Technical Assistance Consultant’s Report

Project Number: 44075-012
October 2013

Provincial Development Strategies for Provinces in Central People’s Republic of China Focused on Rural Development

-Research on Environmental Protection and Management in Rural Areas of Anhui Province (Financed by ADB TA 7737-PRC: Package 1)

Executive Summary

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For Anhui Provincial Finance Department, PRC
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Preface

Anhui is a major agricultural province in the PRC. Since the PRC’s Reform and Opening up in 1980s, significant progress has been made in the industrialization and urbanization of Anhui Province, but traditional agriculture at present still remains an important pillar of its economy. As its climate stands in the middle of the PRC, agriculture in Anhui has characteristic of both South and North PRC and is of typical significance in terms of the issues of “agriculture, rural areas and farmers” in the PRC. With sustained development of socio-economy in Anhui Province, especially the rapid advancement of industrialization and urbanization in recent years, the rural environmental pollution has worsened due to mismanagement of environmental protection. Despite some beneficial explorations, practices and capital investment in rural environmental protection and treatment, the overall situation of rural ecological environment in the province is relatively severe, and rural environmental protection and treatment faces great challenges, such as lack of awareness, imperfection of policies, regulations and systems, inexplicitness of administrative power and insufficiency of investment and technology.

Under such circumstances, the Asian Development Bank’s technical assistance project, namely TA7737-Provincial Development Strategies for Provinces in Central PRC Focus on Rural Development (Package 1: Research on Environmental Protection and Treatment in Rural Areas of Anhui Province”), not only meets the requirement of building ecological civilization in the PRC, but also provides a rare opportunity for promoting environmental-friendly Anhui Province in rural areas. The technical assistance project will certainly provide strong support for Anhui Province to implement the strategy of strengthening the province through ecological civilization during the 12th Five-Year Plan.

This project is the first that uses the Asian Development Bank’s technical assistance grants to do provincial development strategy research in Anhui Province. With the great support from Asian Development Bank (ADB) and the Ministry of Finance, Anhui Provincial Government through its Provincial Department of Finance, the project executive agency, sets up a leading group led by the Director of Anhui Provincial Department of Finance (supported by project management office, the implementing agency), and a technical panel which have provided policy guidance, daily coordination, project management, financial and technical support and services to the project implementation. The project leading group and the panel working with the ADB have provided strong political and technical support to contribute to the quality of this project. The project recruits and selects consultants and experts carefully, conducts surveys and analyzes data seriously, holds mobilization workshop and interim review workshop to review the project implementation and the research reports, and ensures project implementation on schedule and in quality.

With the joint efforts in the past two years, this project has achieved expected objective and solid results. During the project implementation, all members, especially the consulting firm and the consultant team, always uphold the spirits of “pragmatism and innovation”, collect numerous first-hand information from countryside and households in fields, as well as various samples for analysis. Therefore, the research is based on scientific analysis and comprehensive study and across-sector discussions. Its wide scope, specific data, thorough analysis, novel thoughts and practicable measures will play a positive role in rural environmental protection and treatment, and strengthen the Anhui Province’s ecological civilization in contribution to the 12th Five-Year Plan of Anhui Province.
The successful completion of the report would not be possible without the excellent cooperation among all parties concerned, including the guidance ADB, the support from the Ministry of Finance, the leadership of Anhui provincial steering group, technical support from the panel, the sweat of the consulting firm and the consultants, and proactive contribution of relevant governmental agencies, academic circle, media, and across-sector experts. We particularly appreciate the professionalism and excellent expertise of Ms. Junmei Yang, the ADB task manager of this TA who invested huge energy in guiding the project management office and the consultant team on project quality control at daily basis. Lastly, we would like to express our sincere gratitude and high appreciation to all the leaders, sector experts, colleagues and friends who have made indispensable contributions to the project’s final success!
Foreword

This report is the outputs of the technical assistance project (TA7737-PRC-Package 1) financed by the Asian Development Bank (ADB).

The People’s Republic of China (PRC) is the largest developing country in terms of population and urban-rural dualistic structure in the world, and the “issues of agriculture, rural areas and farmers” in the PRC are among the top concerns and priorities to the Chinese Government and even the whole world. The rural ecological environmental protection and agricultural sustainable development directly relate to the optimization of rural ecological environment, food security in the PRC, the health of Chinese people and sustainable and coordinated socioeconomic development of the PRC. Over the past two decades, the PRC has made some achievements in environmental protection, but efforts still lag behind in rural areas in particular, and there are many problems and challenges to be faced and resolved in integrated control and scientific management of pollution in rural PRC.

The outline of the national 12th “Five-Year Plan” has explicitly pointed out the significance to achieve green and sustainable development, and the report at 18th National Congress of the Communist Party of China (CPC) has highlighted the importance of promoting ecological civilization and controlling ecological degradation. This report makes an in-depth study on long-existing issues on rural environmental protection and treatment in Anhui Province and focuses on identifying responsive solutions in terms of technical measures and policy reforms.

Under the report, a series of long-term, systematic and feasible technical solutions and policy suggestions for rural environmental protection and treatment in Anhui Province have been presented by taking into account the actual situations of rural ecological environment, the leading factors that affect rural ecological environment, including industrial and agricultural production, rural resources and energies, farmers’ living conditions and livelihoods, rural systems and policies, rural industrialization and urbanization, laws and regulations.

The project is the first TA delegated by ADB to the PRC in province that is managed by the ADB Resident Mission in Beijing. The TA aims to assist the Anhui government in developing practical policies for rural environmental improvement prioritized on the reform agenda during the 12th Five-Year Plan. The TA mobilization workshop was held on February 28-29, 2012 and TA report review workshop was held on January 25, 2013. Besides these, four seminars were held from March to November 2012 and five review workshops of the project were held by the government from September to December 2012. The governmental officials, experts carefully reviewed and discussed the draft main report and all sub-reports of the project, and provided some valuable comments on revision. On January 25, 2013, the final review workshop was held, which gathered comments from the ADB, related departments of the Anhui government and relevant experts from domestic and abroad. The final main report was thereby formulated. From February to June 2013, three workshops were held to discuss and revise the executive summary of the final main report, and at last, the executive summary was submitted to Anhui provincial government and related national departments for endorsement.

