewage sludge – by requiring pre-treatment to remove toxic wastes, treatment plant effluent and sludge solids may be suitable for certain uses

3. EU Water Resource Management Framework Directive and Watershed Management

3.1 Background

1 71 of the world's 261 international river basins are located in Europe. In past decades, the trans-boundary water pollution has become a widespread phenomenon in Europe. The trans-boundary waters are threatened by untreated or insufficiently treated municipal wastewater, industrial wastewater, waste discharge from agriculture activities, seepage from landfills, and accidental pollution. The discharges of toxic and persistent substances, phosphorus and nitrogenous compounds, which incur eutrophication and sediment contamination, are also among the major contributors to trans-boundary water pollution.

2 Trans-boundary water pollution management presents a significant number of major challenges to politicians, planners, administrators and scientists. To address these challenges, policy makers need access to reliable and relevant information that concerns not only the physical attributes of the water systems, but also the particular political and administrative conditions.

3 According to the United Nations Economic Commission for Europe (UNECE), more than 100 conventions, treaties and other arrangements have been established between/among the European countries to facilitate cooperation on trans-boundary waters. Statistics reveals that a major portion of the treaties focuses on hydropower and water supply, and only a small portion focuses on pollution issues. Although countries can fail to ratify or implement treaty requirements, treaties are still often considered a good instrument for trans-boundary water issues.

4 Since 1975 nearly thirty so-called "daughter directives" have been created by the European Commission. They define water quality standards for various substances and uses and cover topics such as drinking water quality, bathing waters, dangerous substances, municipal wastewater treatment, and integrated pollution prevention and control. However, by the 1990s it became clear that treaties alone would not lead to an integrated water management strategy. Thus the Water Framework Directive was developed by the European Union (EU) to provide an integrated approach for the water management for EU countries.

5 China holds a different yet comparable situation with EU. The EU consists of 25

countries; China is one single country comprised of 32 provinces, municipalities, and autonomy regions. China's policy and decision makers will be able to draw useful experience as the EU develops and implements its Water Framework Directive and river basin management plans that are based on river basin districts rather than countries. This chapter introduces the EU Water Framework Directive broadly with emphasis on certain characteristics which may be of interest to the HRB and TKB pollution control in China.

3.2 Brief Introduction of the Water Framework Directive

1 Along with the increasing interest in trans-boundary water management, in October 2000 the EU officially adopted the Water Framework Directive (or the directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy). The Water Framework Directive became effective on December 22 2000 with its publication in the Official Journal L327.

2 This directive is the result of more than 5 years of discussions and negotiation between a wide range of experts, stakeholders and policy makers. This process has focused on the widespread agreement on key principles of modern water management that form today the foundation of the Water Framework Directive (WFD).

3 The WFD sets a framework for the comprehensive management of water resources in the European Community, using a common approach and with common objectives, principles and basic measures. The WFD establishes a framework for the long-term management approach to protecting the waters regardless of national borders. It is comprehensive in that it enjoins the EU Member States to organize the management of water in River Basins Districts (RBDs), the basic unit for management. If the RBDs cross national borders, the Member States are obliged to set up international river basin authorities and to cooperate on the management of trans-boundary waters. Integrated management is one of the main characteristics of the WFD as below.

- Integrate environmental objectives by combining ecological, qualitative and quantitative objectives for protecting highly valuable aquatic ecosystems and ensuring a generally good status of waters
- Integrate all water resources by combining fresh surface water and groundwater, wetlands, coastal water resources at the river basin scale;
- Integrate measures in a common management approach for achieving the environmental objectives of the WFD. Programs of measure are defined in management plans developed for each river basin
- Integrate water legislations into a common and coherent framework. The requirements of certain older water legislations, such as the Fishwater Directive, the Nitrates Directive, the Urban Wastewater Treatment Directive, have been reformulated, updated, or repealed;
- Integrate disciplines, analyses and expertise by combing hydrology/hydraulics/ecology/soil sciences, engineering, economics to assess current

pressures and impacts on water resources and to identify measures for achieving the environmental objectives of the WFD in the most cost-effective manner

- Integrate stakeholders and the civil society in planning and decision-making, by promoting transparency and information to the public, and by offering an opportunity for involving stakeholders in the development of river basin management plans

- Integration of management and policies from different Member States for the river basins shared by several countries

4 The WFD rationalizes and updates existing water legislation by setting EU-wide objectives. Broad in its scope, the WFD relates to the quality of water in rivers, lakes, canals, groundwater, and transitional (estuarine) water and coastal waters at least one nautical mile from the shoreline. The fundamental objective of the WFD is to maintain "high status" of waters where they exist, preventing any deterioration in the existing waters and achieving at least "good status" in all waters by 2015, where possible. The WFD aims to enhance the state of water ecosystems, the aquatic environment, water quality, and groundwater by a variety of measures. The WFD is also used to promote sustainable water use and to mitigate the effects of floods and droughts. Cost recovery approach is one of the main pillars of the WFD. A crucial element of WFD is to develop financially viable plans based on affordability.

3.3 Implementation of the Water Framework Directive

1 The WFD has been implemented in the EU Member States and candidate countries. Member States will have to ensure the adoption of a coordinated approach to achieve the WFD objectives and to implement the programs of measure. A critical requirement for WFD implementation is the river basin management plan. This plan addresses major characteristics of a river basin, the various human activities, monitoring, objectives, and a program of measures. The plans should be completed before 2015, and reviews and updates will be conducted every six years thereafter.

2 The passing of the Common Implementation Strategy by EU Member States and European Commission in May 2001 in Sweden represents a significant step for the implementation of the WFD. This strategy will allow a coherent and harmonious implementation of the WFD by supporting its implementation and by developing common understanding and coherent guidance on key elements of the WFD.

3 This common strategy sets several crucial principles: sharing information and experiences, developing common methodologies and approaches, involving experts from candidate countries and involving stakeholders from the water community. The common strategy focuses on methodological questions related to a shared understanding of the technical and scientific implications of the WFD. One of the main short-term objectives is to develop non-legally binding and practical guidance documents on various technical issues of the Directive. These guidance documents are targeted to those experts directly or indirectly implementing the WFD in river basins. The structure, presentation and terminology are therefore adapted to the needs of these experts and formal, legalistic language is avoided

wherever possible. The guidance documents developed under the Common Implementation Strategy will play a key role in the process of implementing the WFD.

4 One of the important measures taken is to form a series of working groups, such as the IMPRESS (Analysis of pressures and impacts), HMWB (Heavily modified water bodies), REFCOND (Reference conditions in inland waters), COAST (Typology, reference conditions and classification of transitional and coastal waters), IC (Intercalibration), Monitoring (Monitoring of surface and groundwaters), Groundwater tools (Tools for assessments of groundwater trends), PROCLAN (Best practices in river basin planning, including the work packages on river basin districts, planning process and public participation) and WATECO (Water Framework Directive and Economics, economic analysis in the context of the WFD) to deal specific issues. For example, the main objective of the WATECO is to develop a non-legally binding and practical guidance for supporting the implementation of the economic elements of the WFD.

3.4 Committed Key Actions by the EU Member States

- To identify the individual river basins lying within their national territory, assign them to individual River Basin Districts (RBDs), and identify competent authorities by 2003 (Article 3, Article 24)
- To characterize river basin districts in terms of pressures, impacts and economics of water uses, including a register of protected areas lying within the river basin district, by 2004 (Article 5, Article 6, Annex II, Annex III)
- To carry out, jointly and together with the European Commission, the inter-calibration of the ecological status classification systems by 2006 (Article 2 (22), Annex V);
- To make the monitoring networks operational by 2006 (Article 8)
- Based on sound monitoring and the analysis of the characteristics of the river basin, to identify by 2009 a program of measures for achieving the environmental objectives of the WFD cost-effectively (Article 11, Annex III)
- To produce and publish river basin management plans for each RBD including the designation of heavily modified water bodies, by 2009 (Article 13, Article 4.3);
- To implement water pricing policies that enhance the sustainability of water resources by 2010 (Article 9)
- To make the program of measures operational by 2012 (Article 11)
- To implement the program of measures and achieve environmental objectives by 2015 (Article 4)

3.5 Economic Elements in the Water Framework Directive

1 The WFD has clearly involved the economic dimension of water and put into operation the polluters-pay principle; which is even a novelty in the European Union environmental legislation. The WFD integrates economic principles, approaches and instruments in water

policy-making and in the development of integrated river basin management plans. The more specific points regarding economic element in the WFD are as follows:

- Member States have to perform an economic analysis of water uses for each river basin (Article 5, Annex III)
- The WFD offers Member States the possibility to implement a wide range of measures to achieve its environmental objective of good water status. However, the WFD requests Member States to undertake a cost-effectiveness analysis to identify the measures for achieving the environmental objectives of the WFD at the lowest costs. Its results should be reported in the river basin management plans (Annex III, Article 11)
- Member States will promote pricing policies that provide an adequate incentive for more sustainable use of water resources. Pricing should encourage users to use less water and to reduce pollution (Article 9)
- Member States should ensure adequate cost recovery of water services from the main water uses, disaggregated into at least agriculture, households and industry (Article 9)
- Economic issues are investigated for the designation of water bodies which hydro-morphology is heavily modified as a result of anthropogenic influence. And economics have a role to play in the justification of time and objective derogation proposed by the Member States (Article 4)

2 In summary, the WFD applies the economic principles by adopting the polluters pay principle, the WFD uses economic approaches and tools by implementing cost-effectiveness analysis, and the WFD considers economic instruments by water pricing.

3 However, experiences and expertise in developing economic analysis to support policy decisions at the river basin scale was limited in most EU Member States and candidate countries. The key constraints in undertaking the economic analysis include a poor economy-related information base, limited expertise and capacity, and limited awareness among water experts and stakeholders about the role of economics in water management and policy.

3.6 River Basin Management Plan of the Water Framework

1 The WFD views river basins as natural geographical and hydrological units rather than units bound by administrative or political boundaries. A river basin is an area of land from which all surface run-off flows through a sequence of streams, rivers and possibly lakes into the sea at a single river mouth, estuary or delta. In each river basin district (RBD), some of which will traverse national frontiers, the Member States should coordinate administrative arrangements for water management in related to each RBD lying within their territories.

2 Initiatives in the Maas, Scheldt or Rhine river basins have served as positive examples of this approach. Cooperation and joint objective-setting have gone across Member State borders for the Maas and Scheldt river basins, and in the case of the Rhine the cooperation has even gone beyond the EU territory. While several Member States have already taken the river basin approach, at present it has not yet been the universal case.

3 The river basin management plan is a detailed account of how the river basin objectives (such as ecological status, chemical status and protected area objectives) are reached within the timescale required. The plan includes all the results of the analysis: the river basin's characteristics, a review of the impact of human activity on the status of waters in the basin, estimation of the effect of existing legislation, the remaining "gap" to meet these objectives, and a set of measures designed to fill the gap.

4 One of the first steps in the development of river basin management plan is the characterization of the river basin as required under the Article 5 of the WFD. This characterization identifies key water users and pressures in the river basin, their impact on the status of water bodies, and provides information on the socio-economic importance of existing uses and economic sectors using and polluting water resources.

5 One important activity for the river basin management plan is to carry out an economic analysis of water use within the river basin. This is to enable a rational discussion on the cost-effectiveness of the various possible measures.

6 An important concern for defining environmental objectives in the basin management plan is the integration of economic factors. The WFD defines its quality objectives of good and high water status based on a series of chemical, hydro-morphological, quantitative and ecological criteria. However, under specific circumstances, such as in the heavily modified water bodies where it is impossible to bring surface water bodies back to their nature hydro-morphological conditions as a result of man-made modifications. The EU Member States may aim at low environmental objectives or at reaching these objectives within a longer time frame.

7 Certainly it is required to assess the trends in water demand and supply and how the main pressures and uses evolve by 2015. It must also evaluate the existing and foreseen levels of cost recovery of water services as the WFD requests the Member States to ensure by 2010 an adequate cost recovery of water services by the water uses disaggregated into at least agriculture, households, industry, and to take into account the economic analysis and the polluters-pay principle.

8 It is essential that all interested parties are fully involved in this discussion, and indeed in the preparation of the river basin management plan as a whole. The WFD promotes the active participation of all interested parties, and information and consultation of the public in the development of the river basin management plans.

3.7 Monitoring Program of the Water Framework Directive

1 The EU WFD establishes requirement for the monitoring of surface water status, groundwater status and protected areas. Monitoring programs are required to establish a coherent and comprehensive overview of water status within each river basin district. Three types of monitoring for surface water and groundwater are defined in the WFD: surveillance, operational and investigative monitoring. For groundwater a water level monitoring network is required. The monitoring here does not include the direct measurement of emissions and discharges to water, which is dealt with by another program (undertaking by the "analysis of

pressures and impacts" group).

2 The objectives of surveillance monitoring are to provide information for:

- Supplementing and validating the impact assessment procedure
- The efficient and effective design of future monitoring programs
- Assessment of long-term changes in natural conditions
- Evaluation of long-term changes resulting from widespread anthropogenic activity.

3 The results of such monitoring are reviewed and used, in combination with the impact assessment procedure, to determine requirements for monitoring programs in the current and subsequent river basin management plans. The surveillance monitoring has to be undertaken for at least a period of one year during a period of the river basin management plan. The monitoring programs should start by 22 December 2006, and the ending time for the first river basin management plan is 22 December 2009.

4 The objectives of operational monitoring are to:

- Establish the status of those water bodies identified as being at risk of failing to meet their environmental objectives
- Assess any changes in the status of such bodies resulting from the measures taken

5 Operational monitoring is used to establish or confirm the status of water bodies thought to be at risk. Therefore, it is operational monitoring that will produce the environmental quality ratios used for status classification for those water bodies. It is highly focused on parameters indicative of the quality element most sensitive to the pressures to which the water body or bodies are subject.

6 Investigative monitoring may be required in specified cased, such as:

- Where the reason for any pollution levels above the standards is unknown
- Where surveillance monitoring indicates that the objectives for a body of water are not likely to be achieved and operational monitoring has not already been established, in order to ascertain the causes of water bodies failing to achieve the environmental objectives
- To ascertain the magnitude and impacts of accidental pollution

7 The results of the monitoring would be used to inform the establishment of a program of measures for the achievement of the environmental objectives and to choose specific measures necessary to remedy the effects of accidental pollution. Investigative monitoring should be designed to the specific cases or problems investigated.

8 The WFD also indicates that the monitoring parameters should conform to appropriate international standards which should ensure the provision of data of an equivalent scientific quality and comparability.

3.8 Public Participation in the Water Framework Directive

1 Although the WFD does not use the term public participation,[2] it puts public participation at a very high level that "the success of this Directive relies on" public participation (Preamble 14 of WFD). Public Participation for the implementation of the WFD is recommended at any stages in the planning process and the design of the river basin management plan.

2 The WFD prescribes three main forms of public participation:

- The public[3] access to background information
- Consultation to the public in three steps[4] of the planning process
- Active involvement of interested parties[5] in all aspects of the implementation of the Directive, especially – but not limited to – the planning process

3 These three forms can be interpreted as public participation, although public participation usually covers a wider range of activities than prescribed by the WFD. A guidance document of the WFD uses Figure 1 below to interpret the relations of the three forms of public participation. According to the WFD, the Member States have to ensure the first two types and encourage the third type.

4 The foundation for any form of public participation is information sharing with the public. Background information should be available at any time for everyone.

5 Consultation means that the public can react to plans and proposals developed by the authorities. The first level of real participation is consultation. Administrative bodies consult the public and the interested parties (stakeholders) to learn from their knowledge, perceptions, experiences, and ideas. Consultation is used to gather information and opinions from those involved to develop solutions based on such knowledge. Reports, scenarios, or plans are presented, and people are asked to comment. The process does not concede any share in decision-making, and professionals are under no formal obligation to take on board people's views. The type of written consultation is the minimum requirement of the WFD. Oral consultation is more active and stakeholders have possibilities to have a dialogue or discussion with the competent authorities.

6 Active involvement refers to that interested parties (stakeholders) actively participate in the planning and implementation process by discussing issues and contributing to their

[2] Public participation here means allowing the public to influence the outcome of plans and working processes.

[3] "One or more natural or legal persons, and, in accordance with national legislation or practice, their associations, organizations or groups" (SEIA Directive (2001/42/EC).

[4] Three steps: Step 1 – the timetable and work program for the production of the plan; Step 2 – interim overview of the significant issues; Step 3 – draft copy of the plan available.

[5] Any persons, groups or organizations with an interest or "stake" in an issue, either because they will be directly affected or because they may have some influence on its outcome. "Interested parties" also includes members of the public who are not yet aware that they will be affected (in practice this includes most individual citizens and many small NGOs and companies).

solution. This is a higher level of participation. Interested parties participate actively in the planning process by discussing issues and contributing to the solutions. Essential to active involvement is the potential for participants to influence the process. It does not necessarily imply that they also become responsible for the water management.

7 The choice of the level of the three forms depends on: the timing of public participation and the stage of the planning process, the (political and historical) context for public participation, available resources, objectives or benefits of public participation, and the stakeholders identified to be involved.

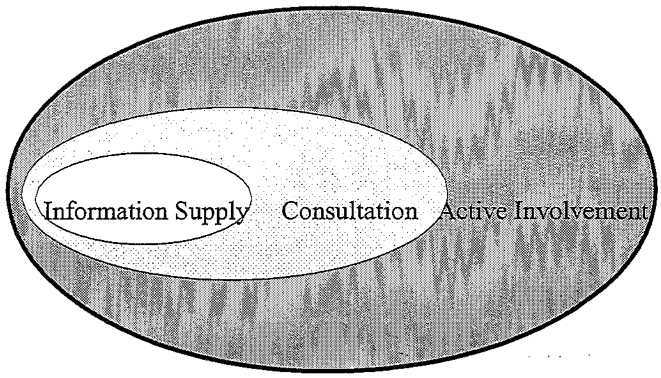


Figure 3.8-1 Three forms of Public Participation

A Typology of Possibly Interested Parties

Professionals - public and private sector organizations, professional voluntary groups and professional NGOs (social, economic and environmental). This also includes statutory agencies, conservation groups, businesses, industries, insurance groups and the academia.
Authorities, elected people - government departments, statutory agencies, municipalities, local authorities.
Local Groups - non-professionally organized entities operating at a local level.
It could be broken down into:
Communities centered on place - attachment centered on place, which includes groups like residents associations and local councils.
Communities centered on interest - e.g. farmers' groups, fishermen, birdwatchers.
Individual citizens, farmers and companies representing themselves. Key individual landowners for example, or local individual residents.

3.9 Priority Substances in the Water Framework Directive

1 The WFD lays down new procedures for the identification of chemical substances and development of control measures. On 17 July 2006, the EU Commission adopted a proposed Directive setting of environmental quality standards for the priority substances, which the Member States must achieve by 2015 to ensure a "good chemical surface water status".

2 The environmental quality standards for surface waters have 41 dangerous chemical

substances including 33 priority substances and 8 other pollutants. The 33 substances or group of substances include selected existing chemicals, plant protection products, biocides, metals and other groups such as Polyaromatic Hydrocarbons (PAH) that are mainly incineration by-products and Polybrominated Biphenylethers (PBDE) that are used as flame retardants.

3 The identified 33 priority substances have been shown to be of major concern for European waters, and 11 substances of them have been identified as priority hazardous substances that are of particular concern for the inland, transitional, coastal and territorial waters. It is required that all priority substances are subject to progressive reduction of emissions, losses and discharges; and priority hazardous substances are subject to cessation or phasing out of discharges, emissions and losses within 20 years.

4 Under the WFD, the Member States should furthermore set quality standards for river basin specific pollutants identified in accordance with the WFD and take action to meet those quality standards by 2015 as part of the ecological status (Article 4, 11 and Annex V, WFD). For this purpose, a program of measures should be in place by 2009 and become operational by 2012.

4. International Environmental Planning

1 Environmental planning began in the developed countries in the 1960s. The series of significant environmental issues brought about by industrialization has led the developed countries to emphasize on environmental legislation and pollution control. Pollution control programs prescribed to tackle various pollutions have been launched. Compared to the developed countries, environmental planning in the developing countries took off only in the 1980s and 1990s. Since the Earth Summit at Rio, both developed and developing countries have intensified environmental planning, since not only the *Agenda 21* requires all countries but also the multilateral development agencies such as the World Bank requires its aid-receiving nations set environmental strategies and action plans. According to the *Global Environmental Outlook 2000* by the UN, environmental planning has been receive more and more attention from the national governments.

2 Nations of both planned and market economies make and implement environmental plans to direct their environmental protection. Despite the difference in macroeconomic regime, the environmental protection plans of both systems are relatively comprehensive.

4.1 Environmental Planning of the US

4.1.1 Planning System

1 The US is a highly developed market-oriented economy. Its macroeconomic management has two distinctive features: (1) no national economic plan or planning, economic management is mainly through legal, fiscal, and financial tools; (2) legislation and decision-making are a bargaining process. The major tools for macroeconomic management of the US government include: legislation, fiscal budgeting, financial tools, and income redistribution and social protection. Although the US does not have national plans, but it does have sectoral plans and medium- to long-term plans at firm level. With the Congress passing the *Government Performance and Results Act* in 1993, governmental planning has been

intensified. The Act has been enacted to update the current government procedures and to offer a new mechanism for improving the government performance and government accountability. It compliments other budgeting, auditing, and financial management acts. The Act requires major government agencies prepare strategic plan and action plans, prepare for annual work plan and performance reports to improve the efficiency, effectiveness, and accountability of the federal government expenses. Strategic plans are reviewed by the Office of Management and Budget (OMB) since 1997. Starting from 1998, the Congress also receives and reviews the annual work plans of various agencies.

4.1.2 Strategic Environmental Plan

1 The US prepared its first *Strategic Environmental Plan* (1997-2002) in 1997. Based on this strategic plan, annual work plans and budgets will be prepared to fulfill the goals outlined in the strategic plan. Currently the *Strategic Environmental Plan* (2003-2007) has been prepared and is under public consultation.

2 The 1997 *Strategic Environmental Plan* is based on the *Government Performance and Results Act*. The USEPA's mission and 10 major goals have been laid out based on the status quo of the US environmental management and its environmental issues. These 10 major goals will serve as the basic framework for USEPA planning and resource allocation decisions. Each goal has specific objectives, tasks, implementation strategy and methods. The *Strategic Environmental Plan* also estimates the costs and benefits of fulfilling the objectives. In general, this comprehensive Plan serves as the blueprint of achieving progress in human health and environmental protection for the US the public for the following 5 years. The 10 goals in the US *Strategic Environmental Plan* are: 1) clean air; 2) clean and safe water; 3) food security; 4) pollution prevention and reduce risks in communities, indoor areas, work sites, and the ecosystems; 5) better solid waste management, restoration of polluted land and emergency response; 6) reduce global and transregional environmental risks; 7) improve the US the public right to know of the environment; 8) improve the public awareness of environmental risks through advances in science and technology, solve the environmental problems through innovation; 9) establish credible pollution deterrence mechanism, and promote more comprehensive law enforcement; and 10) effective administration.

3 Currently the USEPA has completed the *Strategic Environmental Plan* (2003-2007). The new Plan includes 5 objectives: clean air, clean and safe water, land protection and restoration; secure community and ecosystem; environmental enforcement and management.

4.1.3 Features of the Environmental Plan

1 Set environmental objectives through environmental legislation. In 1975 the US Congress passed the *Clean Air Act* and its amendments by the USEPA, which set the air quality management objectives. To fulfill the phased requirements of air quality set by the environmental legislation, the states conducted environmental planning and set their state implementation plans and regional environmental objectives based on the phased objectives laid out by the USEPA.

2 Conduct environmental forecasting and program optimization. Models are widely

adopted in the US environmental planning to evaluate the environmental impacts from factors such as the economic growth, demographic changes, and urbanization and project the dynamics of environmental quality. Guided by the regional environmental objectives, different pollution control methods will be compared and the costs of environmental pollution control evaluated to select the best option.

3 Research in the relation between energy and the environment and set the energy research as the basis of environmental planning research. In 1980 the US Environmental Quality Committee presented to the President *The World of 2000* report. The Report widely covered the major environmental problems that we face today and projected the world population, resources, energy and environment in 2000. The Report pointed out that the US should develop clean or low-pollution industries and conduct researches in clean energy. The Report has served as the ground stone of state-wide environmental planning research.

4 Actively conduct research in environmental planning methods. Environmental planning is built upon careful analysis of the current status. Therefore, qualitative and quantitative methods used for status analysis can also be adopted by environmental planning. Due to the complex relationship between economy, society and the environment, environmental planning frequently adopts and develops quantitative models. Some US universities and research institutes have successfully created atmosphere models, water environment models and landuse models, economic analysis models of the environmental impact. Such models are used to analyze and project the impacts of environmental policies and plans, thus improving the effectiveness of the planning. The US has also based on existing research results conducted the cost benefits analysis of environmental planning, making the benefits from environmental planning more easily understood by senior decision-makers and public.

5 Emphasize public participation. When the environmental planning committees making the environmental plans, government officials are required to participate and commentate; public hearings are mandatory to allow public consultation.

4.1.4 Applicability to China

1 Solve the legal authenticity of the environmental plans. The US environmental protection laws (such as the *Clean Air Act*) have specified clear environmental objectives, so that the objectives in the environmental plans are legally supported. The Chinese laws and acts regarding environmental protection tend to have abstractive wording and often do not provide specified environmental objectives, thus creating difficulties for justifying the authenticity of the environmental plans.