During the project implementation, the project executing agency Anhui Finance Department and the consulting firm organized experts to visit local bureaus, make field study, and
have face-to-face discussions with local villagers on rural environment for data-collection. The project collected and analyzed questionnaires on village spatial distribution planning from villagers in four featured areas in Anhui Province, namely Hucheng Village in Liangyuan Town, Hefei, Sanli Village in Shuizhen Town, Taihe County, Chaoshan Village in Xihu Town, Shizishan District of Tongling and Tianhua Village in Shijian Town, Wuhu. The consultant team also collected and analyzed questionnaires on collective treatment of rural household waste to some villagers in Guoyang County, Chaohu, Jixi County and Feixi County. They made fixed-point monitoring on rural household waste in 60 rural households in 10 counties in Anhui Province, did sample analysis on rural household waste in rural households in 6 places, namely Zhonghan and Sanbing Towns in Chaohu, Yingzhou and Fuling Towns in Jixi County and Longwang and Wangqiao Towns in Guoyang County, and made typical investigation of land circulation in Guoyang County, Dingyuan County and Zongyang County. The consultant team visited 24 villages and towns, gathered information from over 500 rural households, and sent nearly 900 questionnaires in total. All of these efforts have guaranteed the precise, real-time data collection to support the comprehensive and in-depth research on rural environmental protection and treatment in Anhui Province. Eventually, the team put forward the policy framework, feasible technical solutions and relevant policy suggestions on rural environmental protection and treatment in Anhui Province.

As a major province in Central PRC, the agriculture in Anhui Province bears the characteristics of both South and North PRC, and its physical geography and socioeconomic development are of representativeness in the whole country. Therefore, it is of strategic importance to study rural environmental protection and management in Anhui Province which could demonstrate experience to other provinces. The project supports a systematic, comprehensive and in-depth study on rural environmental protection and treatment. It covers macro visions and micro solutions, ranging from laws to policies, from system to management, from urban to rural areas, from industry to agriculture, and from civil society to technology. This book provides a series of strategic visions, practical solutions and policy measures in terms of preventing rural industrial and agricultural pollution, rural household waste and urban pollutant from spreading to rural areas, and the upgrading of rural energy consumption structure, the adjustment of village planning and layout to achieve economies of scale in rural land circulation. The findings of the project contribute important references to Anhui governmental decision-making process in terms of rural environmental protection and management and add value to the whole country.

The report can be used as an important reference book for local governments and related governmental departments at central to promote rural environmental protection in the PRC while making policy-decisions during the 12th Five-Year Plan and beyond. The report could also serve various agencies including research institutes for relevant studies.

Finance Department
Anhui Province
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I. BACKGROUND

Since the Reform and Opening up, the People’s Republic of China (PRC) has developed rapidly in its economy, but environmental problems are also emerging. In recent years, these environmental problems have become more serious, negatively affecting the country’s sustainable, socioeconomic development.

In Anhui for example, the rapid development of agricultural modernization, township industrialization, and accelerated urbanization have, in terms of its rural progression, brought about earth-shaking changes, specifically in rural development, agricultural production and the living standards of farmers. Meanwhile, the rapid economic growth has created many serious environmental problems. The problems in Anhui mainly include: the abuse of fertilizer and pesticide, rural environmental degradation due to the industrialization of the townships, and the spreading of pollution from urban to rural areas, etc. If no measures are taken to address these emerging environmental issues, the rural ecological environment will be destroyed, and consequently the Anhui socioeconomic development will not be sustainable in the long run. Therefore, it is of urgency and of great importance to do the research under ADB TA7737-PRC on rural environmental protection and treatment in the Anhui Province.

The objective of this research is to assist the Anhui government in formulating its rural development strategies focusing on the rural environmental protection. As a major agricultural province, Anhui is one of the six provinces located in the central region of the PRC. Anhui shares many common environmental concerns with other provinces, particularly with the agricultural provinces. The findings and experiences under this research are expected to demonstrate an effective approach in addressing provincial environmental issues and be applied in other provinces, as appropriate.

In the past, many studies have been undertaken in Anhui on the topic of rural environment protection. However, most of the studies have focused only on one or two aspects without a thorough and comprehensive analysis. Since there are many factors concerning rural environment issues in Anhui, this research will apply a systematic approach to comprehensively review the current rural environmental situations and identify the existing problems in various sectors (e.g. water, land, agricultural production, energy, environment, public finance, legislative system, policy environment, public awareness and services, science and technology).

It is the first time that the Anhui has such a systematic and comprehensive research on rural environmental issues, ranging from macro to micro situation, from government policy-making to grass-roots participation, from institutional arrangement to village layout, from legislative system to local financing, from urban areas to rural areas, and from domestic to overseas practices. The research will provide tailor-made solutions at both technical and policy levels to address the existing problems that hinder Anhui’s sustainable development. Good international practices will also be introduced to add value to the research.
II. THE MAIN PROBLEMS OF ANHUI RURAL ENVIRONMENT

A. Current Situations of Environment Quality

1. Water Environment

The overall quality of surface water is slightly polluted while the water quality of the main rivers and lakes is good. According to the statistics published by Environmental Protection Department of Anhui Province in 2011, the overall quality of surface water in Anhui is slightly polluted. The overall quality of Huaihe River is sound with moderate pollution in its tributaries. Chaohu Lake is in a state of mild eutrophication with moderate pollution in its surrounding rivers. The Yangtze River is in good condition despite poor water quality of some tributaries. The overall water quality of Xin'an River is generally good with the surrounding lakes and reservoirs in good condition.

The drinking water quality in most of the cities in Anhui has reached the government’s standards, with the compliance rate of 96.1%. The water quality of the centralized drinking water source in seven cities such as Bozhou and Chaohu does not meet the standards. The aquifer that supplies cities such as Bengbu, Fuyang and Tongling is in poor condition.

2. Atmospheric Environment

The overall quality of the atmospheric environment in Anhui remains stable. According to the statistics from the 2011 Environmental Communiqué of Anhui Province, the urban air quality is generally in good condition with the average frequency of acid rain at 19.8%, despite higher than normal occurrences in some areas. Gas emission continues to increase with dust pollution as a main source.

3. Amount of Main Pollutants

The total amount of main pollutants in Anhui has been relatively controlled in spite of a rising tendency of emission from industrial solid waste. In 2011, Chemical Oxygen Demand (COD) emission in Anhui totaled 953,300 tons, a decrease of 2.05% over 2010. The ammonia nitrogen emission totaled 109,800 tons, with a drop of 1.99%; and SO$_2$ emission totaled 529,500 tons, a decrease of 1.63%.

4. Other Aspects

The overall condition of the noise pollution in Anhui is relatively normal. Radiation and ecological pollution are not serious.
B. Current Situation of Rural Environmental Pollution

1. Rural Industrial Pollution-Worsening Industrial Pollution by Township Enterprises

With the rapid development of the township industry, industrial pollution has become an increasingly serious environmental problem. Typical rural industries such as agro-processing, leather-processing and mining remain the major sources of industrial pollution that contribute to the increasing amount of pollutants year by year. In addition, the small-scale production and low productivity, the high costs of environmental rehabilitation and sewage treatment lead to the lack of motivation for environmental protection, the covert and excessive emissions of township enterprises, and built-up cost of treatment process.

2. Farming Pollution-Deteriorating Pollution of Production Materials

In 2010, COD and ammonia nitrogen have respectively accounted for 42% and 36% of the total emission of agricultural pollutants. These synthetic fertilizers are becoming one of the major sources of pollution. In 2010, the total amount of fertilizer used in Anhui was 5.8 times that of 1980, 57% more than the safety limit. Increasing application of chemical fertilizers coupled with improper fertilization techniques have placed the farmland in environmental degradation. Additional contributor of farmland pollution is the local practice of open burning or discarding of straws in rural areas.

3. Animal Breeding Pollution-Excretions of Livestock and Poultry

Despite the soaring development in the livestock and poultry breeding industry, as well as the aquaculture industry, most farms have failed to give effective treatment and utilization of animal excretions, resulting in a continuous increase of breeding pollutants. The production of breeding pollution has overtaken that of industrial pollution in rural Anhui. The total agricultural emissions of COD and Ammonia Nitrogen are 96.6% and 76.2% respectively.

4. Rural Domestic Pollution-A Growing Concern

Drinking water purification, centralized processing of domestic garbage and toilet renovation are of primary concern in rural Anhui. According to statistics, by the end of 2011, the penetration rate of running water in rural Anhui has only reached 50%, leaving more room for promotion. The coverage of hygienic lavatories stays at 58.0%, far more below the national coverage at 70%. The disposal of domestic garbage and sewage stays at a rather low level due to the increasing emissions resulted from the rural households, the missing infrastructure planning and construction for environmental protection, and the poor awareness of environment protection at local levels. Consequently, most of the domestic garbage has been
littered randomly and most sewage discharged directly into the rivers without any processing and treatment in most areas.

C. Problems of Environmental Pollution and Treatment in Rural Anhui

1. Weak Institutional Capacity

The number of rural environmental protection agencies and employees of the government in Anhui is far below the national average level, leading to postponed treatment of pollution accidents and inconvenience of environmental consultations. The administrative responsibility of rural environmental protection agencies is sprawling amongst agriculture, forestry, water conservancy, and environmental protection agencies, causing overlapped functions and unclear accountabilities. Worse of all, the township governments and village committees in rural areas have no authorities to function in environment inspection and supervision.

2. Insufficient Investment in Environmental Protection

The total investment for rural environmental protection with most cities and counties has long been inadequate. There is no financial support from the township governments and village committees as they have no fiscal revenue. The investment in the rural environmental infrastructure is far away from the rising demand. Little funds are invested in centralized water supply, sewage treatment system and garbage disposals and the investment is below national average level.

During the “Twelfth Five-Year Plan” period, Anhui plans to pilot a new mode of rural garbage disposal in 1,000 villages and towns by applying the method of "classification, collection, transfer, and treatment”. However, there is no clear solution regarding the maintenance and updating of the garbage disposal equipments and the payment of sanitation personnel. This is likely to render the plan a mere paperwork with no actions to be taken in advance.

3. Fiscal Policy in Need of Systematical Planning

In the current centralized fiscal system, fiscal policies concerning rural environmental treatment and ecological protection in Anhui are mainly based on the requirements from the central authorities. The current fiscal policies on environmental conservation are usually delayed and are, none the less, inadequate to meet the actual demands of the rural environmental treatment and ecological protection.

The inadequacy of the fiscal policy is characterized by a lack of systematic design of fiscal policies, imperfect taxation policies, weak capacity to secure expenditures, unavailability of local counterpart funds, the lack of incentives, weak public management and maintenance.
4. Inadequate Publicity of Environmental Protection

In rural areas, public exposure of environmental issues are not accomplished through normal media channels but rather, by traditional approaches, such as mobilization meetings, village radio stations, posters, signs and banners. Farmer awareness on rural ecological environment protection is weak and with less initiative for participation. Being a major agricultural province, Anhui has been abundant in young and middle-aged farmers migrating to cities for better-paid jobs, leaving the elderly, women and children in the countryside with neither initiative nor incentive for environmental protection.

III. RECOMMENDED SOLUTIONS

To address the above issues, it is necessary to identify technical solutions and targeted policy recommendations to effectively protect the rural environment and ensure sustainability in Anhui’s socioeconomic development.

A. Technical Solutions

1. To Reduce Agricultural Production Pollution

   a. Government to Promote “Formula Fertilization Project”

   In Anhui, only 34.4% of the farmers use formula fertilizer which is conducive to the control of soil pollution. According to field surveys, more than 80% of the farmers want to use formula fertilizer though. Based on this, it is encouraging that there is huge potential for the farmers in Anhui to reduce agricultural production pollution. This requires the government to promote the implementation of “formula fertilization project” which is based on soil testing and formula designing.

   b. Facilitate Land Circulation and Reduce Farmland Fragmentation

   Anhui should promote moderate-scaled economy in farmlands through regulating rural land market and facilitating land circulation to reduce farmland fragmentation and optimize the efficiency of land utilization. Technical support and services should be promptly provided in place for farmers so as to educate them how to improve their skills in agricultural production and appropriately use fertilizer.
c. **Improve Policies and Subsidize More on the Pollution Control of Livestock and Poultry Breeding Farms**

To fundamentally remove the pollutions from the livestock and poultry breeding farms, the government should increase the subsidies to farmers and promote the development of organic fertilizer.

d. **Promote “Returning Straw to Farmland Scheme”**

It is important for the government agencies at all levels in Anhui to incorporate this scheme into its economic development programs. The biogas project of putting smashed straws back to farmlands will help improve soil fertility and maintain a clean, green, and environmental-friendly agricultural development.

e. **Build up Public Awareness to Protect Environment**

A raised public awareness contributes to the improvement of environmental protection. A host of measures should be taken to build up farmers’ awareness and provide trainings to influence their daily behavior.