2 The environmental planning has to be tied with China's fiscal budgets. The US strategic plans and annual work plans are closed tied to the annual budgets. The implementation of the strategic plans is secured with funding. However, China's environmental plans are not closely tied to the work plans of the implementation agencies. Frequently the planned programs cannot be implemented due to lack of budgets.

3 Emphasize the preliminary studies prior to the planning. Currently China's pre-planning studies remain feeble and have not provided support to understand the air and water

environmental carrying capacities and the relations between economic development and environmental quality.

4.2 Japan's Environmental Planning

4.2.1 Planning System

1 Japan's market is a market organized under the Japanese government's intense regulation. To a certain extent, government intervention has played a leading role during the market formation. The Economic Planning Agency (vested in the Prime Minister's Office) is the Japanese ministry of economic planning responsible for formulating long-term economic plans, including the *Economic Forecasts and the Basic Attitude toward the Economy* of each fiscal year, and surveying and analyzing the domestic and international economic trends. It is also responsible for preparing the annual *Economic White Paper*, the *White Paper on National Living* and the *World Economic White Paper* and issues the government's economic policies. The Planning Bureau to which the Agency belongs develops long-term economic plans and coordinates with other government agencies on policies and projects important to the long-term economic plans. In the meantime, the Bureau oversees the analysis and forecast on the macroeconomic conditions and plans and coordinates the policy-making and program implementation of the power sector (http://www.epa.go.jp/org.html).

2 The Environmental Protection Plan is prepared by the Planning and Coordinating Bureau under the Department of the Environment (vested in the Prime Minister's Office). The bureau is responsible for the environmental planning, issuing the overarching environmental protection policies, and coordinating environmental management among government agencies. Japan also has a Basic Environmental Plan and an Annual Environmental Policy Plan. Japan's National Economic Plan also incorporates environmental and ecological objectives.

4.2.2 Basic Environmental Plan

1 The *Basic Environmental Plan* is a long-term plan drafted by the Japanese Department of Environment for comprehensive national environmental protection and passed by the cabinet meeting in December 1994. The Plan points out the future direction of Japan's environmental policies – to establish an environmental friendly circular mechanism for materials and to promote harmony between natural and human society. It also encourages collective efforts and participation in sharing the environmental responsibilities by all social sectors and promotes international actions. The Central Environment Committee annually evaluates the implementation of the Plan and its policies and will conduct a thorough evaluation and issue amendments as necessary every five years. Currently, a new Basic Environmental Plan has been issued.

4.2.3 Features of Japanese Environmental Planning

1 The Japanese environmental planning has a clear emphasis on the protection of human health, and especially on the substances such as Hg, Cd, PCBs, SO_2 and NO_x that have caused serious incidents of public hazards. This indicates a narrow focus of the Japanese environmental planning. The six priorities of Japan's fiscal year 1999 included: (1) to establish a new economic society to address the global environmental issues; (2) to prevent

chemical pollutions such as dioxane (miscellaneous) panicum miliaceum and endocrine disruptors; (3) to reduce urban air pollution; (4) to establish a new water recycling system and virtuous water cycles; (5) to facilitate interdependence between human and natural; and (6) to compensate for and prevent the health hazards caused by pollution.

2 **Protection of human health outweighs economic development.** Along with the general development of Japanese living standards and educational levels, Japanese people become increasingly aware of environmental pollutions. The occurrence of public hazardous incidents (such as the Minamata Disease and Itai-Itai Disease) have triggered the public environmental concern and led the health and safety oriented national environmental policy. Such policies require the national economic development yield to the public health and safety, thus lead to environmental policies disregarding economic costs. Many of the Japan's public hazard prevention programs do not take costs into consideration.

3 **Focused environmental planning.** Japanese environmental planning highly focuses on regulating substances such as Hg, Cd, PCBs, SO_2 and NO_x that have caused public incidents with serious health consequences.

4 **Emphasis on direct administration.** Japan's implementation of pollution control policies heavily rely on direct administration.

5 **Standards as basic planning objectives and planning tools.** Standards can be divided into two categories: One is environmental standards, the other is discharge standards. The former is essentially a form of objectives, which has no sanction on polluters but still plays a very important role. The latter one, as a means of environmental policies, mainly restricts the polluters.

6 **Regulating environmental planning by issuing planning manual.** Japanese Department of Environment issued a "Regional Environmental Management Planning Manual", which clarified that the basis of the regional environmental planning is balance the mid- and long-term resource supply and demand while developing the economy. The manual has categorized the environmental planning into comprehensive, supervised, pollution control and designated objective planning.

4.2.4 Applicability to China

1 Protection of the human health and the prevention of pollution should become the priorities of China's environmental planning. China is a populous developing country; protection of human health should be one of the basic objectives of the Chinese environmental regulations.

2 Planning should incorporate the concept of circular economy. Promoting the practice of circular economy is one of the basic objectives of Japan's environmental planning. It also complies to the concept of sustainable development. We should also take the concept of cycle economic into account during our environmental planning.

3 A unified country environmental planning manual is needed to guide China's environmental planning. Currently, with the absence of a unified manual, China's

environmental planning at regional levels varies greatly in qualities. A unified manual would help regional planning to conform to certain standards.

4.3 Korea Environmental Planning

4.3.1 Planning System

1 Korea differs from the Western developed countries in macroeconomic management. Market-based macroeconomic management prevails in the western countries, complemented by limited government intervention. Korea pays equal emphases to both market-based and government regulation when managing the economy, despite that the country itself adopts a market economic system. Korea's Institute of Finance and Economy is the functional department in Korea formulating economic planning. Korea first added the environmental protection terms in its *1993-97 National Economic Plan*. Since 1992, the Ministry of the Environment has strengthened environmental planning by issuing sector and annual plans.

2 Korea adopts a market economy under the government leadership, which is also called a planned market economic model. Its rapid economic development is achieved through unleashing the dynamics of market economy and regulating by the government. Plans have played an important role in the government process and made significant contributions to maintaining a functioning market.

3 Korea's economic plan prioritizes five-year economic and social development plans, which forms a planning system including sectoral development plans, annual economic plans, and special projects plans aimed to resolve important issues. The sectoral development plans, usually enacted in the form of laws, issue and publicize preferential policies to priority industries of the national economy. Projects and enterprises investing in the preferred industries will be able to enjoy the preferential policy from the government. Annual economic plans are analyses and projections toward the annual economic development and economic environment. They have significant impacts on enterprises' microeconomic activities. The special project plans are to resolve certain important issues and areas of development plans, such as the long-term programs at the Bureau of Labor. These different types of plans form a comprehensive planning system by cooperating and complementing with each other.

4 The macroeconomic plans are first drafted by the Economic Planning Bureau. The drafts usually include the estimates of the external environment during the planned period, the main objectives and major macroeconomic indicators, and the government policies. Since the 5th FYP, prior to the draft plans being sent to the cabinet for approval, the drafts are subject to broad commentary of various departments on the plan objectives and policy concepts. Upon approval by the cabinet, the plans will reach all government ministries. According to the requirement of the draft plans, each ministry prepares its own development plans. Since the required budget often exceeds the amount that can be funded, all departments must adjust and consult on each other before amending the comprehensive plans. Then the amended drafts will be sent to a higher level for approval. The drafting and approval cycle of a typical Korean economic plan usually takes 2 years.

5 Korea economic plans presents the following features: (1) the economic plan is

non-mandatory in nature; it is a forecast; (2) its planning system includes the leading "five-year economic and social development plan" and the subordinating sectoral development plans, annual economic plans and special projects plans; (3) flexibility; (4) governance is a major intervention in the economy; (5) the economic planning and the expenditure budgeting are closely integrated; the budgets supports the economic plans, and (6) the planning and its auditing and evaluation are incorporated.

4.3.2 Environmental Planning and Plans

1 In 199 the then newly established Ministry of the Environment made a medium- and long-term plan that combined environmental improvement and the environmental investment during the five-year economic development plan. Other environmental plans, such as the *Natural Environmental Protection Plan* (1994-2003), have aimed at maintaining the balance between natural protection and the development. In 1995, the "Green Vision 21" listed the objectives of Korea's environmental policies in next 10 years. It suggests that with limited national resources, contemporary and future generations' quality of life should be improved through the coordinated development between protection and development. In addition, the project also includes objectives managed by other sectors (mainly the Ministry of Construction and Transportation). Through establishing the Environmental Protection Committee [chaired by the Prime Minister, with 23 members that include five ministers, officials from the relevant departments (appointed by the Director), and representatives from environmental associations or individual], environmental considerations have been mainstreamed into the policies of other sectors (OECD, 1997).

2 In order to carry out the "Agenda 21", Korea developed a second medium-term environmental improvement plan (1997-2001) according to its "Environmental Improvement Charging Act" in 1997. This plan aims at enhancing the local government's management capacity on environmental management, fulfilling Korea's duties as an OECD member country and promoting international environmental technology exchanges. The plan lays emphasis on strengthening the fundamentals of environmental management, improving air quality in major cities, ensuring adequate supply of clean water, and the establishment of a circular society of resource uses. Corresponding investment plans have been set to ensure the implementation of the plan.

4.3.3 Applicability to China

1 Emphasis on sectoral coordination. The environmental protection is not only the business of environmental protection departments. It requires coordinated efforts from all departments and public participation. Viable environmental plans tend to incorporate consultations from various government departments and the public opinion.

2 Improving urban air quality, ensuring clean water supply, and establishing a resource friendly society are the focal areas of environmental protection. They affect directly the human health, environmental quality, and sustainable development and should be the focuses of environmental protection and environmental planning.

4.4 Dutch Environmental Policy Plan

1 Prior to the Summit at Rio, the Netherlands had started to plan for its environmental policies in 1991. The Plan is updated every four years. (The third Environmental Policy Plan has been effective from 1999 to 2002.) Countries such as Norway have established their plans modeled after the Netherlands.

Volume V

SUMMARY AND REFORM RECOMMENDATIONS

Table of Contents

1. Overview ... 1
2. Summary of the HRB Review and Analysis ... 2
   - 2.1 9th and 10th FYPs Pollution Control Plan ... 2
   - 2.2 Water Resources and Hydraulic Facilities ... 4
   - 2.3 Factors Impacting Pollutants Discharge ... 7
   - 2.4 Legislations ... 11
   - 2.5 Institutional Review ... 15
   - 2.6 Investment and Financing ... 17
   - 2.7 Management Review ... 18
   - 2.8 Public Participation ... 21
3. Summary of the TLB Review and Analysis ... 23
   - 3.1 9th and 10th FYPs Pollution Control Plan ... 23
   - 3.2 Water Resources and Hydraulic Facilities ... 25
   - 3.3 Factors Impacting Pollutants Discharge ... 27
   - 3.4 Legislations ... 30
   - 3.5 Institutional Review ... 33
   - 3.6 Investment and Financing ... 35
   - 3.7 Management Review ... 36
   - 3.8 Public Participation ... 39
4. Framework of Reform Recommendations and Priorities ... 41
   - 4.1 Reform Objectives ... 41
   - 4.2 Framework and Priorities of the Reform Recommendations ... 41
5. Prioritized Reform Recommendations ... 44
   - 5.1 Reform Recommendations of the First Priority ... 44
     - 5.1.1 Institutional Reform of SEPA ... 44
     - 5.1.2 Reform in Monitoring & Management of Water Pollution Control ... 44
     - 5.1.3 Management Reform of Discharge Permits and TMLLs ... 45
       - 5.1.3.1 Overview ... 45
       - 5.1.3.2 Management Institutes for Permitting System Implementation ... 45
       - 5.1.3.3 Implementation Procedures of Permits ... 47
       - 5.1.3.4 Monitoring System of Permits ... 47
       - 5.1.3.5 Monitoring and Enforcement ... 48
       - 5.1.3.6 Financing Mechanism ... 49
       - 5.1.3.7 Discharge Permitting System and the Permits Trade ... 50

5.1.4 Investment and Financing Reforms 50
5.2 Reform Recommendations of the Second Priorities 51
5.2.1 Revise the *Environmental Protection Act*, the *Water Act,* and the *Water Pollution Prevention Act* 51
5.2.2 Comprehensive Watershed-Based Planning System 51
5.2.3 Reform Recommendations on Watershed Management Organization and Institution 52
5.2.4 Reform Recommendations on Non-Point Source Pollution Control 52
5.2.5 Modification or supplements to the *General Principles of Civil Law*, the *Criminal Law* and the *Civil Procedural Law* 53
5.2.6 Reform in Public Participation Mechanism 54

1. Overview

The purpose of the analysis and evaluation of the HRB and the TLB water pollution control environmental policies and investment is to identify the issues and provide reform recommendations. Column V will follow the following framework:

(1) Summarize the review and analysis of the HRB and the TLB water pollution control environmental policies and investment, identify the issues;

(2) Provide the framework for policy reform recommendations and set priorities;

(3) Provide recommendations to the prioritized reform.

In addition, Appendix 3 provides a list of other related reform recommendations.

2. Summary of the HRB Review and Analysis

2.1 9th and 10th FYPs Pollution Control Plan

Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Classification	Key Inputs	Key outputs	Key performance
Main Contents	(1) 9th Five-Year HRB Water Pollution Prevention and Control Plan (2) 10th Five-Year HRB Water Pollution Prevention and Control Plan (3) Interim Provisions of the HRB Water Pollution Prevention and Control (August 8, 1995, State Council Order # 183) (4) State Council Office Circular on Enhancing HRB Water Pollution Prevention and Control (State Council Office [2004] No. 93) (5) National laws and policies concerning the environment	(1) The 9th FYP saw 110 monitoring sections established (19 in Henan, 18 in Anhui, 28 in Shandong, and 45 in Jiangsu), while the 10th FYP saw the establishment of another 86 (20 in Henan, 33 in Anhui, 18 in Shandong, and 15 in Jiangsu). (2) By the end of the 9th FYP, the total COD discharge exceeded the TMLL by 187.8%, COD into the rivers exceeded TMLL by 120.7%. By the end of the 10th FYP, total COD discharge exceeded TMLL by 47.14%, NH_3-N by 11.88%. (3) By the end of the 9th FYP, 16.4% of planned municipal WWTPs have been constructed; municipal WWT rate is 56% of the national average; 82% of the planned programs in drinking water guarantee, industrial restructuring, and clean production have been completed. By the end of the 10th FYP, 54.37% of the planned pollution control investment and 72.25% of the planned projects have been completed. (4) The 1997 "universal compliance" and the CZZT activities have mandated industrial discharge compliance; however, non-compliance resurged shortly afterwards. The 2005 statistics reveal that 66% of the enterprises fail to comply with both COD and NH_3-N discharge allowance.	(1) Compared to the beginning of the 9th FYP, proportion of Class II-III water sections in the Huai River water system at the end of the 10th FYP has increased from 7.7% to 19.8%; proportion of worse than Class V water sections reduced from nearly 75% to 32.6%. The overall water quality has been improved. (2) Transprovincial water quality is worse than sections within a province. In 2000, 66.7% of the boarder sections water quality belonged to worse than Class V; in 2003, this number shrank to 56.8 %; by 2004, Class II-III reached 9.4%, Class IV-V reached 56.2%, and worse than Class V reached 34.4%; by 2005, Class II-III water quality reached 12.5%, Class IV-V reached 56.2%, and worse than Class V reached 31.3%. (3) By the end of the 9th FYP, 35.5% monitoring sections met the TMLL target, and the rest 64.5% failed. Among the failed ones, 58.18% belonged to worse than Class V water quality. (4) By the end of the 10th FYP, 40.7% monitoring sections reached the TMLL target, and the rest 59.3% failed, where 32.6% belonged to worse than Class V water quality. (5) By the end of either the 9th or 10th FYP, the objective of clearing out the Huai River laid out in the *Interim Provisions of HRB water Pollution Prevention and Control* has not been achieved. (6) Ultimately, water pollution prevention aims at providing a safe and healthy environment for human livelihood that supports sustainable development. This study does not encompass the evaluation of this ultimate goal.
Major Issues	(1) The efforts in the past decade have deterred the deterioration of water quality in the Huai River since the beginning of the 9th FYP; the overall water quality in the Huai River water body has generally improved. (2) A significant gap from the TMLL targets at both the 9th and 10th FYPs persists. (3) Big gaps persist between the planned and actual investment volume and project implementation in pollution prevention and control in both the 9th and 10th FYPs.		

Classification	Key Inputs	Key outputs	Key performance
	(4) Both FYPs have fallen far short of their water body water quality objectives. As the water quality objectives are the fundamental objectives of the FYPs, this study concludes that the two FYPs did not meet their objectives. (5) Although failed to meet the economic development targets of the 9th FYP, the provinces in the HRB still did not meet the TMLL targets. During the 10th FYP, nevertheless, the provinces have outperformed the economic development objectives by 15-38%, the unexpected fast economic growth could be an important factor to cause for the 10th FYP to fall short of its planned TMLL. (6) The objectives of the 9th FYP have been set beyond achievable given the socio-economic conditions then. Topped with the lacking of synchronizing with the socio-economic development planning and the lack of monitoring of the plan implementation, the implementation has fallen far behind the plans. (7) The relatively inferior quality of transprovincial waters reveals management and coordination problems of transboundary watersheds. (8) The plans have been executed by multiple agencies ranging from the environmental protection, water resources, agricultural, to urban construction. No defined feedback channel to reflect the implementation specifics of the 9th and 10th FYPs; no supervision or monitoring to validate the comprehensiveness, correctiveness, and validity of the information. (9) The key results from the decade-long pollution control can be summarized as: Under the pressure of fast economic growth, the COD discharge at the end of the 10th FYP has reduced to approximately half of the 9th FYP level; the COD discharge per unit GDP experienced a 66% reduction from 11.38 to 3.90 kg per 10^4 yuan from 2000 to 2005. COD discharge per unit GDP has reduced from 78% of the national average by 50%, indicating a more effective pollutant discharge control in the HRB than the national average and fast improvement in control effectives under the pressure of rapid economic development. However, the per acreage GDP in the HRB in 2005 (3.3 times of the national average in 2000, and 4.7 times in 2005; approximately 96% of the US level in 2003) has been high, and compared to the developed countries, the pollutant discharge at similar economic development level in the HRB is much higher – the COD discharge per unit GDP in 2005 is nearly 49 times of the US 2003 level.		

Box 2.1-1 Pollutants TMLL in the HRB 9th and 10th Pollution Control FYPs

The HRB 9th FYP pollutants TMLL targets had been set based on the objective of the clearing out of the Huai River water. Specifically, the planning process was as follows: first setting the COD TMLL of various mainstream and tributary sections at 15 mg/L, 20 mg/L, 25 mg/L, and 40 mg/L respectively during the dry seasons; then calculating the "environmental capacity" of various water sections based on the design flow (90% of the average flow of the dry month); and finally concluding the COD TMLL at 36.80×10^4 ton/year of the entire watershed. Among the 36.80×10^4 ton/year, Henan took 12.74×10^4 ton/year, Anhui took 7.70×10^4 ton/year, Shandong took 6.47×10^4 ton/year, and Jiangsu took 9.89×10^4 ton/year.

The pollutants TMLL of the HRB 10th FYP, however, was no longer set based on the objective of clearing out of the Huai River water but the "further improvement of the mainstream water quality." The 10th FYP further required the target water quality classification of each water quality control section provided that the ecological flow volume had been met. Based on the target water quality classifications, the watershed-wide COD TMLL was calculated at 64.3×10^4 ton/year, where the COD allowance entering into the river was limited to 46.6×10^4 ton/year; NH_3-N TMLL at 11.3×10^4 ton/year, where the NH_3-N allowance entering into the river was limited to 9.1×10^4 ton/year. The 10th FYP did not specify quantitatively the volume of ecological flow.

Unlike the 10th FYP pollutants TMLL, the TMLL of the 9th FYP was set to ensure the water ecological environmental quality. The 10th FYP pollutants TMLL, on the contrary, incorporated more of the viability of the objectives and had loosened the requirements. Therefore, even the 10th FYP TMLLs had been achieved, the Huai River water would not become "clear."

2.2 Water Resources and Hydraulic Facilities

Table 2.2-1 Summary of Water Resources and Hydraulic Facilities

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) 4 HRB Plans prior to 1991 (MWR, State Council) (2) Outline of the HRB Comprehensive Plan (revised in 1991, MWR, State Council) (3) 9th and 10th HRB Hydraulic Development FYPs (4) Opinions on Improving the HRB 2001-2010 Flood Prevention (MWR December 13th, 2001) (5) 9th and 10th National Hydraulic Development FYPs (6) Water Act (July 1, 1988) (7) Flood Prevention Act (August 29, 1997) (8) HRB Flood Prevention Plan	(1) 18 large-scale reservoirs constructed for flood prevention, irrigation, water supply, and freshwater aquaculture; 1168 km of artificial new river for flood prevention and diversion; over 5×10^4 km of dikes and levees for flood prevention; over 5000 water gates – over 600 are large- and medium-scale water gates for prevention and diversion, irrigation, and water supply; 9 of the 19 Key Huai River Pollution Control Projects for flood prevention and diversion, irrigation, and river way shipping. (2) The hydraulic facilities provides water supply to the water users in the watershed. The water supply and usage during the 9th and 10th FYPs have remained stable, where agricultural irrigation water usage exceeds 70%. Due to the rapid urbanization in the HRB, urban domestic and industrial water demands have increased. When the surface water quality faces difficulties to meet the water functional demands, the use of groundwater has increased. (3) Experimented with the coordinated water quality and quantity operation in 2005 to integrate water use, flood prevention, and water environment quality issues of the watershed.	(1) The hydraulic facilities constructed have played an important role in flood prevention, irrigation, water supply, and flood diversion. (2) Although the HRB has constructed many water storage hydraulic facilities, the pollutants concentrations in the water bodies still increases with the reduction of runoff during the dry seasons. (3) The water storages in the hydraulic facilities for water supply have led to accumulation of pollutants in the water bodies in front of the dams and gates and reduced the water quality of the upper stream water bodies. Meanwhile, the downstream runoff has been reduced or diminished, which leads to the decrease in the downstream water body environmental capacity. (4) The flood division during the flood season tends to trigger severe water pollution incidents when releasing the pollutants accumulated during the dry season to the downstream. (5) Plenty artificial waterways and channels disrupt the natural aquatic ecosystems and reduce their self-purification capacities. The river zero-runoff, water body pollution, loss of wetlands, and groundwater depletion in the HRB are closely tied to the missing of environmental and ecological consideration during artificial water channeling. (6) The coordinated water quality and quantity operation to a certain degree relieved the negative impacts on the watershed water quality from the hydraulic engineering.
Major issues	(1) Both the watershed comprehensive planning and the 9th and 10th Hydraulic Development FYPs have aimed at flood prevention and diversion, irrigation, and water supply, and few or little consideration has been given to the water resources protection and comprehensive utilization, let alone the water resources quality and pollution control. (2) Lack of coordination between the hydraulic planning and water pollution planning of the watershed. (3) Traditionally, the HRB hydraulic investment has been aiming at flood prevention and water supply for livelihood and development of the HRB due to the low per capita and unit farmland water resources and the high variation in water quantity between dry and flood seasons. However, currently the water resources shortage and water pollution have influenced the performance of the hydraulic facilities, which in turn impacts the livelihood and development of the watershed. (4) The construction and operation of the hydraulic facilities aiming at flood prevention and water supply have brought about negative impacts to the water quality.		

Box 2.2-1: Hydraulic Engineering and the Ecological Environment

1, Ecological implications of large-scale artificial channeling of the canals

(1) The channeling of the natural river courses monotonizes the habitats. The linear artificial cannels replaced the original winding natural river courses, and the cross sections of artificial cannels stayed trapezoidal throughout. The original staggered deep pits and sandbanks and the alternating rapids and slow flows could support diversified living communities. The channeled river became a monotonous habitat and caused visible deduction in living community diversity. The artificial canals have turned the rivers into stable reservoir with stagnated water levels. As the reservoirs go deeper, the water stratifies into temperature layers. Photosynthesis weakens at the deeper layers. And so reduces the productivity.

(2) The water flow connection in transverse of the watercourse is obstructed. After the construction of the artificial canals, dikes limit the water within the constructed banks, and the flood will not be able to reach flood plain. The disconnected water flow connection in transverse between the river and the flood plain also cut off the connection between the trunk stream and the river arm, river floodplain, and the wetland and impede the nutrients filtration (adsorption) and absorption processes of the wetlands in the flood plain. Consequently, fish and invertebrates have lost their habitats for spawning, food and shelter seeking; and organic matter carried through in the mainstream, which are important nutrients for the freshwater living communities, will not be able to precipitate in the flood plain. The hydraulic retention time in the newly constructed canals tend to be short, which reduces the energy and material exchange in the freshwater food chain and causes massive death of the fish in the water due to dramatically reduced dissolved oxygen.

(3) The changes in the pattern of the dissolved oxygen cause ecosystem degradation. The deep, narrow canals are featured with low ratio of surface area to volume and therefore low aeration rate. As the depth grows, the water stratification increases. The dissolved oxygen reduces visibly with a depth over 1 m. The original dense vegetation shields the river from direct sun exposure and buffers the stratification of the dissolved oxygen and temperature. However, the artificial canals are directly exposed to sunshine; the dissolved oxygen stays low. Moreover, water tends to flow smoothly in the linear form of artificial canals with low disturbance and turbulent exchange of the water currents. Those factors all tend to decrease the dissolved oxygen in the canals, which in turn leads to suffocation of the aquatic life in the water bodies.