2. **To Promote the Utilization of Renewable Energy**

a. **Design and Implement Biogas Project**

In the areas with an intensified and large-scale planting of crops, esp. corn and rape, the government should support large biogas projects and provide subsidies to the farmers to produce and use of biogas for renewable energy development in rural areas. Commercial applications could be explored after purification and refining of the biogas.

b. **Promote DBBF (Densified Biomass Briquette Fuel) Technology**

The DBBF (Densified Biomass Briquette Fuel) technology refers to the mechanical compressing of straws into shapes of rod, block or grains by the molding machines at a certain temperature and pressure. As a clean and renewable energy, it can replace wood and coal, and even natural gas, fuel oil, coal and electricity for daily life in rural areas (e.g. cooking, heating, and lighting).

c. **To Have Integrated Treatment of Rural Solid Waste**

The approaches to treat rural solid garbage and waste mainly include incineration, landfill, composting and comprehensive treatment. It is suggested to apply the comprehensive treatment approach which could select the most
appropriate approach on the basis of a cost-effective mathematical analysis and optimized utilization of incineration, landfill, composting.

d. To Prevent the Urban Pollution Spreading to Rural Areas

i. Enhance the Treatment of Urban Air Pollution

- To improve the control of urban atmospheric pollutants by formulating regional SO2 control objectives, incorporating nitrogen oxide into the overall control process, and achieving denitrification in the thermal power plants in key areas.
- To strengthen particulate pollution controls, and adopt efficient bag-type dust removal technology in cement and thermal power industry and industrial boilers.
- To establish pilot projects of collaborative control of multi-pollutant technology, such as desulfurization, denitrification, dust and mercury removal in the smoke of thermal power unit.

ii. Intensify Disposal of Urban Sewage

- To upgrade existing sewage processing plants;
- To improve the coverage of urban sewerage;
- To strengthen the in-depth “tail-water” treatment of sewage processing plants through artificial wetlands technology;
- To properly treat sludge from sewage processing plants.

iii. Enhance Disposal of Urban Domestic Garbage

- To promote comprehensive disposal of classified garbage.
- To adopt the technology of garbage incineration for power generation.

e. To Optimize Village Layouts

Recommended village layouts are presented in the table below:
### Table: Class structure of villages

<table>
<thead>
<tr>
<th>Featured areas</th>
<th>Compara tive analysis</th>
<th>Class structure of villages</th>
<th>Population per village</th>
<th>No. of villages/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Anhui</td>
<td>Current</td>
<td>13</td>
<td>3,971</td>
<td>337</td>
</tr>
<tr>
<td></td>
<td>Planned</td>
<td>1.42</td>
<td>2,414</td>
<td>1,360</td>
</tr>
<tr>
<td>Central Anhui and along Yangtze River</td>
<td>Current</td>
<td>10.3</td>
<td>2,269</td>
<td>186</td>
</tr>
<tr>
<td></td>
<td>Planned</td>
<td>5.1</td>
<td>1,500</td>
<td>620</td>
</tr>
<tr>
<td>East Anhui</td>
<td>Current</td>
<td>15</td>
<td>3,597</td>
<td>293</td>
</tr>
<tr>
<td></td>
<td>Planned</td>
<td>3.7</td>
<td>2,147</td>
<td>1,013</td>
</tr>
<tr>
<td>South and West Anhui</td>
<td>Current</td>
<td>13.5</td>
<td>2,955</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>Planned</td>
<td>5.2</td>
<td>745</td>
<td>258</td>
</tr>
</tbody>
</table>

### f. To Promote Land Circulation and Achieve Agricultural Economies of Scale

Establish rules and regulations to control and innovate the land circulation: Land transfer contracts must be regulated and properly signed to avoid land disputes in sustainable development of land circulation. Besides, contractual operation right of land must be stabilized.

Regulate market management in order to achieve orderly land circulation: Subcontracting of farmland, lease and transfer payments must be negotiated with farmers according to its grade on the basis of fairness and willingness in order to avoid price fluctuation in the market. Moreover, lands must be exchanged on the basis of mutual consent of will.

Raise awareness by publicities and pilot projects: Mass media can be employed to raise people’s awareness of land circulation policies, particularly for grassroots officials who must realize that land circulation is an effective way in developing modern agriculture, increasing farmers’ income and creating job opportunities.

Strengthen government support in accelerating the development of township industry to promote land circulation: Land circulation should be encouraged and optimized through multiple avenues such as subcontracting, lease, transfer, mutual exchange and shareholding, etc. Furthermore, technicians should be motivated to play their roles as models or demonstrators in the countryside to deliver technical knowledge to farmers.

Cultivate large-scale farms in order to encourage the direct land circulation farmers: The building of “agricultural demonstration parks” should play a pivotal role in cultivating large-scale farms to encourage land circulation.
g. **Assessment and Countermeasures on Rural Water Resources Protection and Water Conservancy Facilities**

The PPP mode refers to an approach where private enterprises participate in the cooperation and operation of related infrastructure. Private enterprises also provide the expected service and take corresponding risks based on the agreement with government departments. Prior to implementation, it is necessary to carry out assessment studies on the feasibility of the PPP model on the construction and maintenance of rural water conservancy facilities. If assessment proves promising, the PPP mode can then be applied to construct three different types of projects, specifically, the minor project used by private households, small facilities beneficial for some households, and small water supply projects for businesses.
### B. Suggested Projects on Environmental Protection and Pollution Management (2013-2017) in Anhui Province

<table>
<thead>
<tr>
<th>No.</th>
<th>Project</th>
<th>The Scale and Main Content</th>
<th>Nature of the Project (New Construction/ Transformation/ Expansion)</th>
<th>Location</th>
<th>Investment (RMB 10,000 yuan)</th>
<th>Effect and Benefit</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project on Protection of Sources and Environment of Drinking Water in Rural Areas</td>
<td>The project mainly includes demarcation of protection zones for drinking water, establishment of signboards, warning boards, boundary markers, fences, etc., relocation and management of drain outlets, water purification, pollution treatment in the sources of water, afforestation surrounding the sources of water and so on.</td>
<td>New construction/ Expansion</td>
<td>Choose 126 villages in counties and districts in Anhui Province</td>
<td>380,000</td>
<td>Improve the environment of sources of drinking water and ensure the safety of drinking water in rural areas.</td>
<td>2013—2017</td>
</tr>
<tr>
<td>2</td>
<td>Project on Treatment of Domestic Pollution in Rural Areas</td>
<td>Construct facilities to process domestic sewage and collect and process the waste according to the actual needs and different situations in different places in Anhui Province. The project mainly includes construction of landfills, construction and transformation of sewage pipes, construction of pipe networks to separate rain from sewage, the centralized processing facilities of domestic sewage, transfer stations of domestic waste and facilities to collect and transport domestic waste, methane tanks to purify domestic sewage, etc.</td>
<td>New construction/ Transformation</td>
<td>Choose 401 villages in counties and districts in Anhui Province</td>
<td>560,000</td>
<td>Solve the problems of dumping and piling up waste everywhere. Improve the “dirty, disorder, bad” situation. Control the pollution caused by domestic waste and sewage. Effectively control and treat the ground pollution. Improve the environment quality</td>
<td>2013—2017</td>
</tr>
<tr>
<td></td>
<td>Project on Control and Management of Pollution Caused by Agricultural Production</td>
<td>The Project mainly includes Comprehensive treatment of excrement from breeding poultry and livestock, construction of methane tanks and facilities to generate electricity with methane, recycle and comprehensive use of waste and straws, construction of demonstration bases for pollution-free planting and those for environment-friendly breeding, etc..</td>
<td>New construction</td>
<td>Choose 321 villages in counties and districts in Anhui Province</td>
<td>470,000</td>
<td>The breeding waste can be used as resources and the sewage can be treated. Reduce the amount of fertilizers and improve the soil structure. Improve the living quality and environment quality as well as develop the circular economy.</td>
<td>2013—2017</td>
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</tr>
<tr>
<td>4</td>
<td>Project on Comprehensive Treatment of Soil Pollution</td>
<td>The project mainly includes treatment of soil pollution caused by pesticides, fertilizers, heavy metals and mining areas.</td>
<td>New construction</td>
<td>Choose 35 villages in counties and districts in Anhui Province</td>
<td>33,000</td>
<td>Alleviate the pollution and harm of pollutants in the soil to crops. Ensure and improve the quality safety of the crops.</td>
<td>2013—2017</td>
</tr>
<tr>
<td>5</td>
<td>Project on Clean Villages</td>
<td>According to the requirements of <em>The Standard of Construction of Beautiful Villages in Anhui Province</em>, the central villages and natural villages should be equipped with necessary facilities to collect, transport and process domestic</td>
<td>New construction</td>
<td>15,000 central villages and 230,000 natural villages in Anhui</td>
<td>280,000</td>
<td>Construct beautiful and livable villages with a tidy and beautiful environment.</td>
<td>2013—2017</td>
</tr>
<tr>
<td>No.</td>
<td>Project Title</td>
<td>Project Description</td>
<td>Province</td>
<td>Cost</td>
<td>Time Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Project on Sewage Treatment in Industrial Parks in Urban and Rural Areas</td>
<td>The project includes upgrading all secondary sewage treatment plants in Anhui Province into primary sewage treatment plants, covering the old towns in urban areas with the sewage pipe networks, constructing 100 sewage treatment plants in industrial parks in rural areas, and constructing 200 small-scale sewage treatment plants first in small towns in Anhui Province.</td>
<td>Anhui Province</td>
<td>2360,000</td>
<td>2013—2017</td>
<td>Control the urban sewage from spreading to rural areas and reduce pollution from industrial sewage in rural areas, meanwhile, solve the problem of sewage discharge in small towns, and protect the water resources in rural areas.</td>
<td></td>
</tr>
</tbody>
</table>
C. Policy Recommendations

1. Establish and Perfect Relevant Laws and Regulations

   a. Revise and Improve the Current Laws and Regulations on Rural Environmental Protection

      At present, there are few legislative regulations focusing on preventing urban pollution from the spreading to rural areas. The current laws and regulations should be updated and revised to timely respond to recent development of rural environmental pollution.

   b. Streamline the Current Laws and Regulations on Rural Environmental Protection

      The current laws and regulations on rural environmental protection are sometimes overlapping and scattered so that they are difficult for enforcement. It is suggested to streamline all the laws and regulations and formulated an independent and comprehensive legislative systems supported by complete and clear-cutting regulations and laws for easy implementation.

   c. Popularize Laws and Regulations on Rural Environmental Protection

      In order to raise people’s awareness of the need for environmental protection, information must be available for farmers and rural township enterprises to educate better laws and regulations on protecting the rural environment. Publicity teams can be assembled to travel from town to town, village to village, not only to popularize laws but also to inspect and supervise environmental protection work.

   d. Strengthen Law Enforcement of Rural Environmental Protection

      On the one hand, law enforcement of rural environmental protection must be coordinated among all government agencies to produce better results. On the other hand, law enforcement of rural environmental protection must be made with a specific focus.

   e. Establish and Supplement Laws and Regulations on Rural Environmental Protection

      At present, there are still “loopholes” in rural environmental legislation which are in dire need of revision.
2. Rural and Agricultural Policy

a. Implement Garbage Classification by Establishing Strict Rules of Reward and Punishment to Promote Recycling and Utilization of Domestic Garbage

Villagers who take the lead in garbage classification and recycling are immediately rewarded while those who discard garbage randomly in non-designated places receive penalties and fines.

b. Improve the Management System through Rural Property Management

Rural waste management institutions should be defined and empowered to make the waste management more standardized and institutionalized. In the new rural construction, rural property management is a new model put forward by the Science and Education Department of the Ministry of Agriculture in carrying out the Rural Sanitation Pilot Project.

c. Promote Comprehensive Disposal Suitable for Rural Waste, and Realize Garbage Industrialization

The promotion of comprehensive garbage disposal should be based on the following six conditions: mature and reliable technology; simple disposal facilities; small investment; convenient operation and maintenance; low cost; licensing system.

d. Carry out the Agricultural Economies of Scale

Agricultural economies of scale contribute to agricultural mechanization and productivity. This will relieve the random use of fertilizers by individual farmers, thus reducing pesticide residue and benefiting cultivation of regional brand.

e. Popularize Advanced Technology to Achieve Agricultural Productivity

With the development of agricultural science and technology, the traditional farming method has been unable to meet the need of modern agricultural production. The agricultural departments at all levels should vigorously promote advanced agricultural technology and coordinate these technological breakthroughs with a rural environmental protection plan.

3. Environmental Policy
a. Improve the Environmental Supervision and Management System

In townships and rural areas with concentrated industrial enterprises, special environmental supervision and administration institutions should be set up with professional, qualified personnel. Environmental protection offices should be established in suitable areas to observe the change in rural environment, gradually completing an integrated system of urban and rural environmental supervision and management.

b. Perfect the Environmental Compensation System

A taxation and penalty system must be implemented to improve the rural ecological environment. The government should build large pollution treatment facilities for the disposal of the so-called “three wastes” (waste gas, waste water and waste residues). Small township and village enterprises, which are unable to purchase the anti-pollution equipment, can procure a loan from the government. In addition, the developed areas should compensate for the environmental cost of under-developed areas.

c. Promote the Establishment of Environmental Construction Project

The environmental protection and treatment of Anhui Province can be divided in accordance with regions, while the projects are to be approved on the basis of regional division according to pollution category. They must be applied by enterprises and government agencies to Anhui Provincial Department of Environmental Protection and Anhui Provincial Department of Finance. The projects should be assessed by the technology experts organized by the Anhui Provincial Department of Environmental Protection and the Anhui Provincial Department of Finance. Moreover, opinions of all involved should be heard and documented.