(4) The artificial adjustment by the water dams evens out the pulses in the water volume flow natural to the hydraulic cycles. The natural hydraulic cycles fluctuate with the annual water cycles and lead to the cycling of the riverbank wetlands. During the flood seasons, the aquatic plant communities flourish. When the water level drops, the aquatic plants give way to the wetland plant communities. Such alternation in the plant communities represents the diverse characteristics of the lake. The evened water volume flow monolizes the ecosystems.

(5) Nature watercourse degenerates. Channeling has significantly altered the features in the water level and water currents. The disappearance of the flood plain wetlands has severely affected the fish and native living communities. Although some of the natural riverbeds have been preserved, the riverbeds still degrade due to deviated water flow from the original mainstream and the reduction in the water flow in the original riverbed.

The overall consequence is the significant reduction in the aquatic ecological environmental quality. Hydraulic engineering is needed for flood prevention and water supply. However, if the hydraulic engineering does not take into consideration its impacts on natural ecology and environment, the sustainability of such hydraulic engineering will be quite low.

2, Dam Removal in the United States

During the past century, the United States has constructed about 75,000 dams and weir railing over 2-3 meters high nationwide with major objectives of power generation, irrigation, river way shipping, flood prevention and water supply. Traditionally the ecological implications of dams have been considered as negligible, and dam removal has been considered an extreme measure of restoring river ecology. However, recently the traditional idea has been challenged, and dam removal has been accepted as a cost effective river management approach and legislated in the United States' regulations in reservoir and dam management.

Up to now, the United States has removed 465 reservoirs considered unnecessary to continue to exist. The major reasons for dam removal in the United States include: (1) The dam is at the end of its life span. (2) The growing reparation cost and safety risks elevate the cost of maintenance to the extent that it exceeds the cost of removal. Even if the costs of maintenance and removal basically equals, the removal can free the dam management authorities from the safety, functional, and environmental obligations laid out in the United States' regulation in reservoir and dam management, and future maintenance and monitoring costs. (3) New legislations have developed approaches without constructing reservoirs and dams to meet the demands. For instance, due to the vastness of the United States and its relatively low population density, flood prevention can be achieved through restoring wetland, maintain the river bank buffering zones, or migration of the households and enterprises out of the flood plain. Those ecologically friendly approaches can not only restore the environment but also prevent floods cost effectively. Nowadays, passing a proposal for dam construction is more and more difficult and rare in the United States.

2.3 Factors Impacting Pollutants Discharge

Table 2.3-1 Summary of Factors Affecting Pollutants Discharge

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) 9th and 10th National Economic and Social Development FYPs (2) 9th and 10th HRB Water Pollution Prevention and Control FYP (3) HRB Provincial Urban Development Plans (4) 9th and 10th Agricultural Development FYPs (5) National laws and policies concerning the environment	*Water pollution sources* (1) Total wastewater discharge has remained stable from the beginning of the 9th FYP to the end of the 10th FYP. Total COD discharge has been reduced by 53% during the 9th FYP, while the reduction in the 10th FYP reached only 11%. (2) Within the COD discharge, contribution from domestic wastewater increased from 16% to 77% during the 2 FYPs. Accordingly, the proportion of industrial wastewater contribution has dropped from 84% to 23%. (3) Fast urbanization. During the 9th and 10th FYPs, the average provincial population growth in the HRB reached 6.9%; however, the urban population average growth rate reached 72.6%, over 10 times that of the average watershed population growth. *Domestic wastewater and its control* (1) During the 9th and 10th FYPs, for the four provinces in the HRB, installed treatment capacity at municipal WWTPs increased 4.7 times, while the collection pipes grew by only a factor of 1.6. This has led to low wastewater collection rate and the under-utilization of the WWTPs. (2) For the 4 provinces in the HRB: municipal WWT has increased by 1.7 times, and the urban domestic WWT rate increased from 26% to 63% during the 2 FYPs. Nevertheless, the centralized WWT rate grew only from 20% to 43% throughout the 10th FYP. Data on municipal WWT discharge compliance rate is not available. (3) The WWT fee collection rate has been universally low throughout the cities surveyed. Changge City, in particular, has only managed to collect 36% of the WWT dues. The collected WWT fee has been far from sufficient to recover the operational cost; the operation is largely dependent on government subsidy. The WWT tariff does not float with the wastewater discharge; neither can it cover the WWT operational cost. *Industrial wastewater and control* (1) During the 9th FYP, annual industrial wastewater COD discharge has reduced by 77%; during the 10th FYP, the reduction reached 44%. Statistics show that by 2005, 77% of the HRB enterprises have met the COD or NH_3-N discharge standards; 66% of the enterprises have met both standards. (2) In general, except for the small surge in Jiangsu in 2001, the wastewater discharge per 10,000-yuan industrial value added of other provinces/in other years have declined. From a sectoral perspective, except for electricity, gas, and water supply industries, the wastewater discharge intensity per unit industrial value added has been reducing. Among the industries, the light and the chemical industries have relatively high discharge intensities. (3) Except the light industry in Henan during the 10th FYP, which has seen an average intensity of 400 ton/10^4 yuan, other industries/provinces have managed to stabilize the wastewater discharge per unit industrial value added below 300 ton/10^4 yuan. (4) Light industry, fine chemicals, food processing, and electricity, gas and water supplies are the major contributors of water pollutants to the HRB and the major non-compliant polluters. (5) Economic growth during the 10th FYP has far exceeded the expected growth in the FYP and has been a major cause for the reduction of COD discharge in the industrial wastewater during the 10th FYP. *Agricultural non-point source pollution and pollution control*	(1) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs (2) Economically, besides the enormous costs incurred by the severe pollution in the HRB water bodies and the loss from human health and productivity, the cost of ecological restoration of the degraded rivers and lakes will create another huge bill to pay

Category	Key Inputs	Key outputs	Key impacts
		(1) Estimates indicate that during the 9th and 10th FYPs, the major agricultural non-point source pollution in the HRB comes from animal husbundry (approximately 80%) and rural domestic (over 15%). The contributions from farmland nutrient loss and freshwater aquaculture in general are limited. However, farmland nutrient loss alone contributes about 10% of the N in the water body. (2) The per acreage husbundry intensity in the HRB is approximately 4 times of the national average. The livestock excrata totaled 4.1×10^8 ton in 2005, approximately 24% of the national total. Its effective utilization rate is under 60%, and 56% of the husbandry waste have not been utilized. (3) Estimates indicate a high non-point source contribution in the HRB. In 1995 the HRB non-point source COD entering into the enviornment reached over 5 times of the wastewater point-source discharge. During the 9th and 10th FYPs, contrary to the significant reduction of point-source [please refer to data in Column (1)], the amount of non-point source pollutants entering the enviornment has been increasing: compared to 1995, the COD has increased by 11%, TN by 6%, and TN by 19% in 2004. Currently, no data is available to illustrate quantitatively the non-point source pollutants in the water bodies. Nevertheless, sufficient evidence is already available to conclude the significance of the non-point source pollution in the HRB during the 10th FYP. (4) The 9th HRB Water Pollution Prevention and Control FYP does not include non-point source pollution prevention and control objectives or assign tasks about non-point source pollution prevention and control. The action plan of the 10th FYP has included 6 local rural non-point source pollution control projects with only project titles and total required investment but no project contents or the results indicators. Currently, no reliable data can be found on the implementation results of the 6 rural non-point source pollution control projects.	(Box 2.2-1)
Major issues	(1) Although the COD discharge reductions have fallen far behind the 9th and 10th FYPs objectives, the total discharge has been cut down to less than half compared to the beginning of the 9th FYP. (2) Nevertheless, as the *Description of the 9th FYP* has indicated that over 60% of the discharge at the beginning of the 9th FYP belonged to non-compliant discharge, and by 2000 the non-compliant wastewater discharge has been basically eliminated, it is fair to say that the reduction during the 9th FYP has been basically the reduction of non-compliant discharge only. (3) A major cause for the shortfall from the 9th FYP objectives and the low COD reduction during the 10th FYP is the lack of control in pollutants discharge beyond the major industrial wastewater discharge compliance control tools such as the pollutants TMLL and urban WWT. (4) HRB pollution control planning and urban development planning is lacking of coordination. (5) The current connection pipes of the WWTPs are far from adequate to collect the discharged wastewater. (6) The collection rate of municipal WWT fee remains low and insufficient for WWTP operational cost recovery. The compliance rate of WWTPs outlet water is questionable. (7) Although the industrial restructuring has made significant achievements, large quantity of non-compliant industrial wastewater discharge persisted during the 10th FYP. (8) Large amounts of pollutants from agricultural non-point sources have entered into the environment, and the amounts are still increasing during the 2 FYPs. Agricultural non-point sources remain untamed. (9) Agricultural non-point sources have become significant contributors to the HRB water pollution. (10) No substantive coordination exists between the agricultural non-point source pollution plan/planning and the agricultural development plans.		

Table 2.3-2 Summary of the Representative Years in the 9th and 10th FYPs of HRB Pollutants Discharge

Item	1993						2000						2005					
	Total discharge			Discharge into rivers			Total discharge			Discharge into rivers			Total discharge			Discharge into rivers		
	Total (10^4 ton)	% from industrial sources	% from domestic sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	Total (10^4 ton)	% from industrial sources	% from domestic sources
Total wastewater	na	Na	na	361408	75	25	na	na	na	na	na	na	350996	34	66	na	na	na
Total COD	201.12[1]	84[1]	16[1]	150.14	85	15	105.9	37	63	81.2	na	na	94.57	23	77	na	na	na

Notes:
1. The results were deduced from the data in the HRB pollution control and prevention 9th and 10th FYP.
2. "na" = not available.

Table 2.3-3 Provincial Wastewater/Pollutants Discharge and the 3 Largest Pollutants Discharge Industries per Unit Industrial Value Added during 9th and 10th FYPs

Province	During 9th FYP			During 10th FYP					
	Wastewater discharge	Wastewater discharge per unit (10^4 yuan) industrial value added		Wastewater discharge	Wastewater discharge per unit (10^4 yuan) industrial value added		COD discharge[2]	COD discharge at unit (10^4 yuan) industrial value added	
	Industries	Industries	Value (ton/10^4 yuan)	Industries	Industries	Value (ton/10^4 yuan)	Industries	Industries	Value (ton/10^4 yuan)
Henan	Na	Na	na	na	Light industry	720-200	na	na	na
	Na	Na	na	na	Fine chemicals	160-70	na	na	na
	Na	Na	na	na	Textile & clothing	80-30	na	na	na
Shandong	Na	Na	na	light industry	Light industry	240-60	Light industry	Light industry	240-80
	Na	Na	na	Fine chemical industry	Power, gas and water supply	70-20	Food industry	Fine chemicals	150-50
	Na	Na	na	Power, gas and water supply	Fine chemicals	60-20	Fine chemicals	Food industry	150-50
Anhui	Steel refining	Steel refining	450-300	Steel refining	Fine chemicals	350-110	na	na	na
	Fine chemicals	Fine chemicals	450-300	Fine chemicals	Steel refining	320-40	na	na	na
	Mining	Light industry	400-200	Power, gas and water supply	Light industry	320-110	na	na	na
Jiangsu	Fine chemicals	Steel refining	410-200	Fine chemicals	Fine chemicals	230-70	na	na	na
	Power, gas and water supply	Fine chemicals	340-210	Textile & clothing	Power, gas and water supply	180-70	na	na	na
	Steel refining	Power, gas and water supply	230-140	Power, gas and water	Steel refining	200-40	na	na	na

Notes:
1. "na" = not available.
2. For Shandong province in the 10th FYP, the 3 largest NH_3-N discharge industries have been the fine chemical industry, light industry and food industry; the 3 largest NH_3-N discharge at unit (10^4 yuan) industrial value added were the fine chemical (48-15), light (20-11) and petroleum chemical industries (18-8).

Box 2.3-1: The Cost of River Restoration

Kissimmee River Restoration Project in the United States

The Kissimmee River is located in the central Florida State of the United States. It flows from the *Kissimmee* Lake and into the second largest freshwater lake in the United States, the *Okeeehobee* Lake. Although the distance between the 2 lakes is only 83 km, the **total length of the river** reached **166 km,** and the **watershed area** reached **7800 km^2**. The watershed encompasses 26 lakes, a river flood plain of 90 km in length and 1.5-3.0 km in width, and 20 tributary swamps.

The Kissimmee River Ecological Restoration Project is the largest river restoration project in the US history. Beginning from the 1970s, the project has launched a long-term study and observation of the ecosystem degradation incurred by the channeling construction at the Kissimmee River. **The pilot restoration engineering began in 1984, and the official construction commenced in 1998. The entire project is expected to be completed in 2010.**

The main contents of this project include: the piloting engineering; backfilling the artificial river course; reconstruction of new river course similar to the historical conditions (the newly constructed river course will have the identical form as the original river course); restoration of the wild animal habitats by restoring part of the flood plain and swamp river course corridor; and ecological restoration monitoring and evaluation. **The total cost of the entire project is 78×10^8 US dollars.**

Wenzhou Heng River Water Body Pollution Control Demonstrative Project in China

The Heng River is located in the urban area of Wenzhou and belongs to the Wen-Rui-Tang river system. With **a total length of 950 m, average width of approximately 25 m,** and **average depth of about 3 m,** the water body covers about 24000 m^2 in area and holds a volume of approximately 72000 m^3. The Wen-Rui-Tang river network plays an important role in Wenzhou's flood prevention, flood diversion, water supply, river way shipping, irrigation, and socio-economic development. For a long time, the Wen-Rui-Tang river system has become one of Wenzhou's largest pollutants "collection and distribution centers." In the urban district alone some 2200 wastewater outlets are connected to the Tang River, among which 6 lead to the Heng River. Before the pollution control project, the water quality in the water body was worse than Class V.

The Heng River Water Body Pollution Control Demonstrative Project has adopted the low-cost biological restoration–ecological reconstruction method **without any hydraulic and water works.** The project employs the natural restoration processes by microbes, aquatic plants and animals and adopted restoration technologies included the floating island, biofilm, and oxygenation by aeration. The project began in 2003 and ended in 2004. **The total cost of the project was 127×10^4 yuan.**

The above two projects exemplify the upper and lower extremes of the construction costs for water body restoration. River water system restoration will have to bear huge costs. For the large watershed as the HRB – of a total area of 27×10^4 km^2, with a mainstream length of 1000 km and total length of river courses 9372 km – even adopting the most cost effective method, the total restoration cost will be overwhelming.

2.4 Legislations

Table 2.4-1 Summary of Legislations

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) Related laws: *Constitute, General Principles of Civil Law, Criminal Law, Civil Procedure Law, Arbitration Law, Environmental Protection Act, Water Act, Water Pollution Prevention Act, Soil and Water Conservation Act* *(2)* Related administrative regulations by the State Council: *River Management Regulation, Flood Prevention Regulation, Implementation Provisions of Water Use Permit System, Interim Regulations on HRB Water Pollution Prevention and Control, Provisional Regulations of Water Pollution Prevention Act, Circular on the Trial of Municipal WWT Fee in HRB* *(3)* Administrative regulations by designated authorities by the State Council on water environment management: *Interim Management Provisions of Water Pollutant Discharge Permits, Drinking Water Source Water Protection District Pollution Prevention and Control Regulations, Provisions on Fishery Water Body Pollution Incidents Investigation and Handling Procedure, Aquatic Flora and Fauna Natural Protection Zone Management*	The laws and regulations are the cornerstones for the HRB water pollution control. They have played a fundamental role for the environmental protection in the past decade. Nevertheless, the following outputs still need to be scrutinized for future policy reforms. <u>*Transboundary water environment management*</u> Many years of practice have revealed overlaps and gaps between the current laws and policies in transboundary water environment management. The overlaps and gaps have created conflicts and become an acute issue in the transboundary water environment management and dispute resolution: (1) Lack of true coordination in the water use and pollutant discharge and pollution control plans and policy. The different jurisdictions in the upper- and downstreams often take advantage from the conflicts and ambiguity of the national laws and policies selectively to implement policies that favor localized interests (Box 2.4-1). (2) The current law and policy framework requires coordination among various agencies to resolve transboundary water environment management. Nevertheless, it does not specify the procedures for coordination and dispute resolution. Together with the difficulty in multi-agency coordination, many transboundary water and water pollution disputes often become more acute rather than being resolved. (3) The detailed watershed information on water and pollutants discharge has not been publicized. Significant information asymmetry exists among the stakeholders. (4) Significant inconsistency exist in the monitoring and statistical data from various related agencies – environmental protection, hydraulic, urban construction – on pollution sources, pollutants discharge and water quality. The inconsistency has further complicated government planning and decision-making. (5) Without many specifications in the laws and policies, the practice and monitoring of damage evaluation seldom receive mutual consensus from the stakeholders. (6) Coordination remains weak among the environmental protection, hydraulic, agricultural and urban construction authorities in economic development, water resources, environmental pollution control and various other aspects of watershed planning. (7) Public and private stakeholders do not have much incentive for public participation in the government administration and policy-making.	(1) The laws, regulations, and policies are the cornerstones for socioeconomic progresses. Limited by its scope, this study discusses only the water environment pollution aspect of the laws, regulations, and policies. (2) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9^{th} and 10^{th} FYPs

Category	Key Inputs	Key outputs	Key impacts
	Provisions, Circular of Enhancing Environmental Monitoring and Prevention of Pollution Incidents (4) Provincial water environment management regulations and policies. (5) Relevant environmental quality standards: *Surface Water Environmental Quality Standard, Groundwater Environmental Quality Standard, Soil Environmental Quality Standard, Seawater Quality Standard* (6) Relevant pollutant discharge standards: National comprehensive discharge standards, such as the *Comprehensive Wastewater Discharge Standards*; national specialized standards, such as the *Urban WWTPs Pollutant Discharge Standards, Paper Industry Water Pollutant Discharge Standards, P-fertilizer Industry Water Pollutant Discharge Standards, and Animal Husbandry Pollutant Discharge Standards*; and local pollutant discharge control standards. (7) Judicial system of the PRC.	(8) The public organizations and individuals are not entitled to protect the public interests on public affairs through law suits. *(9)* The public organizations and individuals are not entitled to persecute offenses to the *Environmental Protection Act.* <u>*Environmental pollution disputes*</u> (1) The massive amount of environmental disputes incurred by water pollution incidents is not categorized in the current judicial system; therefore, no statistics is available. (2) The current environmental judicial system poses a high threshold for the pollution victims, who tends to be the disadvantaged groups in the society. Especially, the requirement of "the advocator proves" and the difficulties in identifying the liabilities, valuation and execution of the indemnity, and reversing the occurred damages have deterred the victims. Consequently, most of the environmental disputes did not enter the judicial process. (3) The current laws do not grant the potency of enforcement to the environmental protection authorities in their handling of the environmental disputes. Either party could initiate the litigation process at the People's Court, should the party disagree with the resolution proposed by the environmental protection authority. Therefore, the decisions made by the environmental protection authorities regarding environmental disputes basically equals to "mediation" or administrative mediation in their effectiveness. (4) About 70% of the environmental disputes in China are resolved through people's mediation, administrative mediation, or administrative handling. However, the degree of satisfaction of the victims is usually low. (5) Given the current legal system and the Chinese history and culture background, environmental disputes are often resolved within the administrative liability regime though administrative punishment. The civil and criminal liabilities are often neglected. (6) The current legal practice of environmental dispute resolution emphasizes stopping the environmental pollution, peacing the conflicts between the tortfeasors and the victims, and impose administrative punishments to the polluters. Nevertheless, compensation and indemnity to the victims and environmental restoration are often neglected.	
Major issues	(1) Lack of integration between the *Water Act* and the *Water Pollution Prevention Act.* Water resources management involves the management of both quantity and quality; however, in practice in China, the water quantity and quality have been disintegrated in a number of ways: (a) disintegrated terminology in the *Water Pollution Prevention Act* and *Water Act*; (b) disintegrated planning, implementation, and monitoring of water resources management plans and water pollution prevention and control plans; (c) lack of coordination mechanism between the SEPA/EPBs and the MWR/WRBs; (d) although the 2 legal acts have assigned the MWR/WRBs the responsibility of boarder water quality monitoring, they did not provide specific regulations on pollution management in the transboundary watershed management. At the time of pollution incidents, no provisions will be available to		

Category	Key Inputs	Key outputs	Key impacts
	clarify the concrete tasks and responsibilities regarding the water body water quality monitoring, management, and law enforcement assigned between the MWR/WRBs or SEPA/EPBs. That is to say, when boarder water quality non-compliance incidents occur, hardly any measures can be taken legally or administratively; (e) The *Water Act* has required the MWR delineate water functional zones together with SEPA, but this provision has proved impractical. Moreover, the *Water Pollution Prevention Act* has required SEPA to delineate water functional zones, and the *Detailed Regulations of Water Pollution Prevention Act* has provided more detailed provisions, which significantly differ from those in the *Water Pollution Prevention Act*; and (f) The *Water Act* mostly addresses water use and water regulation. Contents about the aquatic ecology is missing such as that the MWR should maintain a certain level of ecological flow volume to ensure water quality compliance.		
	(2) The *Water Pollution Prevention Act* has proved unsuited to a number of the issues occurred during the recent decade, which include: the articles are too general to practice; lack of specific provisions on dispute resolution through administrative mediation or litigation; lack of legal provisions on transboundary after pollution dispute resolution; lack of coordination with water resources planning; lack of detailed provisions on discharge TMLLs; lack of articles addressing pollutants discharge permits; lack of provisions on urban and rural non-point source pollution; lack of detailed provisions on monitoring and data validation of pollution sources and water environment; lack of provisions on participation by the water pollution stakeholders; lack of detailed provisions on the enactment, enforcement, and monitoring of the law itself; and lack of provisions on offence to the act by the government agencies.		
	(3) The non-point source pollution, widely linked to urban domestic living and agricultural production, has become an important pollution source to the watershed water bodies. However, no detailed legal provisions or policies are available to address the non-point source pollution control issues.		
	(4) An overwhelming majority of the current national water environment legislations is substantive laws; few are procedural laws, and the enforcement monitoring remains largely absent. As a result, without the assistance from the procedural and enforcement monitoring provisions, the objectives of the substantive laws are difficult to achieve.		
	(5) The current legal system, particularly the *Environmental Protection Act*, does not include monitoring and punishment regulations regarding offenses by government offices or officials.		
	(6) The current legal system, particularly the *Environmental Protection Act*, does not include contents regarding stakeholder participation.		
	(7) The mediation, including people's mediation and administrative mediation, has been the major resolution mechanism of environmental dispute cases. But the laws and policies on the environmental dispute resolution mechanism that address the particularity of the environmental disputes are still lacking.		
	(8) The administrative decisions on environmental dispute cases by the environmental protection authorities do not have the compulsory potency for enforcement. This encourages the polluters and hinders the timely control of the pollution and help the victims.		
	(9) For ordinary people who suffer from pollution, the judicial procedure for environmental dispute resolution imposes a threshold too high to cross. Even if the dispute had been resolved through the judicial process, the punishment imposed to the polluters is often weak.		
	(10) Compared to the high cost of pollution prevention and control, the punishment often presents economic savings in the polluters' eyes.		
	(11) The current laws and policies pose many difficulties in calculating the loss from the environmental pollution and provide no clear definition of removal of hazards and environmental restoration. Given the often massive cost of environmental restoration, clear definitions of environmental restoration is in demand.		

Box 2.4-1 Transboundary Environmental Monitoring Mechanism in China

According to the *Environmental Protection Act* of China, China currently adopts a multi-layered monitoring and consultation mechanism for environmental protection by the environmental authorities. For example, Article 7 of the *Environmental Protection Act* reads that "The competent department of environmental protection administration under the State Council shall conduct unified supervision and management of the environmental protection work throughout the country. The competent departments of environmental protection administration of the local people's governments at or above the county level shall conduct unified supervision and management of the environmental protection work within areas under their jurisdiction. The state administrative department of marine affairs, the harbor superintendency administration, the fisheries administration and fishing harbor superintendency agencies, the environmental protection department of the armed forces and the administrative departments of public security, transportation, railways and civil aviation at various levels shall, in accordance with the provisions of relevant laws, conduct supervision and management of the prevention and control of environmental pollution. The competent administrative departments of land, minerals, forestry, agriculture and water conservancy of the people's governments at or above the county level shall, in accordance with the provisions of relevant laws, conduct supervision and management of the protection of natural resources." Article 15 reads that "Work for the prevention and control of the environmental pollution and damage that involve various administrative areas shall be conducted by the relevant local people's governments through negotiation, or by decision of the people's government at a higher level through mediation."

Currently China's environmental protection adopts the multi-level environmental supervisory, regulatory, and consultations settlement mechanism. Transboundary environmental disputes are resolved through consultation among the related local governments or by the government of higher levels. Although favoring the environmental protection, such mechanism often gets caught among the various agencies and delays the process of environmental dispute resolution.

Some local governments attend to short-term economic return in the sacrifice of long-term environmental losses or even shielding or condone outlaw pollutants discharge. Some other local governments at different levels sometimes attend to their local interests when facing transboundary environmental issues, which in turn impede the proper resolution of transboundary environmental disputes.