4. Land Policy

a. Speed up Land Circulation

Speeding up the rural land circulation and achieving economies of scale has become the inevitable choice of the PRC's agricultural development. Not only is it important in solving the problems of the rural land and the advancement of the economic development in Anhui Province, but also in alleviating the rural ecological destruction and pollution of the environment.
b. Promote the Rural Land Regulation

Governments at all levels must, in accordance with the principles established by Anhui Provincial Government, build a leading team to promote, plan and coordinate rural land regulation with well-defined objectives and clear-cut responsibilities.

5. Energy Policy

a. Policy Suggestions on Transforming the Rural Energy Consumption Pattern

- Improve the feasibility, consistency, authoritativeness and seriousness of development planning, and avoid conflicting regulations from different departments.
- Encourage the application of efficient energy.

b. Policy Suggestions on Changing Rural Energy Consumption Structure

- Speed up the development of wind power generation.
- Popularize and promote the rural solar water heater.
- Establish and improve the service system of rural energy technology.

c. Positively Provide Policy Support for Renewable Energy Association

- Give policy support to Anhui Province Renewable Energy Association.
- Cooperate actively with Anhui Province Renewable Energy Association.

d. Disseminate the “Rural Ecological Energy Bureau” Practice


a. Policy Measures on Rural Water Resource Protection

- Embrace sustainable development of water resources.
- Improve the traditional agricultural irrigation facilities.
- Protect the existing water resources in Anhui Province.
• Develop water-saving crops according to local conditions.
• Make full use of natural precipitation.

b. Policy Measures on the Construction and Management of Rural Water Conservancy Project

• Make long-term plans and strictly guarantee the quality.
• Establish farmer-participatory management mode and ensure sustainable use of the project.
• Strengthen engineering management
• Develop human resources of rural water conservancy project management.
• Improve the monitoring methods to assist and enhance observations.
• Establish and apply diversified rural water conservancy engineering.
• Construct and manage water conservancy associations.

7. Other Non-Financial Policy Suggestions

a. Incorporate the Rural Ecological Protection into the Performance Evaluation Index of Government at all Levels

Anhui rural economic and social development lags far behind that of the urban area, demanding faster development. However, it cannot be achieved at the expense of the environment. We must embrace sustainable designs to keep a balance between economic development and ecological protection. In addition, it is necessary to develop the target system of Anhui rural ecological construction and incorporate it into the performance evaluation system of people's governments at all levels in Anhui Province.

b. Strengthen the Training and Popularization of Rural Environmental Protection to Improve Farmers' Environmental Awareness

The rural environmental protection calls for active participation of farmers who should play a major role in the pollution prevention and control. Mass media such as radio, television, and the Internet must be employed to effectively promote environmental protection; to raise the people’s awareness on pollution controls, rules and regulations towards the rural environmental protection; and to promote agricultural science and technology.
c. **Strengthen the Public Supervision of Rural Environment**

- The public supervision network of environmental protection and pollution control needs to be established and perfected.
- Environmental legislation should guarantee the legitimacy, supervision and reporting information to the public.
- Effective, transparent and open channels must be developed for the public to express opinions and give feedback.
- The role of mass media must be utilized to assist in the supervision of rural environmental protection.

8. **Fiscal Policy Recommendations**

a. **Policy Measures Must Be Taken to Ensure Constant Growth in Financial Investment for Rural Environmental Protection**

- To set up special funds and incorporate rural environmental protection into the people’s livelihood.
- To broaden the financing channels of rural environmental protection through inviting social capital investment.
- To carry out the reform of rural environment taxation and establish the system of rural ecological compensation transfer payment system.

b. **Reforms Must be Deepened to Define Government Funding in Terms of Its Environmental Responsibilities**

- To clearly define the responsibilities of the governments and rural environmental protection entities at all levels, and to perfect the grass-roots financial mechanism.
- To establish incentive mechanisms.

c. **Fiscal Expenditure Must Be Optimized to Enhance Fund Efficiency**

- To highlight investment for rural environmental protection.
- To innovate expenditure mode of rural environmental protection funds.
d. Financial Support Must Be Built to Develop the Sustainability of Rural Environmental Protection Project

- To support policy measures that can improve the quality of project construction.
- To establish effective system of long-term management of rural environmental protection fund.

e. Financial Security Must Be Ensured to Improve Comprehensive Performance

- To carry out the performance evaluation of policy fund expenditures.
- To perfect supervision and inspection mechanisms.

9. Recommendations on Establishing Public Service System

a. A Public Service Function System of Rural Ecological Environment Protection Must Be Established with Clear Demarcation of Responsibilities

- To set up environmental protection bureaus with professional environmental workers in governments at township levels in Anhui Province and to incorporate them as civil servants.
- To set up environmental protection offices with professional environmental workers at each village.
- To build rural environment monitoring stations in every town with full-time personnel and monitoring equipment;
- To reallocate the environmental protection functions of each grassroots environmental protection departments to town’s environmental protection bureaus and village’s environmental protection offices.

b. Rural Ecological Protection Must Be Advanced on the Model of “Led by the Government yet Based on Farmers’ Real Needs”

- Farmers’ initiative must be exercised to ensure popular participation in rural environmental protection.
- Grassroots environmental protection agencies must assume corresponding responsibilities in actively promoting rural environmental investment, supervision, and infrastructure.
c. Sources of Fund Raising Must Be Expanded to Construct Diversified Public Service Supply for Rural Ecological Protection

- To establish long-term transfer mechanism of Anhui rural ecological environment.
- To levy pollution fees on rural pollution enterprises and farmers according to varying degrees of pollution.
- To charge a minimal sanitation fee according to the population of each household.
- To gain social donation from non-profit organizations.
- To levy environmental protection tax in order to guarantee sustainability of the rural environmental protection fund.

d. A Reasonable Rural Pollution Control Mode Must Be Promoted on the Basis of Corresponding Public Service Mechanism

- To fully implement rural domestic garbage treatments of “classified by households, collected by villages, transferred by townships and treated by the counties.”
- To accelerate the construction of rural infrastructure, especially the construction of a rural sewage plumbing network.
- Industrial pollutants should be treated under the basic principle of “whoever pollutes must pay for treatment,” so as to urge rural industrial enterprises to take responsibilities for their pollution control.

IV. INTERNATIONAL EXPERIENCE

A. Learn Advanced Technology to Reduce Emission and Relieve Pollution

In recent years, developed countries in Europe and the United States of America (USA) have successfully applied ecological engineering in large scales to control agricultural non-point source pollution. The European Union (EU) has focused much attention on researching, as well as developing environment-friendly techniques of their agricultural production, such as best nutrition management of farmland, organic agriculture, comprehensive agricultural management mode and measures to protect farmland soil and water. The ecological engineering in the USA has applied pre-tank technology, vegetation cushion technology, artificial wetland
technology, nutrition management technology, and cultivation management technology. This is a source of valuable experience for the PRC.