2.5 Institutional Review

Table 2.5-1 Summary of Institutional Review

Category	Key Inputs	Key outputs	Key impacts
Main Contents	***State Agencies*** *State specialized agencies directly administering water environment:* MWR, SEPA, MOC, MOA, MLR, MOT, and SFA reporting to the State Council. *State agencies with significant impacts on water environment management:* NDRC, MOF, and SDPC (dissolved) reporting to the State Council. *State agencies coordinating water environment management:* State Council, the highest administrative authority. *National water environment management legislator:* National People's Congress, the highest legislation agency. ***Local Agencies*** *Local specialized agencies directly administering water environment:* WRBs, EPBs, construction committees, agricultural, land resources, transportation, and forestry authorities in the provinces, prefectures, and counties that report to the provinces, prefectures, and counties. *Local agencies with significant impacts on water environment management:* DRCs, finance bureaus, and development planning commissions (dissolved) in the provinces, prefectures, and counties that report to the provinces, prefectures, and counties. *Local agencies coordinating water environment management:* the provincial, prefecture, and county governments, the highest administrative authorities at the corresponding level. *Local water environment management legislator:* Provincial People's Congress with legislative authority to make local laws. ***Transboundary, watershed level organizations*** *HRB Management Committee*, the watershed management institute under the MWR. *HRB Water Resource Protection Bureau*, which is in charge of watershed-wide water	The outputs analysis of this study discuss only the organizational effectiveness and issues in the HRB water environment management. (1) Water management by multi-agencies. At the state level, 7 ministry-level agencies participate in water environment management, where the MWR, SEPA, MOC, MOA and MOT are most closely related to water pollution control. At local levels, each province, prefecture, and county has established its matching agencies of the ministries. A massive multi-agency governmental network of water environment management has been established nationwide. Although the responsibilities of various agencies have been defined, overlaps still exist. In practice, the water environmental management network can work more efficacious and efficient if the overlaps or gaps can be removed. (2) The collaboration in water environment management among the involved agencies has been proved less than perfect. All specialized agencies report directly to the State Council without anyone designated to coordinate. From planning to implementation, each agency works on its own business without a truly effective coordination and collaboration mechanism. (3) *De jure*, the *Environmental Protection Act* grants SEPA the monitoring and management authority of environmental protection nationwide. However, *de facto*, SEPA is authorized to issue only quality and discharge standards. Beyond the standards, SEPA does not have any other substantive authority to monitor and manage	(1) This study discusses only from the HRB water environment pollution perspective. (2) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Category	Key Inputs	Key outputs	Key impacts
	resources protection and water pollution prevention and control under the HRB Management Committee. In theory, it is led by both the MWR and SEPA; in practice, it is led only by MWR. *HRB Water Resource Protection Leading Group*, which is consisted of the officials from SEPA, MWR, and the 4 provincial governments, and participated by the NDRC, SDPC, MOF, MOC, MOA, China Light Industry Association, People's Bank of China, China Development Bank. The 2 leaders of the Leading Group are assumed by the ministers of SEPA and MWR. The main task of the Leading Group is to approve water resources protection and water pollution prevention and control plans and tasks during the Leading Group meetings. Seven meetings have been held in the 15 years between 1990 and 2005.	environmental protection. The vertical leadership in environmental protection monitoring and management remains weak from the state to the local. (4) The MWR conducts watershed management through its dispatched organizations; SEPA manages through its watershed pollution prevention and control plans. The HRB Water Resources Protection Leading Group cannot assume the role of day-to-day management.	
Major issues	(1) Successful international experience suggests that environmental monitoring and management requires not only participation by the various local governments and specialized agencies but also coordinated, potent, and substantive management of the monitoring. Nevertheless, in China, the coordinated management of monitoring remains weak. (2) SEPA does not have substantive leadership over the local EPBs. The local EPBs are administered by the local governments in terms of financial, human, and administrative resources. (3) The responsibilities overlap among the state specialized agencies, including SEPA, MWR, MOA, and MLR. The agencies have not established an effective collaboration and coordination mechanism. (4) The transboundary environmental pollution control and dispute resolution have been curbed by the localized interests of the local governments and agencies of various levels and left without an effective resolution mechanism. (5) No watershed-based water environment management. The watershed pollution control planning does not reflect quantitative water demand, and the watershed hydraulic planning does not reflect water pollution control in the watershed. (6) The current watershed-level management agency and mechanism do not integrate the water quantity, quality and pollution control objectives.		

2.6 Investment and Financing

Table 2.6-1 Summary of Investment and Financing

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) Finance Plan in the 9th and 10th HRB Water Pollution Prevention and Control FYPs (2) State policy, "polluters clean up," in pollution control funding source (3) State policy on industrial pollutants discharge permitting system (4) State policy on financing municipal WWTPs: urban wastewater discharge fee (5) Tax exemption policy for fixed asset investment for pollution control investment projects and accelerated depreciation policy for industrial pollution treatment facilities.	(1) The finance plans of both the 9th and 10th FYPs have not been completed: Only 21% of the municipal WWTPs planned in the 9th FYP were completed; the completion rate for other pollution control projects were 82%. During the 10th FYP, completion rate for planned investment reached 54%, where Anhui, Jiangsu, Henan, and Shandong reached 65%, 53%, 48% and 51% respectively. (2) Other funding sources for pollution control included: central government for about 1/5, local governments for about over 1/2, and the rest came from the private sector/bank loans and abroad. (3) Wastewater collection network requires massive investment but generates no direct profits; therefore, the networks can hardly be funded through the finance market. (4) In terms of the use of the funds, most investment came into the construction of the WWTPs. (5) In terms of effectiveness, the COD discharge reduction of the unit actual total investment is only half of the planned volume during the 10th FYP, the NH_3-N discharge reduction of unit actual total investment has reached the planned volume. Assuming that the plans have been set up appropriately, the effectiveness of actual investment in COD reduction is not as effective as expected. (6) The investment return of municipal WWTPs have been generally low due to the low collection rate and WWT tariff. Some of these investment projects have turned out profitable, indicating municipal WWT, a promising industry. (7) In terms of industrial wastewater control, the cost of compliance exceeds the cost of non-compliance. The current Chinese society does not provide tangible benefits for the enterprises to shoulder social responsibilities or to have an environmentally friendly reputation, thus disencourages investments in WWT at the enterprise level.	(1) This study discusses only from the HRB water environment pollution perspective. (2) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs
Major issues	(1) Although, according to the "polluters clean up" policy, majority of the pollution control funding should come from the polluting enterprises, in reality, most of the funding has come from central and local governments. The "polluters clean up" policy is not fully executed and does not sufficiently deter the polluters economically. (2) In the planned economy era, the investment needs for pollution control gave way to the infrastructure and technological advance, and the pollution was not adequately controlled. When history enters into the market economy, the historical burdens from previous pollutants discharge plus the economic disincentive from compliance have added to the investment requirements and made the current investment volume inadequate to curb the pollution. (3) The tariff and fine rates for pollutant discharge are too low given the economic development level to disencourage non-compliance behavior or enterprises' inputs into pollution control. (4) The wastewater discharge fee policy is incomplete and with a relatively loose implementation. In some areas, the WWT fee is far too low to recover the operational costs of the WWTPs. (5) The insufficient financing and guarantee policies especially in foreign and private capital operating in water pollution control area have elevated the risk level for investment return.		

2.7 Management Review

Table 2.7-1 Summary of Management Review

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) The following management institutions have been adopted in the watershed management: • Environmental impact assessment (EIA); • "Three Synchronousness (3S)"; • Pollutants TMLLs and discharge permitting system (the discharge permitting system was launched nationwide in 1988 by SEPA; in 2001 SEPA issued the *Management Provisions for the Discharge Permits in HRB and TLB*); • Accountability of environmental protection objectives; • Pollutants discharge permits; • Time-limited pollution control; • Quantitative performance evaluation of comprehensive urban environment control. (2) Established the multi-layered, multi-agency monitoring mechanism (3) In terms of watershed management, certain areas in Shandong have piloted the small watershed pollution control plan	(1) The EIA and "3S" can effectively control the potential pollution from polluting projects before they are launched. Thus, the EIA and "3S" have been valued by the central and local governments. In 2004, 99.2% of the required projects in the HRB provinces have conducted EIA, which is slightly under the 99.3% national level; the pass rate of 3S has been 90.9%, also under the national average of 95.7%. (2) Since the issuance of the *Management Provisions of the HRB and TLB Discharge Permits*, the provinces in the watershed have issued implementation plans accordingly. Nevertheless, those implementation plans were not executed satisfactorily in a number of aspects: In terms of issuance, the government offices do not have the capacity to facilitate the permits issuance; most of the polluting enterprises do not have permits. In terms of enforcement and monitoring, the governments do not have the capacity to enforce the issued permits or to punish non-compliant behavior. Consequently, except for small, localized areas, the current permits system has not been able to improve the environmental quality. (3) As the environmental accountability has tied the environmental performance with the cadre performance evaluation and promotion, the government at various levels have assigned detailed environmental objectives and been enforcing annual evaluation of the objectives. Nevertheless, demotion due to failure to meet the environmental objectives has seldom been heard. Comprehensive urban environment evaluation, as part of the environmental accountability, has received significant attention. Currently there is no data set to confirm the implementation results of the environmental accountability, although all the new reports have been claiming successful implementation. (4) Limited by funding and enforcement capacities, the time-limited pollution control has played an important role in acute and severe polluting enterprises. However, human factors tend to influence its execution in the selection of the objectives, reasonability of the term, and the feasibility of the plan. (5) In terms of the environmental monitoring institutions, the local governments directly administer the environmental monitoring stations; SEPA and the headquarter monitoring station only issue standards and provide technical guidance. When the interests of the monitoring station and the local government are closely linked together, the independence of the monitoring stations will become questionable. (6) The SEPA, MWR, and MOA each have its own monitoring system. *De jure*, SEPA monitors the water quality outside the water bodies, MWR monitors the quality inside the water bodies, and MOA monitors water quality in the agricultural system. The monitoring is not unified. *De facto*, SEPA is also monitoring the water quality in water bodies, and MWR is monitoring water pollution sources. (7) The locations, times, and frequencies of the monitoring points set by SEPA and MWR are desynchronized. As a result, the monitoring results from SEPA and MWR are not comparable.	(1) This study discusses only from the HRB water environment pollution perspective (2) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Category	Key Inputs	Key outputs	Key impacts
	within one jurisdiction that integrate economic development, urban construction, industrial production, water resources, pollution control, and ecological protection considerations.	(8) The environmental monitoring stations of SEPA, MWR and MOA report to their superior EPBs, WRBs, and agricultural bureaus. Those bureaus, in term, report to the local governments at the corresponding levels as well as the specialized agencies at the higher level. (9) Certain provincial governments are beginning to pay attention to the small watershed comprehensive pollution control. Small watershed comprehensive pollution control planning and piloting have been started and shown promising results.	
Major issues	(1) The large number of construction projects in the watershed, relatively fast economic growth compared to the national average, and the mismatch between the governance system and the economic development have led to the relatively lower implementation rate of EIA and "3S" compared to the national average. (2) The permits system involves a wide scope of arrangements in the dynamics of the natural and artificial water bodies, water resources utilization and tariffs, pollutant discharge TMLLs, watershed economic development planning, monitoring of the water bodies and pollution sources, technical administration of the permits, monitoring and law enforcement, and financing and investment. If the support from any of those aspects is missing, the implementation of the permit system will be challenged. (3) Although all the government offices claimed to have implemented the accountability requirements for the environmental objectives, no substantive improvement in the water quality in the water bodies has been identified. Therefore, either the objectives have been set too low, or the implementation of the accountability requirements of the environmental objectives remains nominal. Although the achievability of the objectives needs to be considered, more important are still the ultimate goals and the stepped action plan to achieve the goals. (4) Given wide-spread non-compliant pollutants discharge and the limited funding and government monitoring and administration capacity, the time-limited compliance can serve as demonstrative law enforcement actions, but intrincally it convey the message of avoiding the simultaneous shut-down of large number of enterprises. In a way, it is a system that sentences the legal offense with suspended execution without prohibiting further offense and can prove counterproductive without careful execution. (5) The 23-year-old *Management Regulations on Environmental Monitoring* can no longer guide the current environmental monitoring and management. (6) Monitoring of water pollution sources requires unified management. The environmental protection authorities have not managed to centralize the administration of pollution source monitoring as required by the *Environmental Protection Act*. (7) Except the headquarter station, SEPA does not have substantive authority over other environmental monitoring stations. The true authority over the environmental monitoring stations falls into the hands of the local governments of various levels. According to the *Environmental Protection Act*, the local governments oversee the environmental protection within its territory. Given the particularities and the required independency of environmental monitoring, the weak vertical leadership of SEPA to EPBs is unfavorable to the environmental protection enforcement and monitoring. (8) The SEPA/EPBs and MWR/WRBs have overlapping responsibilities in the water environment monitoring, which has led to the waste of the limited, if not insufficient, monitoring resources. The segregated institutional arrangement has led to the lack of coordinated, synchronized, and unified arrangements in the set-up of the monitoring systems, selection of the monitoring indicators, locations, time, and frequency. No single agency will summarize, collate, and use the monitoring data from various sources. Actually, under such segregated environmental monitoring system, even if the data were available from those agencies, they tend to be inconsistent and prove difficult to use. (9) Coordination between the *Environmental Protection Act*, the *Water Pollution Prevention Act*, and the *Water Act* in water quality monitoring is still lacking. The standards, management, and institutions in water quality monitoring remain ambiguous.		

Category	Key Inputs	Key outputs	Key impacts
	(10) The lack of watershed-wide groundwater monitoring network has limited the knowledge of the watershed-wide groundwater conditions. (11) The small watershed of a river sometimes can be coordinated at the county level, if the small watershed does not cross multiple jurisdictions. And the comprehensive plan of the small watershed can relatively easily incorporate the local governmental planning. Although no concrete monitoring data can confirm quantitatively the contribution to water quality improvement from small watershed comprehensive pollution control, international experiences suggest that watershed-level comprehensive pollution control is often an approach with low-investment and high-environmental return.		

2.8 Public Participation

Table 2.8-1 Summary of Public Participation

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) The *Constitute of the PRC* stipulates that "The people are entitled by law to manage the state, economic, cultural, and social affairs through various channels." (2) The *Environmental Protection Act* mandates that "all entities and individuals are obliged to protect the environment and are entitled to report to the higher authority or prosecute any entity and individual who pollutes the environment." (3) The *Environmental Impact Assessment Act* specifies that "the State encourages the related organizations, experts and the public to participate in the environmental impact assessment with proper manners." (4) Some provinces have experimented with and explored public participation mechanism. (5) The *Interim Provisions on Environmental Information Disclosure* (SEPA Order No. 35) was issued by on February 8th, 2007 and will be enacted on May 1st, 2008.	(1) Major forms of public participation: • Submit environmental proposals through the People's Congress, CPPCC, and the democratic parties. • Monitoring through the media by publicizing environmental conditions and the evaluation results of the urban comprehensive pollution control programs. The media can establish columns or featured programs for the public opinions on environmental protection. • Environmental petition complaint. The public can pursuit environmental lawsuits through the EPBs to safeguard its own interests and benefits. • Surveys, expert panel discussions, and public hearings during EIA. • The government consults the opinions from the related institutes and experts during policy- and decision-making, and the experts usually conduct surveys at the place of study/interest when preparing the study reports. This process represents one of the forms of the public participation in China. (2) Although in the past 10 more years public awareness of environmental protection has been significantly improved, the public participation has just begun. Forms of public participation are limited, and sound institutional support is yet to be established. (3) SEPA's *Interim Provisions on Environmental Information Disclosure* is likely the first regulatory document on information disclosure issued by the central government since the State Council's *Regulations on Government Information Disclosure*. This interim provision requires a combination of voluntary and mandatory disclosure of government and enterprise environmental information. This will significantly promote the public participation in environmental protection.	(1) This study discusses only from the HRB water environment pollution perspective. (2) Same as "Table 2.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs.
Major issues	(1) Inadequate government and enterprise disclosure of environmental information leave the public with insufficient information to participate. (2) The current public participation activities are mostly the passive participation by the public. For example, "public participation" takes place as the distribution of survey tables to the public by the constructers of development projects and collection of the responses afterwards, without informing the public much about the projects *per se*.		

Category	Key Inputs	Key outputs	Key impacts
	(3) The laws and regulations often remain "in principle" in the form of "advocacy" without specifying much of the procedure, format, time, and rights and responsibilities of the stakeholders of public participation. Without clear guidance to the practice, the public participation regulations can hardly provide any restrictions in practice. (4) Inadequate awareness and understanding of public participation have misguided the mainstream concept of public participation as the participation by individuals. Actually, public participation refers to the participation by all stakeholder groups, which include individuals, civil societies, enterprises, institutes, and local governments. As long as the involved parties consider the discussed issue relates to their interests, they can participate to protect their benefits or to express their opinions. (5) The *Regulations on Environmental Information Disclosure (Trial)* will pioneer in China's information disclosure. As an experiment, the Regulation will need to watch for the following issues: • The local EPBs are charged with the environmental monitoring and information disclosure responsibilities, but the local EPBs are administered by the local governments. Thus, the potential conflict of interests could impede the implementation. • The voluntarily disclosed governmental environmental information by the EPBs often omits the details. For instance, "environmental quality," "environmental statistics and survey information," "contingency plans, forecasting, occurrence and handling of environmental emergencies," and "discharge TMLL allocation and issuance of discharge permits" all remain nonspecific; sometimes the disclosed information is only a brief paragraph of description. • Only "enterprises discharging pollutant exceeding the national or local standards" or "severely polluting enterprises significantly exceeding the discharge TMLLs set by the local governments" are mandated to disclose their environmental information. This accounts for only a small fraction of the total enterprises. Although emphasizing on the non-compliant enterprises, this prevents the public from monitoring the majority of enterprises, nor to encourage better performances of the compliant enterprises. • The punishment to the non-compliant enterprise – a "fine under 100000 yuan and mandated disclosure of the information" – may prove superficial and non-substantive. The regulation on non-compliant punishment can be more detailed, and for severe non-compliant behavior, the punishment could be more severe.		

3. Summary of the TLB Review and Analysis

3.1 9th and 10th FYPs Pollution Control Plan

Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) 9th FYP and 2010 Plan of Tai Lake Water Pollution Prevention and Control (2) 10th FYP of Tai Lake Water Pollution Prevention and Control (3) National laws and policy on the environment	(1) During the 9th FYP, 22 monitoring positions, 27 link-lake and 52 boarder river monitoring sections have been added to the Tai Lake. During the 10th FYP, 20 monitoring positions, 28 link-lake and 50 boarder river monitoring sections have been added to the Tai Lake in 2000; the numbers have been changed to 21 lake monitoring positions, 88 river monitoring sections in 2004. (2) The 9th FYP covered only Jiangsu and Zhejiang provinces. By the end of the 9th FYP the total COD discharge from Jiangsu and Zhejiang in the watershed reached 2.8 times of the TMLL target, TN discharge 3.6 times, and TN discharge 8.1 times. All major indicators had significantly exceeded the TMLL targets. By the end of the 10th FYP total COD discharge was only 57% of the TMLL target, and the NH_3-N discharge was 20% of TML target; all areas except Suzhou have successfully met the objectives (no data for TN is available). (3) By the end of the 9th FYP, 54% of the planned urban WWTPs have been constructed. During the 10th FYP, 84% of the planned urban WWTPs have been constructed, and 89% of the planned WWT capacity has been installed. (4) Survey results suggest an 82% of compliance rate of industrial COD discharge by the end	(1) The Tai Lake water quality had maintained good in the decade prior to the 9th FYP; nevertheless, starting in 1988, the water quality quickly deteriorated. The 9th FYP saw the proportions of Class II and III water bodies diminished from 85% to zero; proportions of Class IV and V water bodies decreased from 15% to 5%; and water bodies of quality class "Worse than V" have surged from 0% to 95%. The 10th FYP saw the proportions of Class II-III water bodies resurface from 0% to 14.2%; proportions of Class IV-V water bodies increased from 5% to 33.4%; and water bodies of quality class "Worse than V" have decreased from 95% to 52.4%. Overall, During the 9th FYP, the Tai Lake water quality quickly deteriorated: Class II-III water bodies diminished, and most of the water bodies deteriorated into Worse than Class V. Although the water quality has been partially restored during the 10th FYP, severe pollution persists, and the water quality is still inferior to that of the beginning of the 9th FYP. (2) The water quality of the TLB has been consistent with the Tai Lake water bodies in the past decade. The 9th FYP saw the proportions of Class II and III water bodies in the TLB diminished from 85% to zero; proportions of Class IV and V water bodies increased from 15% to 19%; and water bodies of quality class "Worse than V" have surged from 0% to 81%. The 10th FYP saw the proportions of Class II-III water bodies resurface from 0% to 14.2%; proportions of Class IV-V water bodies increased from 19% to 40%; and water bodies of quality class "Worse than V" have decreased from 81% to 50%. Overall, during the 9th FYP, the TLB water quality quickly deteriorated: Class II-III water bodies diminished, and most of the water bodies deteriorated into "Worse than Class V." Although the water quality has been partially restored during the 10th FYP, severe pollution still persists, and the water quality is still inferior to that of the beginning of the 9th FYP. (3) The major pollutants in the Tai Lake water bodies are NH_3-N, TN and COD. The major water quality problem is eutrophication. (4) At the end of the 9th FYP, no monitoring sections met the water quality targets of the 9th FYP in the Tai Lake water bodies. Among the failed ones, 95% belonged to worse than Class V water quality. By the end of the 10th FYP, although many more water quality targets of the monitoring sections had been relaxed to the Class V, still 95.2% of the

Category	Key Inputs	Key outputs	Key impacts
		of the 9th FYP and a 91% compliance rate of enterprises meeting both COD and NH_3-N targets by the end of the 10th FYP. (5) The actual investment in the Tai Lake pollution control during the 9th FYP reached 129.5×10^8 yuan, 77% of the planned volume, mainly due to the shortage in municipal WWTP construction funding. The actual investment was 220.1×10^8 yuan during the 10th FYP, 77.8% of the planned level.	monitoring sections failed to achieve the water quality targets. Among the failed ones, 52.4% belonged to water quality worse than Class V. (5) By the end of the 10th FYP, 19.3% of the TLB river monitoring sections met the TMLL targets; the rest 80.7% failed. Among the failed ones, 50% belonged to water quality worse than Class V. (6) By the end of either the 9th or 10th FYPs, the water quality objectives were not achieved. Ultimately, water pollution prevention aims at providing a safe and healthy environment for human livelihood that supports sustainable development. This study does not encompass the evaluation of this ultimate goal.
Major issues	(1) The rapid water quality deterioration of the Tai Lake water bodies during the 9th FYP has led to the shortfall of the 9th FYP objectives. (2) The implementation of the 10th FYP has deterred and partially reversed the trend of water quality deterioration of the Tai Lake water bodies. (3) Since the actual results have fallen far behind the water quality objectives, which are the key water management objectives of the 9th and 10th FYPs, it will be proper to conclude that the 2 FYPs did not achieve their objectives. (4) The 9th FYP pollutant discharge control objectives have not been met yet. The objectives of the 10th FYP were met already (except Suzhou). (5) The 9th and 10th FYP pollution control projects have fallen far behind the planned objectives in either investment volume or the number of projects implemented. (6) During the 9th FYP, the economic growth in the 2 TLB provinces did not reach the planned objectives; nevertheless, their pollutants discharges exceeded the planned levels. During the 10th FYP, when the GDP of the two provinces have exceeded the planned objectives by 33.8% and 44.2% respectively, their pollutants discharges have met the TMLLs. This suggests that the pollutant discharges was not prioritized during the 9th FYP, while the emphasis has been given to promoting economic development. During the 10th FYP, the investment in pollutant discharge control has increased by 65% compare to the 9th FYP, and the government has lowered the targets considering the viability of the objectives. This indicates a general rule that small increase in the inputs can lead to significant reduction in the pollution impacts at the initial, primitive stage of pollution control. (7) The 9th FYP plan targets and objectives were not set in accordance with the socio-economic conditions at the time. Throughout the 9th and 10th FYPs, plan implementation has often be left with no action or results. The entire socio-economic development plan is implemented without sufficient coordinating and supervising. (8) The FYPs are implemented by the environmental protection, hydraulic, agricultural, and urban construction authorities. There is no sound information feedback system on the FYP implementation. Up till now, comprehensive and detailed implementation information remains unavailable, and monitoring of the comprehensiveness, reliability, and validity of the information is still absent. The decade-long pollution control results can be summarized as: Given the rapid economic growth, the COD discharge at the end of the 10th FYP was only 77% of the beginning of the 9th FYP level. During the 10th FYP, COD discharge per unit GDP remained 20%-55% of national average and decreased from 7.95 to 1.54 kg/10^4 yuan, marking an 81% reduction. However, the GDP per unit area in the TLB is high – nearly 16 times that of the national average in 2000, about 20 times in 2005, and equivalent to 4 times of the US level and 1.5 times of the French level in 2003. And the pollutant discharge intensity compared to the developed countries is also high. For example, in year 2005, the COD discharge per unit GDP in the TLB had been 19 times more than that of USA 2003 level.		

3.2 Water Resources and Hydraulic Facilities

Table 3.2-1 Summary of Water Resources and Hydraulic Facilities

Category	Key Inputs	Key outputs	Key impacts
Major Contents	(1) TLB Comprehensive Control Plan (1987) set the 10 Key Tai Lake Pollution Control Projects aimed at flood prevention and diversion. (2) 9th and 10th National Hydraulic Development FYPs (3) Water Act of PRC (July 1, 1988) (4) Flood Prevention Act (August 29, 1997)	(1) 7 large-scale reservoirs with a total storage capacity of 10×10^8 m^3 and flood storage capacity of 4.94×10^8 m^3 constructed for flood prevention, irrigation, and water supply, together with freshwater aquaculture and power generation; 3012 km of dikes and levees for flood prevention; 10 Key TLB Pollution Control Projects of mostly water diversion and direction and dike engineering. The Tai Lake Pollution Control Program embarked in 1991 has constituted the major component of the TLB hydraulic engineering, which has set its main objectives as flood prevention. Specifically, flood prevention usually takes the form of constructing dikes and levees in the upper stream and the lake area and the water diversion and direction engineering that diverts water into the Yangtze River during floods or draws water from the Yangtze during draughts in the downstream Yangtze River area. (2) The hydraulic facilities provides water supply to the water users in the watershed. The water usage during the 9th and 10th FYPs has increased by 22%, and the water use at the end of the 10th FYP was already 2.2 times of the watershed annual surface runoff. Agricultural water use accounted for over 1/3, and industrial water use accounted for over 1/3 too. Water demands that exceed the surface runoff have been supplied by the Yangtze River or from the reused water. Beginning from 1996, groundwater extraction has been limited, but the amount extracted still exceeds the safely extractable amount. (3) During the 10th FYP, large amounts of the Yangtze River water has been infused into the Tai Lake to provide water supply and to temporarily improve the water quality in the Tai Lake water quality.	(1) The hydraulic facilities constructed have played an important role in flood prevention, irrigation, water supply, and flood diversion. (2) Although the HRB has constructed many water storage hydraulic facilities, the pollutants concentrations in the water bodies still increases with the reduction of runoff during the dry seasons. (3) The water storages in the hydraulic facilities for water supply have led to accumulation of pollutants in the water bodies in front of the dams and gates and reduced the water quality of the upper stream water bodies. Meanwhile, the downstream runoff has been reduced or diminished, which leads to the decrease in the downstream water body environmental capacity. (4) The TLB, as a major freshwater aquaculture basis in China, houses 10% of the nationwide aquaculture produce. The lack of environmental objectives in the freshwater aquaculture has posed negative impacts to the water quality. (5) When directing the Yangtze River water into the Tai Lake, the accelerated water circulation and the shortened Tai Lake water trading cycle brought to short-term water quality improvements to the Tai Lake and downstream areas. However, the influence from the mud from the Yangtze River water body subsiding after entering into the Tai Lake and the alteration in living communities remain unknown. (6) The temporal and spatial distribution of the TLB hydraulic engineering and operation have been aimed at ensuring production and domestic water safety, especially flood prevention, irrigation and aquaculture, without considering the environmental and ecological aspects. The diversion from the water pollution prevention and control objectives, the hydraulic engineering and operation have brought negative effects to the water environment.

Category	Key Inputs	Key outputs	Key impacts
Major Issues	(1) Both the watershed comprehensive planning and the 9th and 10th Hydraulic Development FYPs have aimed at flood prevention and diversion, irrigation, and water supply, and few or little consideration has been given to the water resources protection and comprehensive utilization, let alone the water resources quality and pollution control. (2) Lack of coordination between the hydraulic planning and water pollution planning of the watershed. (3) Traditionally, the TLB hydraulic investment has been aiming at flood prevention and water supply for livelihood and development of the HRB due to the low per capita and unit farmland water resources and the high variation in water quantity between dry and flood seasons. However, currently the water resources shortage and water pollution have influenced the performance of the hydraulic facilities, which in turn impacts the livelihood and development of the watershed. (4) The construction and operation of the hydraulic facilities aiming at flood prevention and water supply have brought about negative impacts to the water quality.		

3.3 Factors Impacting Pollutants Discharge

Table 3.3-1 Summary of Factors Affecting Pollutants Discharge

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) 9th and 10th National Economic and Social Development FYPs (2) 9th and 10th TLB Water Pollution Prevention and Control FYP (3) TLB Provincial Urban Development Plans (4) 9th and 10th Agricultural Development FYPs (5) National laws and policies concerning the environment	*Water pollution sources* (1) COD discharge has increased by 1.74 times during the 9th FYP, while the 10th FYP saw a 56% reduction in COD discharge. Similarly, the 9th FYP witnessed a 2.54 time increase in annual TN discharge, while the 10th FYP experienced an 85% reduction in TN. (2) Within the COD discharge, contribution from domestic wastewater increased from 42% to 63% during the 2 FYPs. Accordingly, the proportion of industrial wastewater contribution has dropped from 39% to 37%. (3) Fast urbanization. Sample statistics shows that by the end of the 10th FYP, Suzhou, Zhenjiang, and Shanghai already have an urbanization rate of 100%, and the growth rate of urban population in Hangzhou, Huzhou, Jiaxing, and Wuxi have been 18, 47, 3, and 3 times of the provinces they belong respectively. *Domestic wastewater and its control* (1) During the 9th and 10th FYPs, the installed treatment capacity at municipal WWTPs increased by 3.8 times. But the collection pipes grew by only a factor of 2.1 between 2002 and 2005, and some of the urbanized areas are still not connected to the WWTPs. This has led to the low wastewater collection rate and the under-utilization of the WWTPs (except in Shanghai). (2) Municipal WWT has increased by 1.6 times, and the urban domestic WWT rate increased from 40% to 74% during the 2 FYPs. Nevertheless, the centralized WWT rate grew only from 29% to 59% throughout the 10th FYP (Shanghai has grown from 62% to 70%). Data on municipal WWT discharge compliance rate is not available. (3) The WWT fee collection rate has been universally low throughout the cities surveyed. *Industrial wastewater and control* (1) During the 9th FYP, industrial wastewater COD annual discharge has increased by 94%; during the 10th FYP, the discharge reduced by 63%. (2) Statistics show that by 2000, 82% of the TLB enterprises have met the COD discharge standard; by 2005, 92% and 96% of the enterprises have met either NH_3-N or COD discharge standards, and 91% of the enterprises have met both standards. Throughout the 10th FYP, the industrial wastewater discharge compliance rates in the TLB areas have been consistently increasing except in Hangzhou and Huzhou. *Agricultural non-point source pollution and pollution control* (1) Estimates indicate that during the 9th and 10th FYPs, the major agricultural non-point source pollution in the TLB comes from animal husbundry (approximately 60-80% of COD), rural domestic and (again) animal husbundry (70-80% of TP) and farmland nutrient loss (30-40% of TN). For example, the feed intensity in the freshwater aquaculture in Zhejiang has reached 3998 kg/ha, and about 48.3% of the feed enters into the environment. The CODcr discharge per unit freshwater aquaculture area should also be high. However, due to data unavailability, the estimation of the CODcr discharge from freshwater aquaculture is unviable.	(1) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs. (2) Economically, besides the enormous costs incurred by the severe pollution in the HRB water bodies and the loss from human health and productivity, the cost of ecological restoration of the degraded rivers and lakes will create another huge bill to pay (Box 2.3-1).

Category	Key Inputs	Key outputs	Key impacts
		(2) Estimates indicate a non-point source COD contribution 1-3 times of the point sources in the TLB during the 2 FYPs. The contribution from non-point source pollutants has been increasing steadily: 49% for COD, 61% for TN, and 60% for TP from 1995 to 2004. Currently, no data is available to illustrate quantitatively the non-point source pollutants in the water bodies. Nevertheless, sufficient evidence is already available to conclude the significance of the non-point source pollution in the TLB during the 10th FYP. (3) The 9th TLB Water Pollution Prevention and Control FYP has articulated that non-point source pollution control is an important part of the pollution control program. The 9th FYP has also layed out 8 non-point source pollution prevention and control demonstration projects with a planned investment volume of 5400×10^4 yuan. Surprisingly, the actual investment reached 2.9×10^8 yuan. Nevertheless, TLB's rich waterways favor the non-point source pollutants migration into the water bodies. The agricultural non-point source pollution prevention and control lacks legal support and effective control technologies, and the N and P pollutants from non-point sources were not effectively reduced. The 10th FYP has included 14 agricultural non-point source pollution control projects with a planned investment volume of 23×10^8 yuan. The implementation might have been completed. However, due to the lack of specified monitoring indicators and the monitoring of the non-point source pollution, it is difficult to estimate quantitatively the non-point source pollutants entering into the water bodies.	
Major issues	(1) Different from the HRB's consistent reduction in total pollutants discharge, the TLB experienced discharge surge in the 9th FYP, when COD nearly doubled and TN increased by 1.5 times. (2) Although during the 10th FYP, the pollutants TMLL targets have generally been met, the COD level at the end of the 10th FYP was only 23% less than the beginning of the 9th FYP. This suggests that the water quality deterioration in the Tai Lake is largely caused by the massive pollution discharged during the 9th FYP. The efforts in the 10th FYP restored the pollutants discharge back to the level at the beginning of the 9th FYP. The absolute discharge level remains high. Although by the end of the 10th FYP, the water quality showed the trend of improving, the water quality was still quite low. (3) Coordination between the watershed pollution control planning and urban development planning is still lacking. (4) The current connection pipes of the WWTPs are far from adequate to collect the discharged wastewater. (5) The collection rate of municipal WWT fee remains low and insufficient for WWTP operational cost recovery. And the compliance rate of WWTPs outlet water is questionable. (6) Large quantity of non-compliant industrial wastewater discharge persisted during the 10th FYP. (7) Large amounts of pollutants from agricultural non-point sources have entered into the environment, and the amounts are still increasing during the 2 FYPs. Agricultural non-point sources remain untamed. Agricultural non-point sources have become significant contributors to the TLB water pollution. (8) No substantive coordination exists between the agricultural non-point source pollution plan/planning and the agricultural development plans.		

Table 3.3-2 Summary of TLB Pollutants Discharge of the Representative Years in the 9th and 10th FYPs

Item	1994				2000				2005			
	Total discharge				Total discharge				Total discharge			
	Total (10^4 ton)	% from industrial sources	% from domestic sources	% from non-point and other sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	% from non-point and other sources	Total (10^4 ton)	% from industrial sources	% from domestic sources	% from non-point and other sources
Total wastewater	318769	17	10	73	150120	69	31	Na	na	na	na	na
Total COD	28.2404	39	42	19	49.15	44	29	27	21.616	37	63	na
TN(1994)/NH_3-N (2000,2005)	7.9552	16	25	59	13	4	18	78	1.9879	41	59	na
TP	0.5660	10	60	30	1.44	6	27	67	na	na	na	na

Notes:
1. "na" indicates no data.

3.4 Legislations

Table 3.4-1 Summary of Legislations

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) Related laws: *Constitute, General Principles of Civil Law, Criminal Law, Civil Procedure Law, Arbitration Law, Environmental Protection Act, Water Act, Water Pollution Prevention Act, Soil and Water Conservation Act* *(2)* Related administrative regulations by the State Council: *River Management Regulation, Flood Prevention Regulation, Implementation Provisions of Water Use Permit System, Interim Regulations on HRB Water Pollution Prevention and Control, Provisional Regulations of Water Pollution Prevention Act, Circular on the Trial of Municipal WWT Fee in HRB* *(3)* Administrative regulations by designated authorities by the State Council on water environment management: *Interim Management Provisions of Water Pollutant Discharge Permits, Drinking Water Source Water Protection District Pollution Prevention and Control Regulations, Provisions on Fishery Water Body Pollution Incidents Investigation and Handling Procedure, Aquatic Flora and Fauna Natural Protection Zone*	The laws and regulations are the cornerstones for the HRB water pollution control. They have played a fundamental role for the environmental protection in the past decade. Nevertheless, the following outputs still need to be scrutinized for future policy reforms. Transboundary water environment management Many years of practice have revealed overlaps and gaps between the current laws and policies in transboundary water environment management. The overlaps and gaps have created conflicts and become an acute issue in the transboundary water environment management and dispute resolution: (10) Lack of true coordination in the water use and pollutant discharge and pollution control plans and policy. The different jurisdictions in the upper- and downstreams often take advantage from the conflicts and ambiguity of the national laws and policies selectively to implement policies that favor localized interests (Box 2.4-1). (11) The current law and policy framework requires coordination among various agencies to resolve transboundary water environment management. Nevertheless, it does not specify the procedures for coordination and dispute resolution. Together with the difficulty in multi-agency coordination, many transboundary water and water pollution disputes often become more acute rather than being resolved. (12) The detailed watershed information on water and pollutants discharge has not been publicized. Significant information asymmetry exists among the stakeholders. (13) Significant inconsistency exist in the monitoring and statistical data from various related agencies – environmental protection, hydraulic, urban construction – on pollution sources, pollutants discharge and water quality. The inconsistency has further complicated government planning and decision-making. (14) Without many specifications in the laws and policies, the practice and monitoring of damage evaluation seldom receive mutual consensus from the stakeholders. (15) Coordination remains weak among the environmental protection, hydraulic, agricultural and urban construction authorities in economic development, water resources, environmental pollution control and various other aspects of watershed planning. (16) Public and private stakeholders do not have much incentive for public participation in the government administration and policy-making.	(1) The laws, regulations, and policies are the cornerstones for socioeconomic progresses. Limited by its scope, this study discusses only the water environment pollution aspect of the laws, regulations, and policies. (2) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9^{th} and 10^{th} FYPs

Category	Key Inputs	Key outputs	Key impacts
	Management Provisions, Circular of Enhancing Environmental Monitoring and Prevention of Pollution Incidents (4) Provincial water environment management regulations and policies. (5) Relevant environmental quality standards: *Surface Water Environmental Quality Standard, Groundwater Environmental Quality Standard, Soil Environmental Quality Standard, Seawater Quality Standard* (6) Relevant pollutant discharge standards: National comprehensive discharge standards, such as the *Comprehensive Wastewater Discharge Standards*; national specialized standards, such as the *Urban WWTPs Pollutant Discharge Standards, Paper Industry Water Pollutant Discharge Standards, P-fertilizer Industry Water Pollutant Discharge Standards, and Animal Husbandry Pollutant Discharge Standards*; and local pollutant discharge control standards. (7) Judicial system of the PRC.	(17) The public organizations and individuals are not entitled to protect the public interests on public affairs through law suits. *(18)* The public organizations and individuals are not entitled to persecute offenses to the *Environmental Protection Act.* <u>*Environmental pollution disputes*</u> (7) The massive amount of environmental disputes incurred by water pollution incidents is not categorized in the current judicial system; therefore, no statistics is available. (8) The current environmental judicial system poses a high threshold for the pollution victims, who tends to be the disadvantaged groups in the society. Especially, the requirement of "the advocator proves" and the difficulties in identifying the liabilities, valuation and execution of the indemnity, and reversing the occurred damages have deterred the victims. Consequently, most of the environmental disputes did not enter the judicial process. (9) The current laws do not grant the potency of enforcement to the environmental protection authorities in their handling of the environmental disputes. Either party could initiate the litigation process at the People's Court, should the party disagree with the resolution proposed by the environmental protection authority. Therefore, the decisions made by the environmental protection authorities regarding environmental disputes basically equals to "mediation" or administrative mediation in their effectiveness. (10) About 70% of the environmental disputes in China are resolved through people's mediation, administrative mediation, or administrative handling. However, the degree of satisfaction of the victims is usually low. (11) Given the current legal system and the Chinese history and culture background, environmental disputes are often resolved within the administrative liability regime though administrative punishment. The civil and criminal liabilities are often neglected. (12) The current legal practice of environmental dispute resolution emphasizes stopping the environmental pollution, peacing the conflicts between the tortfeasors and the victims, and impose administrative punishments to the polluters. Nevertheless, compensation and indemnity to the victims and environmental restoration are often neglected.	
Major issues	(1) Lack of integration between the *Water Act* and the *Water Pollution Prevention Act*. Water resources management involves the management of both quantity and quality; however, in practice in China, the water quantity and quality have been disintegrated in a number of ways: (a) disintegrated terminology in the *Water Pollution Prevention Act* and *Water Act*; (b) disintegrated planning, implementation, and monitoring of water resources management plans and water pollution prevention and control plans; (c) lack of coordination mechanism between the SEPA/EPBs and the MWR/WRBs; (d) although the 2 legal		

Category	Key Inputs	Key outputs	Key impacts
	acts have assigned the MWR/WRBs the responsibility of boarder water quality monitoring, they did not provide specific regulations on pollution management in the transboundary watershed management. At the time of pollution incidents, no provisions will be available to clarify the concrete tasks and responsibilities regarding the water body water quality monitoring, management, and law enforcement assigned between the MWR/WRBs or SEPA/EPBs. That is to say, when boarder water quality non-compliance incidents occur, hardly any measures can be taken legally or administratively; (e) The *Water Act* has required the MWR delineate water functional zones together with SEPA, but this provision has proved impractical. Moreover, the *Water Pollution Prevention Act* has required SEPA to delineate water functional zones, and the *Detailed Regulations of Water Pollution Prevention Act* has provided more detailed provisions, which significantly differ from those in the *Water Pollution Prevention Act*; and (f) The *Water Act* mostly addresses water use and water regulation. Contents about the aquatic ecology is missing such as that the MWR should maintain a certain level of ecological flow volume to ensure water quality compliance. (2) The *Water Pollution Prevention Act* has proved unsuited to a number of the issues occurred during the recent decade, which include: the articles are too general to practice; lack of specific provisions on dispute resolution through administrative mediation or litigation; lack of legal provisions on transboundary after pollution dispute resolution; lack of coordination with water resources planning; lack of detailed provisions on discharge TMLLs; lack of articles addressing pollutants discharge permits; lack of provisions on urban and rural non-point source pollution; lack of detailed provisions on monitoring and data validation of pollution sources and water environment; lack of provisions on participation by the water pollution stakeholders; lack of detailed provisions on the enactment, enforcement, and monitoring of the law itself; and lack of provisions on offence to the act by the government agencies. (3) The non-point source pollution, widely linked to urban domestic living and agricultural production, has become an important pollution source to the watershed water bodies. However, no detailed legal provisions or policies are available to address the non-point source pollution control issues. (4) An overwhelming majority of the current national water environment legislations is substantive laws; few are procedural laws, and the enforcement monitoring remains largely absent. As a result, without the assistance from the procedural and enforcement monitoring provisions, the objectives of the substantive laws are difficult to achieve. (5) The current legal system, particularly the *Environmental Protection Act*, does not include monitoring and punishment regulations regarding offenses by government offices or officials. (6) The current legal system, particularly the *Environmental Protection Act*, does not include contents regarding stakeholder participation. (7) The mediation, including people's mediation and administrative mediation, has been the major resolution mechanism of environmental dispute cases. But the laws and policies on the environmental dispute resolution mechanism that address the particularity of the environmental disputes are still lacking. (8) The administrative decisions on environmental dispute cases by the environmental protection authorities do not have the compulsory potency for enforcement. This encourages the polluters and hinders the timely control of the pollution and help the victims. (9) For ordinary people who suffer from pollution, the judicial procedure for environmental dispute resolution imposes a threshold too high to cross. Even if the dispute had been resolved through the judicial process, the punishment imposed to the polluters is often weak. (10) Compared to the high cost of pollution prevention and control, the punishment often presents economic savings in the polluters' eyes. (11) The current laws and policies pose many difficulties in calculating the loss from the environmental pollution and provide no clear definition of removal of hazards and environmental restoration. Given the often massive cost of environmental restoration, clear definitions of environmental restoration is in demand.		

3.5 Institutional Review

Table 3.5-1 Summary of Institutional Review

Category	Key Inputs	Key outputs	Key impacts
Main Contents	***State Agencies*** *State specialized agencies directly administering water environment:* MWR, SEPA, MOC, MOA, MLR, MOT, and SFA reporting to the State Council. *State agencies with significant impacts on water environment management:* NDRC, MOF, and SDPC (dissolved) reporting to the State Council. *State agencies coordinating water environment management:* State Council, the highest administrative authority. *National water environment management legislator:* National People's Congress, the highest legislation agency. ***Local Agencies*** *Local specialized agencies directly administering water environment:* WRBs, EPBs, construction committees, agricultural, land resources, transportation, and forestry authorities in the provinces, prefectures, and counties that report to the provinces, prefectures, and counties. *Local agencies with significant impacts on water environment management:* DRCs, finance bureaus, and development planning commissions (dissolved) in the provinces, prefectures, and counties that report to the provinces, prefectures, and counties. *Local agencies coordinating water environment management:* the provincial, prefecture, and county governments, the highest administrative authorities at the corresponding level. *Local water environment management legislator:* Provincial People's Congress with legislative authority to make local laws. ***Transboundary, watershed level organizations*** *TLB Management Committee*, the dispatched agency by the MWR in the TLB, Qiantang River watershed and Zhejiang and Fujian provinces (except the Han	The outputs analysis of this study discuss only the organizational effectiveness and issues in the TLB water environment management. (1) Water management by multi-agencies. At the state level, 7 ministry-level agencies participate in water environment management, where the MWR, SEPA, MOC, MOA and MOT are most closely related to water pollution control. At local levels, each province, prefecture, and county has established its matching agencies of the ministries. A massive multi-agency governmental network of water environment management has been established nationwide. Although the responsibilities of various agencies have been defined, overlaps still exist. In practice, the water environmental management network can work more efficacious and efficient if the overlaps or gaps can be removed. (2) The collaboration in water environment management among the involved agencies has been proved less than perfect. All specialized agencies report directly to the State Council without anyone designated to coordinate. From planning to implementation, each agency works on its own business without a truly effective coordination and collaboration mechanism. (3) *De jure*, the *Environmental Protection Act* grants SEPA the monitoring and management authority of environmental protection nationwide. However, *de facto*, SEPA is authorized to issue only quality and discharge standards. Beyond the standards, SEPA does not have any other substantive authority to monitor and manage environmental protection. The vertical leadership in environmental protection monitoring and management remains weak from the state to the local.	(1) This study discusses only from the TLB water environment pollution perspective. (2) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Category	Key Inputs	Key outputs	Key impacts
	River watershed). As a state-owned institute with administrative functions, it represents the MWR and administers the water management responsibilities in the watershed. *TLB Water Resource Protection Bureau*, in charge of watershed-wide water resources protection and water pollution prevention and control, which is under the TLB Management Committee. In theory, it is led by both the MWR and SEPA; in practice, it is led only by MWR.	(4) The MWR conducts watershed management through its dispatched organizations; SEPA manages through its watershed pollution prevention and control plans. SEPA cannot assume the role of day-to-day monitoring and management.	
Major issues	(1) Successful international experience suggests that environmental monitoring and management requires not only participation by the various local governments and specialized agencies but also coordinated, potent, and substantive management of the monitoring. Nevertheless, in China, the coordinated management of monitoring remains weak. (2) SEPA does not have substantive leadership over the local EPBs. The local EPBs are administered by the local governments in terms of financial, human, and administrative resources. (3) The responsibilities overlap among the state specialized agencies, including SEPA, MWR, MOA, and MLR. The agencies have not established an effective collaboration and coordination mechanism. (4) The transboundary environmental pollution control and dispute resolution has been curbed by the localized interests of the local governments and agencies of various levels and left without an effective resolution mechanism. (5) No watershed-based water environment management. The watershed pollution control planning does not reflect quantitative water demand, and the watershed hydraulic planning does not reflect water pollution control in the watershed. The current watershed-level management agency and mechanism do not integrate the water quantity, quality and pollution control objectives.		

3.6 Investment and Financing

Table 3.6-1 Summary of Investment and Financing

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) Finance Plan in the 9th and 10th HRB Water Pollution Prevention and Control FYPs (2) State policy, "polluters clean up," in pollution control funding (3) State policy on industrial pollutants discharge permitting system (4) State policy on financing municipal WWTPs: urban wastewater discharge fee (5) Designated Subsidy Plan of Zhejiang Provincial Environmental Control and Protection, Policy Measures of Expediting Industrial Discharge Compliance of Jiangsu Province	(1) During the 9th FYP, the Tai Lake planned pollution control investment was 129.5×10^{8} yuan; The actually investment completion rate was 77%, which was largely due to the shortage in urban WWTP construction. During the 10th FYP, the Tai Lake planned pollution control investment was 220.1×10^{8} yuan; The actually investment completion rate was 77.8%, where Zhejiang completed 99.66%, Jiangsu completed 65.79%, and Shanghai completed 50.36%. (2) The funding sources for pollution control included: central and local governments, private sector/bank loans and abroad. Different from the HRB, the TLB may have a relatively higher share of investment from the enterprises, bank loans and foreign investments. (3) Investment requirements for wastewater collection network are massive; however, the networks do not generate direct profits and can hardly be funded through the financial market. (4) In terms of the use of the funds, most of investment came into the construction of the WWTPs. (5) In terms of effectiveness, the COD discharge reduction of unit actual investment is 3.2 times of the planned volume during the 10th FYP, the NH_3-N discharge reduction of unit actual unit investment has reached 4.8 times of the planned volume. Assuming that the plans have been set up appropriately, the effectiveness of actual investment in COD reduction has been as effective as expected. (8) The investment return of municipal WWTPs have been generally low due to the low fee collection rate and WWT tariff. Some of these investment projects have turned out profitable, however, indicating municipal WWT a promising industry. (6) In terms of industrial wastewater control, the cost of compliance exceeds the cost of non-compliance. The current Chinese society does not provide tangible benefits for the enterprises to shoulder social responsibilities or to have an environmentally friendly reputation, thus disencourages investments in WWT at the enterprise level.	(1) This study discusses only from the TLB water environment pollution perspective. (2) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs
Major issues	(1) Although, according to the "polluters clean up" policy, majority of the pollution control funding should come from the polluting enterprises, in reality, most of the funding has come from central and local governments. The "polluters clean up" policy is not fully executed and does not sufficiently deter the polluters economically. (2) In the planned economy era, the investment needs for pollution control gave way to the infrastructure and technological advance, and the pollution was not adequately controlled. When history enters into the market economy, the historical burdens from previous pollutants discharge plus the economic disincentive from compliance have added to the investment requirements and made the current investment volume inadequate to curb the pollution. (3) The tariff and fine rates for pollutant discharge are too low given the economic development level to disencourage non-compliance behavior or enterprises' inputs into pollution control. (4) The wastewater discharge fee policy is incomplete and with a relatively loose implementation. In some areas, the WWT fee is far too low to recover the operational costs of the WWTPs. (5) The insufficient financing and guarantee policies especially in foreign and private capital operating in water pollution control area have elevated the risk level for investment return.		