At present, there is a lack of application of advanced agricultural production technology in Anhui Province. The development of emission reduction is still in its infancy. Direct introduction of advanced technology from the European and American countries does not accord with the PRC's national conditions. Advanced technologies from home and abroad should gradually be applied to reduce pollution emissions. Soil testing is most suitable for soil fertilizer management in Anhui. In 2005, the Province carried out the soil testing formula fertilization project, but the effect of promoting soil testing formula fertilization is not significant. Thus it is proposed to incorporate soil testing fertilization technology into the agricultural technology system. Ecological engineering technologies such as artificial pool, vegetation buffer zone, and wetland system are very effective in controlling agricultural non-point source pollution. However, the unique natural geographical environments in Anhui Province, coupled with the current economic conditions, as well as other restrictions present obstructions to these technologies.

B. Adopt Effective Policies to Support the Development of Rural Areas, Agricultural Production and Farmers

In 1999, the EU officially promoted the "Agenda of 2000", which matched the implementation of environmental protection standards with payments to farmers. Meanwhile, environmental investments have been considerably increased. The US government provides technical support, education, as well as funding for those eligible farmers and ranchers to help them find more environment-friendly and economical ways to make use of soil, water and natural resources. The Japanese government has implemented many favorable policies for green agriculture. For example, special interest-free loans are offered to farmers who engage in organic agricultural production and constructional investment subsidies. Tax refund policies are also provided for composting agricultural facilities, organic agricultural storage, and transportation facilities.

Anhui Province, a large agricultural province of Eastern PRC, has attached great importance to the development of "rural areas, agricultural production and farmers", but the formulation of policy is not made overnight. It demands overall planning, on-the-spot investigation, and gradual implementation. It can start by developing pilot projects similar to the Demonstration Area of Wanjiang. Subsequent promotions will follow the lessons and experiences of these pilot projects. The focus of government subsidies must shift from agricultural to ecological production. A strong incentive mechanism must be in place to terminate fertilizer subsidies or even levy fertilizer tax to encourage farmers to use environment-friendly agricultural production technologies.
C. Carry out Effective Measures to Dispose of Rural Domestic Sewage and Garbage

In rural USA, the government establishes laws to guide and subsidize the construction of domestic sewage disposal facilities. The domestic waste is compressed and then disposed by an electrical waste processor. Farmers are encouraged to install sewage tanks to deal with daily feces. Almost all the rural communities in the EU have constructed concentrated rainfall drainage systems and each household has its own septic tank and domestic sewage disposal facility. In Japan, the drainage project uses a small-scale buried sewage treatment system, small in size, with a low cost and simple operation.

Some areas of Anhui Province have carried out effective measures to deal with the rural domestic garbage and sewage. For example, Jixi County instituted a variety of integrated disposal methods with urban and rural garbage. The system is based on un-powered anaerobic disposal of sewage, comprehensive disposal of livestock and poultry waste and incineration of small garbage. Chizhou has released its rural sanitation project, planning to build waste transfer stations, and professional garbage truck, etc. in all of its villages and towns from 2010 to 2014. Anhui Province may draw lessons from other countries or cities to perfect infrastructure of rural garbage disposal; introduce garbage recycling industry; adopt reward policy for garbage recycling; and strengthen the system of garbage disposal supervision.

D. Promote the Efficient Utilization of Rural Resources through New Engineering Technology

Sachsen, a city in the large agricultural country of Germany, supports methane projects in most farms, as well as several large-scale biogas projects. The biogas projects use resource plants (mainly maize straw) as its raw materials or the fermentation of straws, animal dung and domestic waste to produce methane. Since the early 1980s, the non-traditional resource department of India has been promoting family-scale methane production, and it provides funds and subsidies for the construction, maintenance and training of the methane tank, the cultivation of citizens’ awareness and the activities in the technical center.

In 2010, rural biogas consumption households in Anhui Province has amounted to 727,400, which stays at the middle level in the PRC but at the lower level among central provinces. Anhui local governments should pay attention to the construction of rural biogas service company (station) at the county level, find fund for daily operation of rural biogas service network, stabilize the construction service team of rural biogas and ensure the healthy and sustained development of rural biogas. In terms of large and medium-sized biogas projects in farms, it is suggested that related provincial departments issue as soon as possible New Rural Biogas Project Management Methods to further perfect the supervision mechanism.
E. Learning from Good Models in Unified Rural Construction

Japan’s rural construction is characterized by:

Housing: scattered rural residences are integrated into building a more concentrated rural community in order to decrease the infrastructural costs.

Land: government will take all measures to ensure smooth progress of construction in line with regulations in farmland reconditioning and encouraging concentrated communities.

Investment: investment is supported mainly by the central government, where local governments support to a smaller extent, followed by the farmer who provides the least. Environment: the environment protection policy is very strict in Japan. During the infrastructural construction, the government pays much attention on the construction of waste disposal facilities and implements a policy of discouraging tree falling to facilitate afforestation, which has achieved great success.

The development mode, industrial development, land system, fiscal management and policy formulation in Japan’s rural areas all have provided inspiration for the PRC’s rural planning and management.

The village distribution in rural Anhui varies with geographic locations. In northern Anhui, villages scatter irregularly, which should be integrated and centralized; In Mid Anhui and areas along Yangtze River, due to the disordered village hierarchy, it is necessary to rationally guide the spatial distribution and administrative levels of the villages; in the Eastern Anhui, the number of administrative villages can be moderately reduced and merging some villages with smaller populations and inconvenient traffic; in Southern and Western Anhui, because of natural topography in mountain lands, the villages distribute sparsely with a smaller population. Therefore, villages should be distributed in line with the spatial development, and the population of central villages and basic-level villages should be increased.

F. Effective Restraints of the Urban Pollution Transfer to the Countryside

Legislation and economic penalty are two common ways to restrain the transfer of the urban pollution to the rural areas. Legislation is an effective guarantee of environmental protection. The USA formulated the Equal Environmental Rights Act 1993, and issued Guidelines to Bring Environmental Justice into Environmental Impact and Environmental Assessment and Guidelines for Citizens to Realize Environmental Justice by Federal Laws, in order to curb pollution transfer. In 2003, the EU signed Protocol on Registration of Pollution Emissions and Transfer, and established Pollutant Release and Transfer Register (PRTR) in 2004. Japan has made Prevention and Control of Atmospheric Pollution and Prevention and Control of Water Pollution, setting strict pollution compensation system.