3.7 Management Review

Table 3.7-1 Summary of Management Review

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(1) The following management institutions have been adopted in the watershed management: • Environmental impact assessment (EIA); • "Three Synchronousness (3S)"; • Pollutants TMLLs and discharge permitting system (the discharge permitting system was launched nationwide in 1988 by SEPA; in 2001 SEPA issued the *Management Provisions for the Discharge Permits in HRB and TLB*); • Accountability of environmental protection objectives; • Pollutants discharge permits; • Time-limited pollution control; • Quantitative performance evaluation of comprehensive urban environment control. (2) Established the multi-layered, multi-agency monitoring mechanism (3) In terms of watershed management, certain areas in Jiangsu and Zhejiang have piloted the small watershed pollution control plan within one jurisdiction that integrate economic development, urban construction, industrial production, water resources, pollution control,	(1) The EIA and "3S" can effectively control the potential pollution from polluting projects before they are launched. Thus, the EIA and "3S" have been valued by the central and local governments. In 2004, 99.2% of the required projects in the TLB provinces have conducted EIA, which is slightly under the 99.3% national level; the pass rate of "3S" has been 94%, also under the national average of 95.7%. (2) Since the issuance of the *Management Provisions of the HRB and TLB Discharge Permits*, the provinces in the watershed have issued implementation plans accordingly. Nevertheless, those implementation plans were not executed satisfactorily in a number of aspects: In terms of issuance, the government offices do not have the capacity to facilitate the permits issuance; most of the polluting enterprises do not have permits. In terms of enforcement and monitoring, the governments do not have the capacity to enforce the issued permits or to punish non-compliant behavior. Consequently, except for small, localized areas, the current permits system has not been able to improve the environmental quality. (3) As the environmental accountability has tied the environmental performance with the cadre performance evaluation and promotion, the government at various levels have assigned detailed environmental objectives and been enforcing annual evaluation of the objectives. Nevertheless, demotion due to failure to meet the environmental objectives has seldom been heard. Comprehensive urban environment evaluation, as part of the environmental accountability, has received significant attention. Currently there is no data set to confirm the implementation results of the environmental accountability, although all the new reports have been claiming successful implementation. (4) Limited by funding and enforcement capacities, the time-limited pollution control has played an important role in acute and severe polluting enterprises. However, human factors tend to influence its execution in the selection of the objectives, reasonability of the term, and the feasibility of the plan. (5) In terms of the environmental monitoring institutions, the local governments directly administer the environmental monitoring stations; SEPA and the headquarter monitoring station only issue standards and provide technical guidance. When the interests of the monitoring station and the local government are closely linked together, the independence of the monitoring stations will become questionable. (6) The SEPA, MWR, and MOA each have its own monitoring system. *De jure*, SEPA monitors the water quality outside the water bodies, MWR monitors the quality inside the water bodies, and MOA monitors water quality in the agricultural system. The monitoring is not unified. *De facto*, SEPA is also monitoring the water quality in water bodies, and MWR is monitoring water pollution sources. (7) The locations, times, and frequencies of the monitoring points set by SEPA and MWR are	(1) This study discusses only from the TLB water environment pollution perspective (2) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs

Category	Key Inputs	Key outputs	Key impacts
	and ecological protection considerations.	desynchronized. As a result, the monitoring results from SEPA and MWR are not comparable. (8) The environmental monitoring stations of SEPA, MWR and MOA report to their superior EPBs, WRBs, and agricultural bureaus. Those bureaus, in term, report to the local governments at the corresponding levels as well as the specialized agencies at the higher level. The environmental monitoring stations can also inform the monitoring stations of the higher level about the monitoring results directly. (9) Certain provincial governments are beginning to pay attention to the small watershed comprehensive pollution control. During the 10th FYP, Jiangsu Wuxi implemented the comprehensive pollution control of 11 creeks; Zhejiang Lin'an has implemented the pollution control programs/projects of 4 creeks. Small watershed comprehensive pollution control planning and piloting have been started and shown promising results.	
Major issues	(1) The large number of construction projects in the watershed, relatively fast economic growth compared to the national average, and the mismatch between the governance system and the economic development have led to the relatively lower implementation rate of EIA and "3S" compared to the national average. (2) The permits system involves a wide scope of arrangements in the dynamics of the natural and artificial water bodies, water resources utilization and tariffs, pollutant discharge TMLLs, watershed economic development planning, monitoring of the water bodies and pollution sources, technical administration of the permits, monitoring and law enforcement, and financing and investment. If the support from any of those aspects is missing, the implementation of the permit system will be challenged. (3) Although all the government offices claimed to have implemented the accountability requirements for the environmental objectives, no substantive improvement in the water quality in the water bodies has been identified. Therefore, either the objectives have been set too low, or the implementation of the accountability requirements of the environmental objectives remains nominal. Although the achievability of the objectives needs to be considered, more important are still the ultimate goals and the stepped action plan to achieve the goals. (4) Given wide-spread non-compliant pollutants discharge and the limited funding and government monitoring and administration capacity, the time-limited compliance can serve as demonstrative law enforcement actions, but intrinsically it convey the message of avoiding the simultaneous shut-down of large number of enterprises. In a way, it is a system that sentences the legal offense with suspended execution without prohibiting further offense and can prove counterproductive without careful execution. (5) The 23-year-old *Management Regulations on Environmental Monitoring* can no longer guide the current environmental monitoring and management. (6) Monitoring of water pollution sources requires unified management. The environmental protection authorities have not managed to centralize the administration of pollution source monitoring as required by the *Environmental Protection Act*. (7) Except the headquarter station, SEPA does not have substantive authority over other environmental monitoring stations. The true authority over the environmental monitoring stations falls into the hands of the local governments of various levels. According to the *Environmental Protection Act*, the local governments oversee the environmental protection within its territory. Given the particularities and the required independency of environmental monitoring, the weak vertical leadership of SEPA to EPBs is unfavorable to the environmental protection enforcement and monitoring. (8) The SEPA/EPBs and MWR/WRBs have overlapping responsibilities in the water environment monitoring, which has led to the waste of the limited, if not insufficient, monitoring resources. The segregated institutional arrangement has led to the lack of coordinated, synchronized, and unified arrangements in the set-up of the monitoring systems, selection of the monitoring indicators, locations, time, and frequency. No single agency will summarize, collate, and use the		

Category	Key Inputs	Key outputs	Key impacts
	monitoring data from various sources. Actually, under such segregated environmental monitoring system, even if the data were available from those agencies, they tend to be inconsistent and prove difficult to use. (9) Coordination between the *Environmental Protection Act*, the *Water Pollution Prevention Act*, and the *Water Act* in water quality monitoring is still lacking. The standards, management, and institutions in water quality monitoring remain ambiguous. (10) The lack of watershed-wide groundwater monitoring network has limited the knowledge of the watershed-wide groundwater conditions. (11) The small watershed of a river sometimes can be coordinated at the county level, if the small watershed does not cross multiple jurisdictions. And the comprehensive plan of the small watershed can relatively easily incorporate the local governmental planning. Although no concrete monitoring data can confirm quantitatively the contribution to water quality improvement from small watershed comprehensive pollution control, international experiences suggest that watershed-level comprehensive pollution control is often an approach with low-investment and high-environmental return.		

3.8 Public Participation

Table 3.8-1 Summary of Public Participation

Category	Key Inputs	Key outputs	Key impacts
Main Contents	(6) The *Constitute of the PRC* stipulates that "The people are entitled by law to manage the state, economic, cultural, and social affairs through various channels." (7) The *Environmental Protection Act* mandates that "all entities and individuals are obliged to protect the environment and are entitled to report to the higher authority or prosecute any entity and individual who pollutes the environment." (8) The *Environmental Impact Assessment Act* specifies that "the State encourages the related organizations, experts and the public to participate in the environmental impact assessment with proper manners." (9) Some provinces have experimented with and explored public participation mechanism. (10) The *Interim Provisions on Environmental Information Disclosure* (SEPA Order No. 35) was issued by on February 8th, 2007 and will be enacted on May 1st, 2008.	(4) Major forms of public participation: • Submit environmental proposals through the People's Congress, CPPCC, and the democratic parties. • Monitoring through the media by publicizing environmental conditions and the evaluation results of the urban comprehensive pollution control programs. The media can establish columns or featured programs for the public opinions on environmental protection. • Environmental petition complaint. The public can pursuit environmental lawsuits through the EPBs to safeguard its own interests and benefits. • Surveys, expert panel discussions, and public hearings during EIA. • The government consults the opinions from the related institutes and experts during policy- and decision-making, and the experts usually conduct surveys at the place of study/interest when preparing the study reports. This process represents one of the forms of the public participation in China. (5) Although in the past 10 more years public awareness of environmental protection has been significantly improved, the public participation has just begun. Forms of public participation are limited, and sound institutional support is yet to be established. (6) SEPA's *Interim Provisions on Environmental Information Disclosure* is likely the first regulatory document on information disclosure issued by the central government since the State Council's *Regulations on Government Information Disclosure*. This interim provision requires a combination of voluntary and mandatory disclosure of government and enterprise environmental information. This will significantly promote the public participation in environmental protection.	(1) This study discusses only from the TLB water environment pollution perspective (2) Same as "Table 3.1-1 Review and Summary of Pollution Control Targets of the 9th and 10th FYPs
Major issues	(1) Inadequate government and enterprise disclosure of environmental information leave the public with insufficient information to participate. (2) The current public participation activities are mostly the passive participation by the public. For example, "public participation" takes place as the distribution of survey tables to the public by the constructers of development projects and collection of the responses afterwards, without informing the public much about the projects *per se*. (3) The laws and regulations often remain "in principle" in the form of "advocacy" without specifying much of the procedure, format, time, and rights and		

Category	Key Inputs	Key outputs	Key impacts
	responsibilities of the stakeholders of public participation. Without clear guidance to the practice, the public participation regulations can hardly provide any restrictions in practice. (4) Inadequate awareness and understanding of public participation have misguided the mainstream concept of public participation as the participation by individuals. Actually, public participation refers to the participation by all stakeholder groups, which include individuals, civil societies, enterprises, institutes, and local governments. As long as the involved parties consider the discussed issue relates to their interests, they can participate to protect their benefits or to express their opinions. (5) The *Regulations on Environmental Information Disclosure (Trial)* will pioneer in China's information disclosure. As an experiment, the Regulation will need to watch for the following issues: • The local EPBs are charged with the environmental monitoring and information disclosure responsibilities, but the local EPBs are administered by the local governments. Thus, the potential conflict of interests could impede the implementation. • The voluntarily disclosed governmental environmental information by the EPBs often omits the details. For instance, "environmental quality," "environmental statistics and survey information," "contingency plans, forecasting, occurrence and handling of environmental emergencies," and "discharge TMLL allocation and issuance of discharge permits" all remain nonspecific; sometimes the disclosed information is only a brief paragraph of description. • Only "enterprises discharging pollutant exceeding the national or local standards" or "severely polluting enterprises significantly exceeding the discharge TMLLs set by the local governments" are mandated to disclose their environmental information. This accounts for only a small fraction of the total enterprises. Although emphasizing on the non-compliant enterprises, this prevents the public from monitoring the majority of enterprises, nor to encourage better performances of the compliant enterprises. • The punishment to the non-compliant enterprise – a "fine under 100000 yuan and mandated disclosure of the information" – may prove superficial and non-substantive. The regulation on non-compliant punishment can be more detailed, and for severe non-compliant behavior, the punishment could be more severe.		

4. Framework of Reform Recommendations and Priorities

4.1 Reform Objectives

1 The contents of the reform will be determined by the current issues and the target reform results, and the target reform results will in turn be determined by the ultimate objectives of the reform.

2 The sections above have summarized the current issues. The ultimate objectives of the reform, just as the *Environmental Protection Act* has articulated, should be "to protect and improve the living and ecological environment, prevent pollution and other public hazards, ensure human health, and promote socialist modernization." Since all reform recommendations have been made based on the study of the HRB and TLB water pollution control environmental policies and investment, the direct objective of the reform is to control the pollution in the two watersheds so as to improve the water environment in the HRB and TLB shared by the human and other living organisms.

4.2 Framework and Priorities of the Reform Recommendations

1 Through reviewing, analyzing, and summarizing the HRB and TLB water pollution control environmental policies and investment, this study has identified the issues within the water pollution control environmental policies and provided reform framework (Table 4.2-1).

2 The framework has designed 6 categories of target reform results: watershed baseline database; monitoring of watershed pollution source and water quality and quantity; pollutant discharge control and water body restoration; planning and financing; monitoring, management and enforcement; and government institution and collaboration.

3 The framework has classified the reform into 3 categories: policy and institutions; government institutions; and laws and regulations. Among the 3 categories, the policy and institution reform is comparatively easy due to its flexibility in scope, depth, and adaptability; the governmental institution reform involves a wide range of issues with profound implications and will be difficult to be adjusted frequently; laws and regulations reform has an impact that is even more far-reaching and will require long, in-depth preparation and involve complex processes.

4 The expected reform results revolve around the discharge permitting system; others, to a certain degree, can be regarded as its supporting system. In terms of the reform contents, the SEPA institutional reform and the reform in discharge permitting system have been identified as of the first priority in terms of action taking; other reforms can be launched after or together with the first priority reforms.

5 In setting the reform priorities, the reform in discharge permitting system has been identified as the core of the reforms and will be supported by others: the SEPA institutional reform provides institutional support; the monitoring and management reform provides the enforcement support to monitoring; and the financing and investment reform provides economic support. The launching of the supporting reforms will also facilitate the advancement of each other. The long time span required by the legal reform will not allow waiting for the maturity of its prerequisites due to the urgency of the current Huai River and the Tai Lake water pollutions. Each bits of additional

pollutants discharged will add on to the task of future environmental rehabilitation and restoration.

6 The reforms of the secondary priorities are not unimportant in terms of their significance and urgency; rather, they are reforms that will need to be built upon the first priority reforms.

Table 4.2-1 Framework and Priority of the Reform Recommendations

Priority Level	Required inputs (contents of reform)			Outputs (expected reform results)						Reform objectives	
	Laws and regulations	Govern-ment institutions	Policy and institutions	Government institutions and collaboration	Monitoring, management and enforcement	Planning and financing	Pollutant discharge control and water body restoration	Watershed pollution source and water quality and quantity monitoring	Watershed baseline databases	Phased objectives	Ultimate objectives
Level 1		Institutional reform of SEPA	Discharge permit system and TMLLs reform	Coordination among the different laws, regulations, and institutions	Unified leadership of environmental monitoring, management and law enforcement system	Comprehensive watershed-based pollution control and water resources plan that incorporates water quality and quantity and reflects the economic development features of the watershed	TMLL-based pollutants discharge target; the setting, approval, and allocation mechanism of pollutants TMLL	Unified pollution source/water quality and quality monitoring standard	Database of watershed natural/artificial environmental attributes	When the water functional objectives cannot be achieved in the short run, the phased water environment objectives can help gradually achieve the water functional area objectives or a historical relative good water quality	To protect and improve the living environment of humans and the ecological environments of other living organisms so as to ensure the sustainable development
		Water environmental protection monitoring & management reform	water pollution financing and investment reform				Discharge permitting system and its implementation mechanism	Unified requirements on pollution source/water quality and quantity monitoring and evaluating reporting	Watershed environmental/ ecological safety baseline		
Level 2	*Environmental Protection Act, Water Act, Revised Water Pollution Prevention Act*	watershed organizational and institutional reform	Watershed comprehensive planning system	Coordinated management of water environment	With proper and substantive monitoring, management, legal enforcement authorization	Pollutants discharge fee system that matches discharge permit system	Technical guidance system of discharge permits	Unified pollution source/water quality and quantity monitoring and evaluation technical guideline.	Pollutants environmental capacity baseline based on watershed ecological safety	Water functional zone objectives aiming at meeting the human water demands in production and domestic living	
							Legal requirements of water body restoration	Unified reporting/disclosure mechanism of pollution source/water quality and quantity monitoring data	Environmental capacity baseline of the environmental functional zone		
	General Principles of Civil Law, Criminal Law, Civil Procedure Law Revised	public participation reform	non-point source pollution control reform	Collaboration between multi-agencies	Judicial system that protects the interests of pollution victims	Market-based financing mechanism guided by the government	Standard system of water body restoration	monitoring technologies and monitoring institutions	Pollutants TMLLs based on phased objectives of watershed planning	Ecological safety of the water environment for the human, fauna, and flora	
							Technical guidance mechanism on water body restoration	Authorized pollution source/water quality and quantity monitoring organizations	Pollutants TMLLs regional/phased objectives.		

Notes: Arrow ⇨ indicates support from the base level to the higher level; double-headed arrow ⇔ indicates mutual support. The core and pioneering reforms are indicated with a deeper shade of color in its own area

5. Prioritized Reform Recommendations

5.1 Reform Recommendations of the First Priority

5.1.1 Institutional Reform of SEPA

1 This reform aims at establishing a new SEPA that is empowered with the unified authority to administer all affairs regarding China's pollution control and equipped with sufficient financial resources. The new SEPA will take in charge of and be held accountable for the water pollution control:

- SEPA be empowered with the complete authority to lead and enforce environmental legislations and equipped with the required funding.
- SEPA be authorized with the complete authority of environmental monitoring and equipped with the required funding.
- SEPA directly administer the provincial and local EPBs.
- In water environmental protection, SEPA be authorized to coordinate with other specialized agencies.

2 In order to ensure the effective direct administration of SEPA to the EPBs, the new SEPA could adopt an authorizing mechanism, where SEPA authorizes the provincial, prefecture, and county level EPBs the corresponding authorities in environmental protection under SEPA's monitoring; in the case of improper or mis-conduct by the authorized EPBs, SEPA can immediately withdraw its authorization. The authorization can be re-issued when the improper or mis-conduct have been corrected and the related EPB will be able to properly implement the policies.

3 An alternative to the institutional reform is to establish a Ministry of Environment & Resources to integrate the environmental functional departments under the current SEPA, MLR, MWR and other ministries. Considering the negligible chance of macro-scope administrative adjustment among the Chinese government agencies, this report does not provide detailed recommendations on the founding of a Ministry of Environment.

5.1.2 Reform in Monitoring & Management of Water Pollution Control

1 This reform aims at establishing a comprehensive set of monitoring and management institutions of water pollution control through:

- Establishing the monitoring and management institutions and implementation guidelines for water pollution control planning/plans. SEPA should be responsible for coordinating the monitoring and management of key water pollution control plans including watershed environment plans across the agencies. Such monitoring and management also include that of the water quality in the water bodies.
- Establishing the monitoring and management institution of discharge permits and TMLLs. SEPA should set the TMLLs and manage the monitoring of all key implementation processes including the inspection, auditing, approval, issuance, and

retiring of the discharge permits. This also includes the monitoring of the pollution sources. Considering the massive damage to the public and private assets caused by environmental hazards, SEPA should be endowed the authority of environmental policing so as to take immediate mandatory measures to stop polluting activities; otherwise, the public security departments must be obliged to team up with the EPBs for environmental law enforcement.

5.1.3 Management Reform of Discharge Permits and TMLLs

5.1.3.1 Overview

1 The study from the technical assistance project "TA3588-PRC Transjurisdictional Environmental Management Project" of the ADB has indicated that the discharge permits systems is an effective method of transjurisdictional watershed pollution control. SEPA has issued the *Management Regulation of the Key Water Pollutants Discharge Permits in the HRB and TLB (Trial)* in 2001. The negative experiences from the past 5 years of the implementation of the regulation have revealed problems in not the discharge permitting system *per se* but the inadequacy in its support systems. A sound supporting system should incorporate:

- Management institutions,
- Implementation procedures,
- Technical guidelines,
- Independent monitoring and its self-checking mechanism,
- Enforcement and monitoring institutions, and
- Financial support.

2 The following paragraphs will provide recommendations on the management reform in the supporting systems of the HRB and TLB water pollutants permits.

3 The reform objectives include establishing a comprehensive discharge permits and TMLLs management institution and the matching supporting system for the discharge permits implementation.

5.1.3.2 Management Institutes for Permitting System Implementation

1 The pollutant discharge permitting is a venue to achieve the TMLL targets. The institutional and legal framework as follows will sort out and clarify the implementation and monitoring mechanism of pollutants TMLLs and the discharge permits.

(1) SEPA should be responsible for coordinating with the MWR/WRBs and the related provincial governments to set the key water body functional zones and water environmental quality standards.

(2) SEPA should be responsible for coordinating with the MWR/WRBs and the related local governments to set the TMLL plans of key watersheds and of the transjurisdictional water bodies. The TMLL plans include the pollutants environmental capacity check of water body sections, identification of the major pollutants for TMLL planning, setting of the TMLLs and pollutants reduction quota and its time limits, and allocation of TMLLs within the

jurisdictions.

(3) It will be important to gradually incorporate all pollutants from industrial, urban wastewater, and agricultural point sources into the scope of pollutant discharge permitting system.

(4) The reform will need to establish a new SEPA that directly administers the provincial EPBs, which, in turn, administer the local EPBs. The new SEPA will have the authorities to administer the provincial EPBs and approve or disapprove their funding. EPBs at provincial, prefecture, and county levels will report administratively to the governments at the corresponding levels.

(5) As an intermittent solution, the new SEPA could adopt an authorization approach, where the new SEPA authorizes the provincial, prefecture, and county level EPBs the authorities to exercise environmental protection. In the case of improper or mis-conduct by the authorized EPBs, SEPA can withdraw its authorization immediately. The authorization can be re-issued when the improper or mis-conduct are corrected and the involved EPB will be able to properly implement the policies. **The following paragraphs will address the intermittent solution in greater detail.**

(6) SEPA authorizes the governments of provinces, autonomous regions, and municipalities to audit, approve, issue, or retire the discharge permits according to the pollutants TMLLs. The local EPBs are the designated agencies to implement the discharge permits.

(7) SEPA authorizes and monitors the implementation of the discharge permits. SEPA also authorizes the local EPBs to monitor. In case of non-compliance, SEPA can withdraw temporarily its authorization to the provincial-level governments for auditing, approval, issuance, or retiring the discharge permits or its authorization to the local EPBs for monitoring the permits and delegate to their higher level EPBs.

(8) The pollutants TMLLs should be disclosed to the public through fixed channels by the EPBs.

(9) The auditing, approval, issuance, or retiring of the discharge permits are open to the public. Per SEPA's authorization, the provincial-level governments are responsible for informing the public.

Box 5.1.3.1-1 Inconsistency regarding Pollutants TMLLs and Permits Management in the *Environmental Protection Act*, *Water Act*, and *Water Pollution Prevention Act*

The *Environmental Protection Act* does not include contents regarding pollutants TMLLs and permits management. Article 27 reads that "Enterprises and institutions discharging pollutants must report to and register with the relevant authorities in accordance with the provisions of the competent department of environmental protection administration under the State Council." This can be understood as that so long as the registration has been successful, the discharge will be legal. This is not permits management.

Article 32 of the *Water Act* has required the MWR to verify the water environment capacity and the TMLLs. The MWR monitors the water quality. In the case of non-compliant discharge or the failure to meet the water quality requirements of the water functional areas, the MWR should report to the related authorities and notify SEPA.

Article 16 and 17 of the *Water Pollution Prevention Act* have designated the provincial

governments or higher to implement the pollutants TMLLs. The State Council is responsible for issuing the detailed approaches. SEPA/EPBs together with the MWR/WRBs and the related provincial governments select the appropriate water environmental quality standards for the water bodies at provincial boarders in the key watershed. Upon the State Council's approval, the standards will be enforced.

Article 6 through 10 of the *Implementation Details of the Water Pollution Prevention Act* spelled out the TMLLs planning, and the allocation and issuance of the discharge permits. Based on those articles, SEPA together with other related agencies and the local governments issue the TMLL plans of the key watersheds for the State Council's approval. The TMLLs of transjurisdictional water bodies will be made through consultation among the involved provinces, autonomous regions, and municipalities.

5.1.3.3 Implementation Procedures of Permits

1 To successfully implement the permits, the current permits management institutions need to be revised and the permits implementation mechanism be perfected gradually through:

(1) Establishing a state-level specification on delineating the water body functional zones, where the details on management, organizational structure, principles, methods, and procedure of setting or revising water functional zones and water quality standards are articulated.

(2) Establishing the legislative standard procedures for calculating and verifying the water body pollutants TMLL, which is based solely on the environmental and ecological safety.

(3) Establishing the standard procedure for operationalize water body pollutants TMLL plans, which specifies the management, organizational structure, principles, methods, and procedure of water bodies pollutants TMLL plans. Considering that most water bodies have been receiving pollutants exceeding their environmental capacity based on ecological safety, the pollutants TMLL plans need incorporate the reduction plan of pollutants exceeding the TMLL.

(4) Establishing the detailed allocation scheme of the pollutant discharge TMLL and its reduction plan among the industrial, urban wastewater, agricultural point sources. The allocation will be the only basis for permits issuance.

(5) Setting detailed regulations of pollutant discharge permits including declaration, registration, and verification of pollutants discharge and the auditing, approval (or rejection), retiring, monitoring (including punishment) of the permits. The issued permits must be equal or less than the allocated pollutants discharge.

(6) Specifying the contents and formats of the permits, including the types of pollutants, discharge limits, effective time frame, rights and obligations, monitoring methods and requirements (locations of sampling, sampling methods, water flow measurement, time, frequency, analysis, and legislation), day-to-day self-monitoring of the pollution dischargers, and the requirements of government monitoring reports.

5.1.3.4 Monitoring System of Permits

1 The current environmental monitoring institutions needs to match the requirements for permitting system, where:

(1) SEPA is responsible for the monitoring and evaluation of the water quality in the water bodies nationwide, the reporting of the water quality, and the establishment, management, and publicizing of the water quality database.

(2) SEPA is responsible for setting and updating/publicizing regularly the national standard water quality monitoring & evaluation reporting standards and the guideline for reporting, which include the objectives, indicators, design (location of the monitoring points, sampling methods, time, frequency, analysis, and legislation), quality assurance, data evaluation, water quality evaluation legislation, and water quality evaluation results. Any monitoring organization can conduct monitoring in the designated watershed according to the selected standards, once authorized by SEPA.

(3) SEPA is responsible for the data summary, analysis, and publicizing of the pollution sources. All other environmental monitoring organizations, including the environmental monitoring stations under SEPA, MWR, MOA, MLR, industries, and any other legal, certified monitoring stations and laboratories, can conduct independent monitoring within the scope of SEPA's authorization and receive funding accordingly from SEPA.

(4) The subordinate environmental monitoring organization of SEPA includes only the headquarter and regional central stations. Their responsibilities include making the regulations and guideline, summarizing and analyzing data, technical guidance, monitoring and auditing other monitoring stations. All other environmental monitoring organizations, including the environmental monitoring stations under SEPA, MWR, MOA, MLR, industries, and any other legal, certified monitoring stations and laboratories, can conduct independent monitoring within the scope of SEPA's authorization and receive funding accordingly from SEPA.

(5) The monitoring rights of individuals, NGOs and other entities not authorized with monitoring responsibilities should be legitimatized to monitor the water bodies and pollution sources according to the publicized monitoring standards. The results of the monitoring can serve as evidence for non-compliance. The authorized monitoring stations are responsible for verification. The rights of the individuals, NGOs, and other entities not authorized with monitoring responsibilities are inviolable. Impedance of their sampling of the water bodies or pollution sources with the approved procedure is prohibited.

5.1.3.5 Monitoring and Enforcement

1 Successful monitoring and enforcement would require changes in the segregated management framework between the central and local agencies and adoption of the monitoring and management authorization by SEPA, where:

(1) SEPA is responsible for the monitoring of the discharge permitting implementation; SEPA can authorize the local EPBs to monitor.

(2) Articles on civil and criminal liabilities to the *Civil Litigation Act* and the *Criminal Law* regarding pollutant discharge permitting should be added.

(3) Polluters are required to establish self-monitoring systems according to the monitoring

standards and report the monitoring results, including non-compliance results, to the overseeing EPBs. SEPA or the authorized EPBs will dispatch inspectors to check the pollutants discharge. The pollutant discharge monitoring results from the self-monitoring facilities or the EPBs will be open to the public.

(4) Impose premier level discharge tariff to non-compliant discharge exceeding the permits. For severe non-compliant discharge, SEPA or the authorized EPBs will enforce immediate ceasing of the discharge (not timed correction) and impose fines. The amounts of the fines should far exceed the regular cost of pollution control. For cases where environmental restoration is needed, the EPBs will evaluate the cost of restoration, mandate environmental restoration, and monitoring and acceptance of the restoration efforts. The polluters will bear the cost of restoration.

(5) For deliberate violation to the discharge permitting or severe damage to the environment or human health due to pollutant discharge, SEPA or the authorized EPBs will inform and immediately initiate civil or criminal procedures together with the judiciary according to the *Civil Law* or the *Criminal Law*. The EPBs will be responsible for the valuation of environmental indemnity or the cost of restoration.

(6) SEPA can withdraw partially or in entirety the authorization to the government offices designated the management of environmental monitoring in the case of incompetence, neglect, or misconduct and hand over the authorization to its superior agencies. SEPA can also withdraw partially or in entirety the authorization to the monitoring organizations and reduce its funding in the case of incompetence, neglect, or misconduct and hand over the authorization to other monitoring organizations.

(7) The *Regulations on Administrative Handling of Environmental Disputes* and the *Regulations on Health Hazards Compensation* should be issued and enacted.

5.1.3.6 Financing Mechanism

1 The new financing mechanism should increase the SEPA/EPBs administrative budget and add monitoring and enforcement budget of SEPA's in the state budget. In particular, it should:

(1) Impose pollutants discharge fee to the discharge within the discharge permits quota, where the pollutants discharge tariff must be set with full consideration of the accumulated pollution in the surface water, groundwater, and soil and the potential future restoration costs. Impose premier pollutants discharge fee for discharge exceeding the permits allowance, where the premier tariff must fully consider the pollution cleaning and environmental restoration costs.

(2) Establish the State Pollution Control Fund and its independent management organization. The Fund provides loans to pollution control research, design, and engineering projects. SEPA approves and monitors the fund uses.

(3) EPBs at various levels are responsible for the collection of the pollutants discharge fees. The collected pollutants discharge fee will be fused into the State Pollution Control Fund.

(4) Establish the State Environmental Pollution Risk Insurance Fund and mandate participation of the polluters according to their discharge levels. The polluters can choose to increase the amount of insurance.

(5) The administrative and monitoring and enforcement costs of SEPA should be included in the state budget. SEPA then disburses its monitoring funding through limited tendering to the authorized monitoring organizations.

(6) The administrative and enforcement expenses of the EPBs are listed in the government budget of the according level.

5.1.3.7 Discharge Permitting System and the Permits Trade

1 Upon the successful enforcement of the discharge permit system, the polluters will tend to trade the permits to maximize efficiency. The state should allow the permits trade to develop and issue regulations on permits trade.

2 The permits trade is closely related to the institutions, policies, and the monitoring and management system of pollutants TMLLs, pollutant discharge fees, watershed pollution control, and water resources utilization. It is a market-oriented behavior by the economic entities under the complex of policies and institutions.

3 In the two watersheds, the supporting policies for the discharge permits traiding system are far from adequate. The low collection rate of wastewater discharge fee, low tariff of water resources extraction fee, and the current weak inforcement of the discharge permits disencourage permits trade. Therefore, this study recommends first launching the reforms in legislation, institution, and policies then gradually launch the permits trading, depending on the needs for the trade. However, the reforms in legislation, institution, and policies need take into full consideration of the possible future permits trade.

5.1.4 Investment and Financing Reforms

1 The reform objective is to establish a market-based water pollution control mechanism under the governmental guidance. Its main features include:

- Raising the wastewater discharge tariff and impose high premier fee standards for non-compliant discharge (excessive in quantity or pollutants density) to economically disencourage non-compliant activities. The imposed premier fee must be as high as the total treatment cost of the non-compliant discharges. When environmental restoration is needed, the restoration costs will be imposed to reflect the "polluters clean up" policy. The fees are to internalize the pollution costs to the accounting of the polluters and to free the public from pollution hazards and the government from the cost of cleaning up.
- Raising urban wastewater tariff, tightening the wastewater fee collection, encouraging the use of the civil society funding in urban WWT, issuing regulations and promoting public private partnerships (PPP), and promoting domestic and foreign civil investment into the water pollution prevention and control.
- Establishing the government public budget system and increasing the budget allocation

to watershed pollution control in central and local government expenses, especially in the investments in the municipal WWTPs.

- Establishing the State Pollution Control Fund to centralize all available funding for pollution control.
- Establishing the compulsory State Environmental Pollution Risk Insurance Fund to ensure restoration incurred by pollution incidents.

Box 5.1.4-1 Reversed Economic Incentive of Pollution Control

A close look at the discharges from a chemical enterprise required for Grade II discharge standards reveals the reversed economic incentive for pollution control. The plant discharges daily 1000 m^3/day wastewater of pH 10.8, which contains on average COD 750mg/L, anionic surfactants 180 mg/L, BOD 190mg/L, and SS 330mg/L. This wastewater has exceeded the standard requirements. According to the *Collection and Management Provisions of Pollutants Discharge Fee* (State Council, 2003 Order No. 31), the discharge fee for the non-compliant discharge should be 3.01 yuan/m^3. However, should the enterprise opt to treat its wastewater prior to discharging, it will need to invest 1348×10^4 yuan in the WWTP and pay for the WWT cost (including equipment depreciation) at 5.36 yuan/m^3. On top of that, the plant will still need to pay for the wastewater pollutants discharge fee at 0.17 yuan/m^3. Thus, paying for the non-compliant discharge is much cheaper.

5.2 Reform Recommendations of the Second Priorities

5.2.1 Revise the *Environmental Protection Act*, the *Water Act*, and the *Water Pollution Prevention Act*

1 The reform objective is to establish a potent environmental protection and monitoring system where the government agencies coordinate and collaborate in pollution control and the mutually supporting and coordinated environmental legislations through:

- Revising the *Environmental Protection Act* by legitimatizing SEPA's authority in leading the monitoring and coordinating from the central to the local governments and the hydraulic, agricultural, land resources, and construction authorities.
- Revising the *Water Act* the *Water Pollution Prevention Act* based on the revised *Environmental Protection Act* to reflect the new pollutants TMLLs and discharge permitting system and to resolve the issues of overlapping or undefined responsibilities and sketchy regulations.

5.2.2 Comprehensive Watershed-Based Planning System

1 The reform aims at establishing a watershed-based planning system, which includes water pollution control, water ecology, water resources utilization, and flood prevention. First, the management of water quality and quantity cannot be segregated; the water management planning must integrate both. Second, detailed and programmatic requirements for collaboration between the SEPA/EPBs and MWR/WRBs must be defined. Third, by drawing experiences from the watershed-based comprehensive planning among the EU countries, the water management planning must be watershed based and reflect the collaboration between SEPA/EPBs and

MWR/WRBs. Forth, the plans must incorporate water pollution control, water ecology, water resources utilization, and flood prevention and coordinate with the enforcement reform to establish a dynamic monitoring and inspection mechanism for the plans.

5.2.3 Reform Recommendations on Watershed Management Organization and Institution

1 The reform aims at establishing a coordinated and unified water environment management institution:

- The SEPA, MWR and the provincial governments work toward unified watershed management through joint watershed planning. SEPA should be responsible for the monitoring and management of pollution control and water quality in watershed planning.
- SEPA should be responsible for the monitoring and management of watershed pollutant discharge, the water quality in the water bodies and groundwater quality. Upon SEPA's authorization, the monitoring organizations under SEPA, MWR, and MLR should conduct monitoring and report the monitoring results to SEPA based on the standardized monitoring requirements. SEPA will provide the funding for the monitoring.
- It will be necessary to reorganize the current watershed water resources protection bureau into an office with combined responsibility of monitoring and management for watershed water resources and water environmental protection. With SEPA's authorization, this office will monitor and manage the development and exploitation of the watershed water resources on SEPA's behalf. Specifically, its responsibilities will include: organizing the preparation of watershed water resource protection plans and monitoring the plan implementation by the local governments; inspecting, monitoring and management of the local water resource development projects; monitoring of transjurisdictional water quality and providing guidance to transjurisdictional pollution dispute resolution; preparing the watershed ecological water use or ecological flow plans and monitoring their implementation.

5.2.4 Reform Recommendations on Non-Point Source Pollution Control

1 The reform aims at establishing the agricultural non-point source survey and study plan and making agricultural non-point source control plan together with the current rural development plan in China:

- As the agricultural non-point source pollution has become an increasing signficant water pollution source, SEPA in collaboration with the MOA should immediately launch the watershed-wide agricultural non-point source survey and study. Upon understanding of the agricultural non-point source conditions, SEPA and MOA should together work on the agricultural non-point source control plan.
- SEPA together with the MOC should initiate the survey and study on urban non-point source pollution.

- Further actiions includ issuing the *Regulations on Agricultural Clean Production* to form an agricultural and ecological legal system to prevent the rural non-point source pollution from its sources, revising and issuing new standards, technical guidance and operational guidelines on rural non-point source pollution prevention and control, issuing prescribed agricultural technical standards, and improving the industrial layout of plantation and husbandry.

- The reform also includes promoting environmentally friendly agricultural production techniques through subsidies and adopting agricultural production technical standards. The promoted technologies include improved fertilizing techniques, low toxicity, low residual and biological pesticides, utilization of animal excreta, and agricultural clean production.

- The reform will also issue the *TLB Rural Non-Point Source Pollution Prevention and Control Plan* and the *HRB Rural Non-Point Source Pollution Prevention and Control Plan* as part of the watershed comprehensive plan.

5.2.5 Modification or supplements to the *General Principles of Civil Law*, the *Criminal Law* and the *Civil Procedural Law*

1 The reform aims at establishing and improving the environmental pollution dispute handling mechanism, the environmental torts civil liability institution and victim assisting legal institutions through:

- Issuing the *Environmental Tort Civil Liability Act*. As a special civil law, the Act supplements the indemnity liability of environmental torts, which covers the environmental torts indemnity and damage removal liability. The articles on indemnity for environmental liability should be defined based on the principle that the environmental indemnity should cover all damages and designate the identification organization of the damage and indemnity, lay out the scope and valuation of indemnity, and put forth and restoration requirements. The liability in damage removal should cover both damage removal and interest measure. The articles on indemnity for civil liabilities should clarify the suitable elements for liability removal, suitable conditions for measurements of interests, and the liability removal methods

- Perfecting the environmental litigation procedures to fit into the particularities of environmental torts, relaxing the filing requirements and enforcing the reversed burden of proof, and perfecting group and environmental public interest litigation.

- Enforcing the "total indemnity" principle that all damages should be compensated to achieve civil indemnity for restoration, punishment, prohibition, and prevention and defining the scope and amount of compensation. The affordability issue of the tortfeasors should be resolved through environmental torts liability insurance.

- Laying out the scope of environmental torts indemnity, which should encompass direct and indirect property damage, personal injury, and pollution control and environmental restoration. The traditionally defined indemnity scope of property damage in the *Civil*

Law can no longer suit the particularities of environmental torts. The valuation of environmental torts indemnity should clarify the scope of the indemnity liability and how the victims could be timely assisted. The scope of personal injury indemnity should be legitimized according to the "total indemnity" principle. The valuation standards and procedure of the damage should be defined in the regulations based on the protection of the disadvantaged groups to reduce the randomness during valuation processes. Standards and procedures on environmental restoration will be needed to clarify that environmental damages bring detriments to not only individual health but also the living environment of the human. Environmental restoration needs to be long-term oriented.

5.2.6 Reform in Public Participation Mechanism

1 The reform aims at establishing the mechanism for public participation in environmental monitoring, decision-making, and proactive law enforcement/plan implementation by establishing specific regulations and implementation guidelines through:

- Acknowledging the public's right to know and right to participate in environmental affairs in the legislation, standardizing the legal procedure of public participation in the practices of the permitting system, and specifying concrete and practical procedures in the related civil and administrative litigation to ensure the effective participation by the public in the environmental affairs.
- Timely publicizing and updating environmental law enforcement information including water bodies environmental monitoring, pollution source discharge monitoring, and discharge permit system.
- Timely publicizing the implementation information of environmental legislation/plans and issue the concrete and practical procedural provisions on public participation in pollution control planning/plans.
- Establishing the mechanism of public participation in environmental monitoring by allowing the public monitoring of water quality and pollution sources of the water bodies.
- Revising the *Constitute* at a proper time to spell out the citizens' environmental rights by acknowledging the public's right to know of and the right to participate in the environmental affairs and confirming a procedure that ensures the citizens to exercise their right to participate when issuing and revising the environmental legislations and other laws concerning environment and resource protection. Through legislation, an environmental information disclosure mechanism should be established to cover the various aspects and levels of environmental protection administrative authorization, specify the approaches and forms of public participation in environmental decision-making, standardize the legal procedures of public participation in environmental administrative authorization, improve the related civil and administrative litigation system and civil and administrative indemnity mechanism concerning the citizens' environmental rights, and ensure the public participation in the environmental affairs with more concrete institutions and more practical procedures.

Volume VI

GUIDELINES FOR WATERSHED EVALUATION

Table of Contents

1. Overview 1
   - 1.1 Inroduction 1
   - 1.2 Objective 1
   - 1.3 Framework 1
   - 1.4 Users 1
   - 1.5 Notes on Use 1
2. Evaluation Methods 2
   - 2.1 Types and Meanings of Evaluation 2
   - 2.2 Basic Methods of Evaluation 2
     - 2.2.1 Basic Evaluation Methods 2
     - 2.2.2 Introduction of the Major Techniques and Tools of Evaluation 4
   - 2.3 Basic Procedure of Evaluation 6
     - 2.3.1 Introduction 6
     - 2.3.2 Objective of Evaluation 6
     - 2.3.3 Set the Scope of Evaluation 7
     - 2.3.4 Setting the Evaluation Principles 8
     - 2.3.5 Setting the Evaluation Work Plan 10
     - 2.3.6 Survey, Data Collection and Data Quality Control 11
     - 2.3.7 Data Analysis and Application of Models 12
     - 2.3.8 Optimizing Evaluation Results 12
     - 2.3.9 Preparing Evaluation Reports 13
3. Important Evaluation Tools 13
   - 3.1 Result-Based Logic Model 13
     - 3.1.1 Concept of the Logic Model 13
     - 3.1.2 Logic Model and its Application in Evaluation 13
   - 3.2 Objective Tree 15

1. Overview

1.1 Introduction

1 This guideline is prepared for watershed environmental policies and investments evaluation; it is based on the requirements of the TA project "Evaluation of Environmental Policies and Investments for Water Pollution Control in the Huai River Basin and the Tai Lake Basin". The guideline describes the methodologies adopted in this TA project; and thus can also serve as the summary of the methods used in this TA project.

1.2 Objective

1 The objective of the guideline is to provide a comprehensive and widely applicable methodology for the watershed evaluation of environmental policies and investments in watershed pollution control.

1.3 Framework

1 This Guideline includes the following major components:

- Overview — Describe the background, objective and the major notes on use of the Guideline.
- Evaluation methods — Introduce and explain the recommended major evaluation methods, and elaborate the evaluation procedures.
- Evaluation tools — Introduce the major tools for the evaluation.

1.4 Users

1 The recommended users of this Guideline include researchers and policy-makers of environmental and investment policies on watershed water pollution control, and planners of comprehensive watershed water pollution control plans. This Guideline can also serve as a useful reference during evaluation and decision-making for professionals in other related organizations such as governments, NGOs, and corporations.

1.5 Notes on Usage

1 This Guideline focuses on the environmental and investment policy evaluation of watershed water pollution control on the following aspects:

- Recommending suitable evaluation methods ;
- Laying out evaluation process;
- Elaborating crucial evaluation tools ;
- Exemplifying with cases the application of important methods and tools.

2. Evaluation Methods

2.1 Types and Meanings of Evaluation

1 Evaluations can be briefly classified as pre-evaluation, which is to understand the design and feasibility of the evaluated objects; in-progress evaluation, which is to track the project progress, understand the effectiveness of the evaluated objects, and to provide recommendations on amendments if needed; and post-evaluation, which is to understand the effects of the evaluated objects, and to provide recommendations for future endeavors.

2 Evaluation of policies and investments is actually the analysis of the values of the policies and investments in a broad sense. In the narrow sense, policies and investments evaluation is to find the effects of policies and investments when implemented, understand the current level of achievement and causes of the expected and unexpected results, and the gaps between the objectives and the actual results, so as to provide interpellation and recommendations.

3 From a typical "decision-making – execution – results – evaluation" policies and investments cycle, one can see that evaluation is an important part of the entire life cycle. Evaluation facilitates understanding the reasonability of the policies and investments and their objectives, finding potential problems, and providing recommendations.

4 The evaluation Guideline in this volume has been prepared and thus applied to the post-evaluation. But the guideline can be used for pre- and in-progress evaluations, given the wide applicability of evaluation methods.

2.2 Basic Methods of Evaluation

2.2.1 Basic Evaluation Methods

1 Generally speaking, any method/model, which can help reason and deduce, link the input with the output/outcome such as the logical and mathematical analysis methods and models, can be an evaluation method.

2 The environmental policy, water pollution control investment, and water pollution control planning of water basins exhibit their specific attributes: macro, wide in scope, with lasting impacts, related to various government agencies, and a variety of uncertainty in the course of implementation. Accordingly, the evaluation will require large quantity of comprehensive, consistent data that tend to be difficult to acquire. Moreover, compared to the evaluation of construction projects, policies and investments evaluation is more sophisticated, needs to incorporate more impact factors, and considers more complicated causality and richer information sources. Subsequently the evaluation methods employed should respond to those specifics. Among the available evaluation techniques and methods, no single method would be able to meet the comprehensive requirements of this evaluation task; therefore, this evaluation will adopt multiple evaluation methods.

3 This Guideline recommends the following evaluation methods based on the need of policies and investments evaluation. The following methods/tools are not necessarily exclusive of each other, nor meant to be independent of each other evaluation method but an

attempt to summarize categories of evaluation methods/tools or approached from an applied perspective.

(1) Qualitative Evaluation

4 The qualitative evaluation is to derive or infer concepts from the indicators, specific instances or occurrences, and perform the evaluation through the process of description, analysis, argumentation or comparison. It is mainly used to evaluate policy outcomes and impacts, and laws; and in cases where indicators are difficult to measure but more of qualitative descriptions.

(2) Quantitative Evaluation

5 The quantitative evaluation is to quantify the objectives, occurrences or indicators, and evaluate the intended targets by mathematical or numerical analysis or numerical comparison. It is mainly used to evaluate program implementation results and to measure against the objectives; and incases where indicators are well defined, and measurable.

(3) Relative Evaluation

6 The relative evaluation will compare the current facts with the history and the goals expected in a plan. It mainly evaluates policy outcomes and impacts, laws, program implementation and investment and economic conditions; in cases where baseline or reference values are used.

(4) Absolute Evaluation

7 The absolute evaluation will compare the current facts with the pertinent national standards. It is mainly used for evaluation for environmental quality and program implementation.

(5) Evaluation by On-Site Spot Testing or Monitoring

8 The evaluation by on-site monitoring is to obtain or verify the data, evidence or information through site visit, survey or on-site monitoring/measuring, and then identify potential problems or reasons. It is mainly used for data quality control and the evaluation for program implementation.

(6) Adopting Models

9 Here in this report, the evaluation by making use of a model means to employ the logic model. The logic model will help to tidy up the components of the instances or occurrences like input, activities, outputs and outcomes by logical relations; and the logic model will also help to analyze the inherent or any other potential relations of the components. Then we could draw or deduce conclusions and suggestions through the qualitative and quantitative evaluation, the relative and absolute evaluation, or the evaluation by monitoring on site. The logic model represents a method to present the logical relations between events took place in the past or to take place in future. It can be used throughout the evaluation process.

(7) Expert Opinion

10 Evaluation by using expert opinions takes place subsequent to the preliminary analysis through qualitative, quantitative, relative, and absolute evaluation methods and on-site monitoring and drafting of the evaluation reports. The experts from various related disciplines will receive the draft reports and provide their opinions.

11 Given the wide scope and impacts of the watershed environmental policies, water pollution control investment and plans, different experts tend to draw different conclusions from the same set of facts and analytical results. This will be even more evident when the experts belong to different fields of studies or from different interest groups. This adds value to the opinions from the experts, as they help enrich and make comprehensive the evaluations, especially when the necessary data are incomplete and are difficult to quantify, and in cases where a diversified stakeholders are encountered as in this TA project.

(8) Public Participation

12 Public participation evaluation is a process that engages the general public through social survey and consultation (such as designing questionnaires, distributing to the stakeholder groups and the public, acquiring public opinion and publicizing survey results). After having the preliminary evaluation results, public participation will organize meetings/workshop/symposia to convey results, initiate further debate/discussions widely participated by stakeholders to allow exchange between the evaluation team and the stakeholders. In principle, public participation evaluation should impose decisive influence on the evaluation results. However, considering the situations in China where public consultation is a new concept, the scope, depth and reliability of public participation results may be limited. Therefore, the results of public participation evaluation will only be used as reference currently.

13 In practices, evaluation methods should suit the needs of the scope, objects, objectives and basis of the evaluation. Due to the wide scope and objects of the evaluation in this TA, the evaluation methods should combine qualitative and quantitative evaluations, relative and absolute evaluations, and on-site measuring and modeling.

2.2.2 Introduction of the Major Techniques and Tools of Evaluation

1 In the evaluation process, a combination of evaluation techniques and tools has been adopted:

(1) Statistical Analysis

Statistical analyses include statistics inference, statistical tests, regressions, correlation analysis. Mathematical statistical techniques and tools are mostly used in collating, comparing, and analyzing data.

(2) Inventory or Matrix Analysis

Inventory and matrix analysis include data table and data matrix analysis and impact factors inventory and matrix analysis. Data table and data matrix analysis are mostly used to compare data and trend analysis. Impact factors inventory and matrix analysis are mostly used for multi-factor identification and nexus analysis among the impact factors.

(3) Forecast Methods

Forecast methods include analogy forecast and logical deduction forecast. Analogy forecast is often used in referencing international and domestic experiences and trend analysis processes. Logical deduction forecast is frequently used causality deduction from either the causes to the results or from the results to the causes.

(4) Logic Models

Logic models include the logic model and objective tree analysis. The logic model is to analyze the nexus between multiple factors so as to identify the hidden problems or to illustrate reasoning.

(5) Sampling and Monitoring Techniques

Sampling and monitoring techniques include socio-economic survey sampling techniques (which is mainly used for the verification of economic data) and sampling and monitoring techniques for water quality and quantity (which is mainly used to check the reliability and usability of water quality and quantity data and on-site data verification).

(6) Survey and Questionnaire

According to the objective and the scope of the evaluation, survey questionnaires are designed for various sub-topics, which include the general laws policy survey questionnaires, special policy, institution survey questionnaires, and economic investment survey questionnaires. The survey and questionnaire methods are generally used in the public participation evaluation.

(7) On-site Survey and Interviews

According to the evaluation objective and its scope, typical survey sites are selected. During the surveys, informants will be interviewed on-site. On-site survey and interviews are mostly used for data collection and case studies.

(8) Information Dissemination Using Media Resources

Information dissemination using public media resources including broadcasting, television, newspaper, Internet about the evaluation will serve two purposes: Dissemination during evaluation processes aims at broader public participation; post-evaluation dissemination is to inform the public about the evaluation results and to take active actions.

(9) Expert Symposia

Water basin, policies and investments are topics covering a broad scope of disciplines. Although the evaluation experts belong to their own particular fields, due to the complexity and inter-connections of the impact factors, experts of a particular field also need the support and assistance from experts of other fields, especially for the comprehensive issues. Symposia that convey experts of various fields thus become an

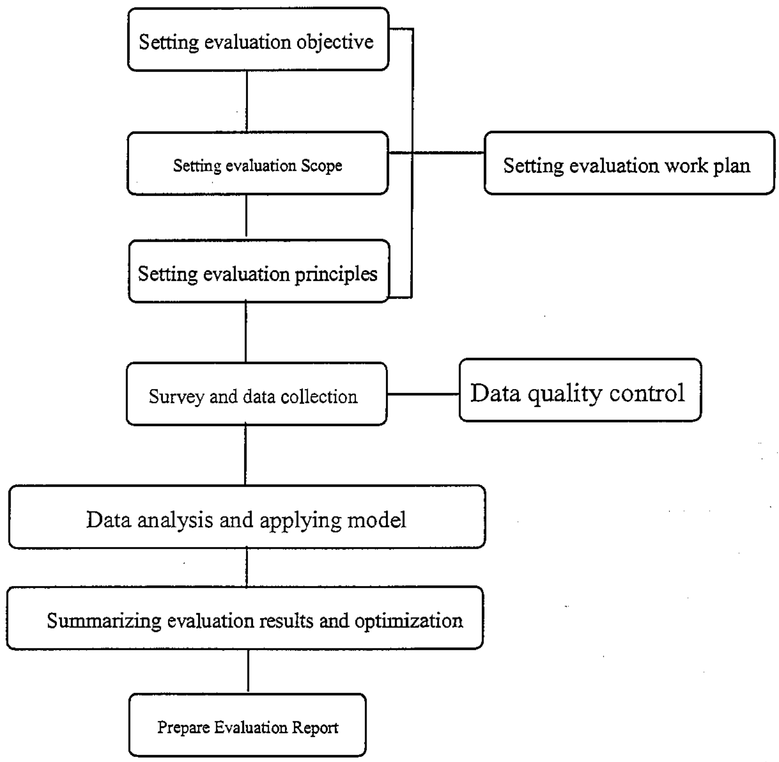
important evaluation tool to consolidate expertise and solve the difficult issues.

2.3 Basic Procedure of Evaluation

2.3.1 Introduction

1 The basic procedure of evaluation includes setting the work plan, objective, scope, and the principle, conducing survey, collecting data, performing data quality control, data analysis, applying the models, summarizing and optimizing the results, and preparing evaluation reports. Each step should incorporate the commentaries from external experts beyond the evaluation team. This is especially important during the preparation of the evaluation report, which requires at least one commentary by external experts. Figure 2.3.1exhibits the framework of basic evaluation procedure.

Figure 2.3.1-1 Framework of the Basic Evaluation Procedure



2.3.2 Objective of Evaluation

1 The objective of the evaluation is the core of the evaluation and needs to be confirmed and agreed upon by the parties involved prior to the evaluation. The evaluation objective also needs to be definite and clear, as the defining and detailing of other aspects of the evaluation will all depend on the evaluation objective.

Evaluation of Environmental Policies and investments for Water Pollution Control in the HRB and TLB

Evaluation Objective:

Conduct comprehensive evaluation of the **efficacy** of the policy framework and investment in the HRB and TLB during the 9th and 10th FYPs.

2.3.3 Set the Scope of Evaluation

1 The scope of the evaluation is frequently set together with the evaluation objective, because the evaluation objective usually decides the scope of evaluation. Once the evaluation objective is being set, the scope of the evaluation can be specified and shall be as detailed as possible. When setting the evaluation scope, the evaluation objective must be fully covered, but the scope itself has to remain viable; it needs to be realistic and cannot cover everything.

Evaluation of Environmental Policies and investments for Water Pollution Control in the HRB and TLB

Scope of the evaluation:

For the "Evaluation of Environmental Policies and investments for Water Pollution Control in the HRB and TLB," its scope is the central and provincial governments' environment and investment laws, policy, statutes, plans, programs, criteria and management system and capacity regarding the HRB and TLB during the 9th and 10th FYPs. The detailed contents are as follows:

(1) Laws on Water Pollution Control in the PRC

- Environmental Protection Act of PRC, December 26th, 1989
- Water Act of PRC, October 1st, 2002
- Clean Production Promotion Law of PRC, January 1st, 2003
- Environmental Impact Assessment Act of PRC, September 1st, 2003
- Water Pollution Prevention and Control Act of PRC, May 15th, 1996
- Flood Prevention and Control Law of PRC, January 1st, 1998
- Soil Conservation Law of PRC, June 29th, 1991
- Township Enterprise Law of PRC, January 1st, 1997
- Administrative Permission Act of PRC, July 1st, 2004

(2) Regulations and Policies on Water Pollution Control in the PRC

- Detailed Regulation for the Implementation of the PRC Water Pollution Prevention and Control Law, The PRC State Council, March 20th, 2000
- Construction Project Environmental Protection Regulation, the PRC State Council, November 11th, 1998
- Decision Regarding the Implementation of Scientific Development and Strengthening the Environmental Protection, The PRC State Council, December 3rd, 2005
- Administrative Punishment Measures in Water Sector, December 26th, 1997, MWR

- Implementation Measures of Water Intake Permit, September 1st, 1993
- Management Measures on Water Function Zone, May 30th, 2003, MWR
- Management Measures on Pollution Sources Monitoring, November 1st, 1999, SEPA
- Management Measures on Livestock and Poultry Breading Pollution Control and Prevention, SEPA
- Environmental Protection 10th FYP, SEPA, December 30th, 2001
- HRB and TLB Important Water Pollutants Discharge Permits Management Provisional Measures, October 1st, 2001, SEPA

(3) Regulations, Policies and Plans on Water Pollution Control in the HRB

- HRB Water Pollution Prevention and Control Provisional Regulation, August 8th, 1995, State Council
- HRB Water Pollution Prevention and Control Plan and 9th FYP
- HRB Water Pollution Prevention and Control 10th FYP
- Government Performance Evaluation Methods on Realizing of HRB Water Pollution Prevention and Control Objectives, December 12th, 2005, SEPA
- Circular on the Strengthening of HRB Water Pollution Prevention and Control Works, 2004-12-28, State Council of PRC
- Circular on the Implementation of HRB Water Pollution Prevention and Control 10th FYP, June 25th, 2003, SEPA
- Schedule during 2003-2005 for the HRB Water Pollution Prevention and Control 10th FYP, January 20, 2004, Henan, Anhui, Jiangsu, Shandong Provinces
- Work Assignment on the Implementation of the Strengthening of HRB Water Pollution Prevention and Control from the State Council, April 22nd, 2005 SEPA

(4) Regulations, Policies and Plans on Water Pollution Control in the TLB

- TLB Water Pollution Prevention and Control 9th FYP and 2010 Strategic Plan
- TLB Water Pollution Prevention and Control 10th FYP
- Circular on Authorization the Water Intake Permit Management to TLB Management Bureau, January 10th, 1995, MWR

2.3.4 Setting the Evaluation Principles

1 Evaluation principles refer to the criteria of assessment and or judgment. Fairness and reasonability are the fundamental features of the evaluation principles. The principle of assessing the watershed policies and investments should be whether the objectives of the policies and investments have been achieved. The assessment/judgment should be made based on the indicator system and the criteria selected, as well as the indicative data and their spatial and temporal features.

Evaluation of Environmental Policies and investments for Water Pollution Control in the HRB and TLB

The HRB and TLB 9th and 10th FYPs summarize all policies and investments in the HRB and TLB during the decade. Thus the basis of the evaluation should be compatible with the indicator system, collection data (temporal and spatial features), the objectives of the FYPs adopted in the 9th

and 10^{th} FYPs.

(1) Index system of the Evaluation

Basic Index

1) The section or point index of the river or lake. (the Class based on the national surface water body standards, COD_{Mn}, NH_3-N, TP)
2) The compliance index of the wastewater discharged into water body. (COD_{cr}, NH_3-N, TP)
3) The COD_{cr} discharge amount at major discharge locations. The reduced pollutant discharge amount of each province in the basin. (COD_{cr}、 NH_3-N、 TP)
4) The amount of phasing-out of the high environmental cost industrial production lines.

Construction Project Index

5) The completion ratio of the planned water quality and wastewater discharge monitoring capacity building projects in the basins.
6) The function changes of the basin management organizations and institutions.
7) The completion ratio of the planned drinking water projects.
8) The completion ratio of the municipal wastewater treatment projects.
9) The completion ratio of the planned industrial pollution sources control projects.
10) The completion ratio of the rural non-point source pollution control projects.
11) The completion ratio of the ecological and regional comprehensive pollution control projects.

(2) Time and Location of the Data

Time

1) 1995 – the baseline year of the 9^{th} FYP
2) 2000 – the close year of the 9^{th} FYP and the baseline year of the 10^{th} FYP
3) 2005 – the close year of the 10^{th} FYP

Location

1) The section or point index of the river or lake – in consistent with the 9^{th} and 10^{th} FYPs
2) The compliance index of the wastewater discharged into water body – in consistent with the 9^{th} and 10^{th} FYPs
3) The COD_{cr} discharge amount at major discharge position – in consistent with the 9^{th} and 10^{th} FYPs
4) The reduced pollutant discharge amount of each province in the basin – based on the provincial total amount
5) The amount of phasing-out of the high environmental cost industrial production lines – based on the provincial total amount
6) The completion ratio of the planned water quality and wastewater discharge monitoring capacity building project in the basins – in consistent with the 9^{th} and 10^{th} FYPs
7) The function changes of the basin management organization and institution – based on

the basin or province

8) The completion ratio of the planned drinking water project – based on the provincial total amount
9) The completion ratio of the municipal wastewater treatment projects – based on the provincial total amount
10) The completion ratio of the planned industrial pollution sources control projects – based on the provincial total amount
11) The completion ratio of the rural non-point source pollution control projects – in consistent with the 9th and 10th FYPs
12) The completion ratio of the ecological and regional comprehensive pollution control projects – based on the provincial total amount

Evaluation Criteria

The criteria to assess efficacy of the policy and investment should be based on whether the actual results of the policy and investment are coincident with the policy and investment goals and expectations. Therefore, the evaluation criteria should be the target values/final objectives set in the Pollution Prevention and Control 9th and 10th FYPs for HRB and TLB. The target values/objectives in the 9th and 10th FYPs are as follows:

1) The section or point index of the river or lake.
2) The compliance index of the wastewater discharged into water body.
3) The COD_{cr} discharge amount at major discharge position.
4) The reduced pollutant discharge amount of each province in the basin.
5) The amount of phasing-out of the high environmental cost industrial production lines.
6) The completion ratio of the planned water quality and wastewater discharge monitoring capacity building project in the basins.
7) The function changes of the basin management organization and institution.
8) The completion ratio of the planned drinking water project.
9) The completion ratio of the municipal wastewater treatment projects.
10) The completion ratio of the planned industrial pollution sources control projects.
11) The completion ratio of the rural non-point source pollution control projects.
12) The completion ratio of the ecological and regional comprehensive pollution control projects.

2.3.5 Setting the Evaluation Work Plan

1 The objectives, scope, and principles of the evaluation will determine evaluation tasks. A detailed evaluation work plan should confirm the objectives, scope, and principles of the evaluation.

2 A detailed evaluation work plan is the road map for an evaluation. When making the evaluation plan, the evaluator should have well understood the objective, scope, and principles of the evaluation as well as the social and environmental background of the watershed.

3 Technically, the evaluation work plan should include the contents of the activities, corresponding timetable, and the task list for each evaluation expert.

2.3.6 Survey, Data Collection and Data Quality Control

1 Survey, data collection and data quality control are the foundational tasks of the evaluation. They include:

- Conduct survey and identify data sources;
- Select data collection or acquisition methods;
- Acquire or collect data;
- Analyze the reliability, accuracy, fairness, and statistical representation of the data collected;
- Data processing to convert the data into usable forms.

2 Data can be collected either through locating existing secondary data or direct measurement and monitoring. Due to the wide geographic territory of the watershed, the scope of the study, and the lasting impact of policy impacts, collecting existing secondary data can be a valid and cost-effective data collection method.

3 Moreover, evaluation results of other watersheds can be important references for this evaluation. Appropriately referencing existing results and conclusions from other watersheds can reduce workload, put results in perspective and improve evaluation effectiveness.

Evaluation of Environmental Policies and investments for Water Pollution Control in the HRB and TLB

(1) Data Sources

Nice major data sources:

1) General environmental statistic and report system, SEPA
2) Environmental statistic and report system for HRB and TLB, SEPA
3) Agricultural statistic and report related with HRB and TLB, MOA
4) Municipal construction statistic and report related with HRB and TLB, MOC
5) Water resource statistic and report system in HRB and TLB, MWR
6) Judicatory records in national, provincial, city and county level related with HRB and TLB
7) Survey questionnaire conducted by the evaluation experts in HRB and TLB
8) Site visits of the evaluation experts to HRB and TLB
9) Survey and monitoring results in the HRB and TLB

(2) Data Collection Methods

Majority of the data fall into the category of secondary data for this TA. They come from official governmental statistics, reports, and archives. Data collected from questionnaires, on-site and designated surveys and monitoring will serve as complements, QA/QC to support or verify the official data.

(3) Designated Survey and Monitoring

The objective of the designated survey and monitoring is to collect the historical water quality

monitoring data (including surface water quality classification, COD_{Mn}, NH3-N, TP), watershed industrial wastewater discharge and pollutants discharge data (including COD_{cr}, NH3-N, TP), watershed domestic wastewater discharge and pollutants discharge daa (including COD_{cr}, NH3-N, TP), and related agricultural non-point source data (including pesticide and fertilizer use, livestock quantity, aquaculture produce, sowed area) of the key water bodies in the HRB and TLB during the 9^{th} and 10^{th} FYPs. Moreover, sampling of pre-selected pollution sources without pre-notice using the selected monitoring methods will be conducted.

Designated survey and monitoring include industrial pollution sources survey and monitoring, urban WWTPs survey and monitoring, agricultural non-point sources, groundwater survey and monitoring.

The bulk of the data for this TA is from the secondary sources as discussed above, complemented by on-site survey. The secondary data are obtained mainly from the monitoring systems installed and supervised by SEPA through SEPA's coordination. On-site data are collected by sampling without pre-notice the pre-selected industrial water pollution sources and municipal WWTPs.

(4) Lessons and Experiences from Other Watersheds

- Transjurisdictional Environmental Management, ADB TA3588-PRC, Strategic Planning Study for the Preparation of the Yellow River Law, ADB TA3708-PRC
- Study on Control and Management of Rural Non-Point Source Pollution ADB TA 3891-PRC

2.3.7 Data Analysis and Application of Models

1 The major activities of evaluation are the analysis of data and the application of models. In the process, the logic model will be adopted to categorize data, identify the potential problems and trends, and uncover the nexus between inputs and target outcomes and impacts, through sorting the program process of policies and investments into data, outputs, outcomes and impacts, then comparing the changes in indicators and the outcomes and impacts and comparing the results with the objectives.

2 Once the problems are identified, the objective tree can be used to further analyze the data, outputs, outcomes and impacts. In this stage, comparative analysis will be adopted to integrate qualitative and quantitative evaluations, relative and absolute evaluations, and measuring and models.

3 Section 3 presents a detailed description of the application of logic model and objective tree.

2.3.8 Optimizing Evaluation Results

1 Different problems and issues will be identified in different areas of policies and investments evaluation. However, these different results also pose different levels of significance and urgency. Thus, further analysis will be necessary to uncover the nexuses between the results of different areas so as to prioritize the issues and provide distinguished

reform recommendations

2 Inventory, matrix analysis, and evaluation expert symposia are important tools to optimize evaluation results.

2.3.9 Preparing Evaluation Reports

1 Often the objective of watershed policies and investments evaluation is to assess the efficacy of the policies and investments. The evaluation report will need to express clearly and accurately the evaluation results and lessons and experiences learned so as to provide the policy-makers the basis of policy adjustment and updated planning.

2 The evaluation report should include at least the executive summary, introduction of the evaluation background; introduction of the watershed social and natural environmental background; data collection methods and process; analysis of the policies and investments and the indicators, problems identified; evaluation results and priority analysis; policies and investments reform recommendations.

3. Important Evaluation Tools

3.1 Result-Based Logic Model

3.1.1 Concept of the Logic Model

1 The logic model concept was originally developed and gradually gained increasing usage from the 1970s. Currently the logic model is widely used for strategy, planning, and evaluation in private and public sectors as well as international organizations. Therefore, the logic model may be regarded as a proven tool in this regard. Through decades of development, the logic model has evolved into multiple forms. The version that we will adopt for this evaluation emphasizes connecting the original state/baseline, the occurred inputs, the current outcomes, and the future inferable outcomes and impacts by establishing a clear framework of causality。

2 Typically, the logic model describes or expresses the inter-relationship or linkages among resources inputted, activities performed, participants in the process, outputs, outcomes and impacts through a table framework or figure. In nature, the logic model may be regarded as a way of logical thinking, to illustrate, address and analyze the comprehensive system. The logic model could connect all of the system components and clarify their relationships by identifying the obviously, obscurely or potentially logical relationships of the system components.

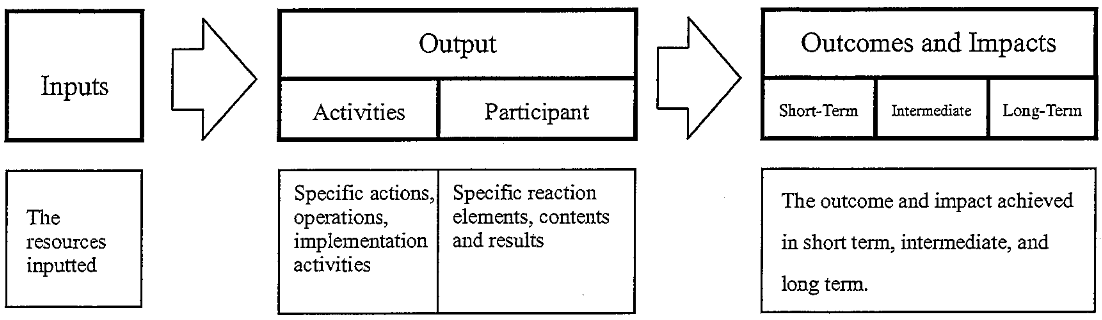
3 In this evaluation, the logic model will be applied to address the specific topics under discussion.

3.1.2 Logic Model and its Application in Evaluation

1 The logic model is composed of the three basic parts: input, output, and outcome/impact. The output could include the activities, participants, changes implemented and "immediate"

physical results. The outcome and impact could include short term, intermediate and long term results. The figure below shows the basic composition of the logic model.

Figure 3.1.2-1 Basic Composition of the Logic Model



Inputs

The input is the resources brought into the activities and operation processes by an organization or a project. It is presumed that expected results could be produced through the processing of the resources. The input could be the labor, capital, equipment, material, time, law, regulation, plan, policy, standard, method, institutional arrangement and organization etc.

Outputs

The output is the operation activities, actions, participants, changes formed and direct products. The output could be the activities and results for/from the implementation of law or policy, the activities and results for/from the implementation of plan, people and organization involved, facilities for the pollution control and environmental protection, various institution and organization building, and environment monitoring system building etc. Normally there are various logical relationships among the output components afore mentioned.

Outcomes and Impacts

The outcome and impact are the benefits, achievements, and its impacts during and after the completion of the operation process. The outcome and impact directly connect with the objectives and goals and are usually observed in short term, intermediate, and long term separately. Especially there are also logical relationships among the outcomes in short term, intermediate, and long term. The outcome and impact could be the changes of the water quality, the changes of environmental ecology, the changes of the resources utilization, the changes of economic development, the changes of the health and safety, and the harmonious development of society etc.

2 The logic model is not a simulation model that re-acts the reality, nor is it an "evaluation model" per se. Its key function is to provide a logic flow among the resource inputs, activities performed, outputs generated, and the final outcomes and impacts and to decipher the causality.

3 When applying the logic model in evaluation, one has to first sort all relevant information into data input, outputs, outcomes and impacts according to the theme, objective, contents, and the questions to be answered of the evaluation, illustrate their connections through the logic model, then evaluate all, part of, or only the outcomes and impacts of the entire "input, outputs, outcomes and impacts" units using a combination of the qualitative, quantitative, relative, and absolute evaluations, and measuring and models.

4 With the evaluation results and the logics presented in the logic model, comprehensive analysis can be performed, the problems identified, and the reform recommendations provided.

5 Therefore, although the logic model is not an evaluation model, but for large, complex, and systematic evaluations, evaluations based on logic models will be clearer, of better reasoning, and more effective for problem identification.

6 For post-evaluations, the recommended steps of using the logic model are:

- Review the entire system to be evaluated, list all the significant factors as "inputs", "outputs", "outcomes and impacts";
- Fill the listed factors into the logic model table under the corresponding column;
- Sort out the logical relationships between the factors; the logical relationships can be parallel, supporting, and causal.
- Add graphical expressions of these logical relationships to the logic model table;
- Identify and analysis issues using the "data, outputs, outcomes and impacts" framework. When analyzing key issues, the objective tree is recommended.
- Summarize the evaluation, and express the conclusions concisely in tables or the matrixes.

3.2 Objective Tree

1 The objective tree is a concrete application of the logic model. Events usually take complex forms that bear not only the mainstream but also tributaries. By mimicking the trees in the nature, the objective tree method first begins with the mainstream, analyzes the problems horizontally as well as vertically, follows to decipher the connections between events, uncover the path of events development, deduce and infers the occurrence of series of events, and finally identifies the issues and draws the conclusions within the logic model.

2 During the entire course of the deduction, the mainstream of the events unfolds tiered tributaries to form a tree-shaped logical structure. Therefore, the logic model table can be framed into this tree shape to depict the tiered and stratified inference.

3 The objective tree can be classified into: (1) top-down objective trees, which begins with the objectives (the needs) to the expected results (possibilities) but deduces from the impacts back to the required outcomes, prerequisite outputs and necessary data; and (2) bottom-up, which begins with the expected results (possibilities) to the objectives (the needs) but deduces

from necessary data to the prerequisite outputs, required outcomes, and the impacts.

4 The objective tree in the logic model is frequently used in program design and evaluation plan, as it is a model to plan for the future. It can help define whether certain objectives can be achieved, and, if yes, when and how. It can also help identify the key data, outputs, outcomes and impacts of the essential objectives and thus the best approach toward achieving the objectives.

5 Nevertheless, the objective tree analysis of the logic model can also be applied to the post-evaluation of policies and investments:

6 If using the top-down post-evaluation objective tree, the analysis will begin with setting the ideal objectives of the policies and investments and sorting the factors into data, outputs, outcomes and impacts, then, by mimicking the branching of the trees, list the available approaches to fulfill those objectives according to the logical tires. The analysis will then move on to comparing ideal (expected) data, outputs, outcomes and impacts and the actual, observed data, outputs, outcomes and impacts to locate the "broken link" and uncover the problems. Based on the problems identified, recommendations will be provided.

7 If using the bottom-up post-evaluation objective tree, the analysis often begins with the substantive contents of the policies and investments when defining the policies and investments and sorts the factors into data, outputs, outcomes and impacts, then, by mimicking the branching of the trees, lists the possible outputs, outcomes and impacts according to the logical tires. The analysis will then move on to comparing ideal (expected) data, outputs, outcomes and impacts and the actual, observed data, outputs, outcomes and impacts to locate the "broken link" and uncover the problems. Based on the problems identified, recommendations will be provided.