Economic penalty serves as a back-up plan to protect the environment. The USA takes economic measures like cap-and-trade for emission or environmental tax to deter polluters. The EU lawmakers partake more in economic influences instead of regulation control to restrain pollution transfer. However, economic measures are
controversial for in their complexity. For example, the cap-and-trade system is mature enough in the US, but it can still lead to unfair pollution transfer.

Anhui Province should integrate administrative system and economic measures to reduce pollutant emission, curb the transfer of pollution and strengthen pollution controls. Currently, national demonstration area for accepting the industrial transfer has been set up in cities along the Yangtze River in Anhui Province; and they are responsible for the large scale industrial transfer from the coastal regions in the east. The transfer at county and village level in these regions must strictly follow the environmental standards in project constructions to curb pollution. Illegal emission should be given heavy penalties and fines, while more efforts need to be made to prevent pollution as early as possible.

V. CONCLUSION

The research is of great importance to the Anhui government for formulating a provincial rural development strategy during the 12th Five-Year Plan period. Being located in a transitional area that carries on the PRC’s industrial transfer from the coastal to the central region, and disseminates advanced technologies and best experiences to the western region, Anhui is the mainstay of the national 12th Five-Year Plan implementation and plays an indispensable role for promoting the economic rise of the central region in the PRC. The research under ADB TA7737-PRC aims to contribute to Anhui’s sustainable socioeconomic development.

The research report contains one major report and ten sub-reports. It presents in-depth analysis on local situations in the rural areas and sector conditions associating with the existing environmental problems. The studies conducted include field surveys, case studies, and the generation of sufficient practices in the different sectors, regions, and countries on rural environmental issues. It introduces the advanced technologies and best international practices to the government, and recommends technical solutions and policy suggestions for sector innovations and policy reforms to improve Anhui’s rural environmental protection.

Compared with other Anhui studies on rural environmental topics, this research is unique in the following aspects:

- Adopting a systematic research approach: most of the previous studies focused only on one or two aspects concerning environmental protections and the solutions are separated with different perspectives. This research identifies fundamental issues on environment problems and analyses them from multiple angles at different layers.
- Reflecting the common concerns over the rural environmental issues, especially in those agricultural provinces of the PRC. The findings and experiences of this research could be demonstrated and disseminated to other provinces and help to promote a sustainable economic growth in Anhui and beyond.
• Putting forward a host of tailor-made recommendations at the technical and policy levels. They are aimed at giving operational feasible recommendations to serve the government in rural environmental protection.
• Introducing advanced technologies and best international practices which provide valuable references to the government for decision-making and to reform interventions.
• Identifying potential projects on environmental protection and pollution management in the next 5 years in Anhui Province. This will help foreseen the investment opportunities of potential investors, including ADB and other international and multilateral agencies.
Technical Assistance Consultant’s Report

Project Number: 44075-012
October 2013

Provincial Development Strategies for Provinces in Central People’s Republic of China Focused on Rural Development

-Research on Environmental Protection and Management in Rural Areas of Anhui Province (Financed by ADB TA 7737-PRC: Package 1)

Final Main Report

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Research Institute of Fiscal Science of Anhui Province, PRC

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# CONTENTS

## I. INTRODUCTION

### A. General Introduction to Socioeconomic Conditions in Rural Areas in Anhui Province

1. Geographic Location and Socioeconomic Development of Anhui Province 1
2. Basic situation of socioeconomic development of Anhui Province 3

### B. The Strategic Status of Anhui Province in the Socioeconomic Development of China

1. An Important Province Connecting the North and South and Linking the West to the East in China 5
2. A Fast-developing Province in Mid-China 5
3. A Major Agricultural Province with the Climatic Features of Both Southern and Northern China 6

### C. Necessity and Significance of the Research

1. The Necessity of the Research 6
2. The Significance of the Research 7

### D. The Overall Framework of the Research

1. The Definition of Concepts and the Scope of the Research 7
2. The Framework of the Research 8
3. The Originality of the Research 10

## II. THE CURRENT SITUATION OF ENVIRONMENTAL PROTECTION AND MANAGEMENT IN RURAL ANHUI PROVINCE

### A. The Overall Environmental Quality in Anhui Province

1. Aquatic Environment 11
2. Atmospheric Environment 13
3. Industrial Solid Waste 14
4. Acoustic Environment 14
5. Ecological Environment 15

### B. The Current Situation of Environmental Pollution in Rural Anhui Province

1. Industrial Pollution 16
2. Farming Pollution 16
3. Breeding Pollution 18
4. Domestic Pollution 18
5. Urban Pollution is Spreading to Rural Areas 19
C. Basic Measures and Problems of Environmental Protection and Treatment in Rural Areas in Anhui Province

1. Basic Measures of Environmental Protection in Rural Areas in Anhui Province

2. Problems in Environmental Protection and Treatment in Rural Anhui Province

D. Hazards Caused by Ecological Imbalance in Rural Areas in Anhui Province

1. Hazards Caused by Imbalance of Water Environment

2. Hazards Caused by Imbalance of Soil Environment

3. Hazards Caused by Imbalance of Air Environment

4. Hazards Caused by Overall Environmental Imbalance

III. MAIN CAUSES OF ENVIRONMENTAL IMBALANCE IN RURAL AREAS IN ANHUI PROVINCE

A. Internal Factors in Rural Areas

1. Factors in Industrial Production

2. Factors in Agricultural Production

3. Rural Life Patterns

4. Institutional Factors

5. Factors in Resources and Energy Consumption

6. Other Factors

B. External Factors——Transfer of Urban Pollution

IV. IMPACTS OF ECO-ENVIRONMENTAL IMBALANCE ON ECONOMY AND SOCIETY IN RURAL ANHUI PROVINCE

A. Hinder Rural Economic Development

1. The Increasing Input-output Ratio in Agriculture

2. The Rising Cost in Environmental Management

B. Hinder Social Development in Rural Areas

C. Undermine Health of Urban and Rural Residents

1. Water Pollution and Human Health

2. Solid Waste Pollution and Human Health

3. Air Pollution and Human Health

D. Affect Food Security in Urban and Rural Areas

E. Endanger Eco-environment in Big Rivers and Lakes

1. Chaohu Lake Region and the Surrounding Areas

2. Huaihe River Basin

3. Yangtze River Basin
V. FEASIBILITY AND TECHNICAL PROPOSAL FOR ENVIRONMENTAL PROTECTION AND MANAGEMENT IN RURAL ANHUI PROVINCE

A. Technical Solutions to Remediating or Reducing Production Pollution in Agriculture
   1. Implement “Four Savings and One Reduction” Project
   2. Apply “Ecological Energy” Project

B. Technical Solutions to Increasing Renewable Resource Consumption
   1. Steadily Carry out Large-scale Stalk Biomass Biogas Project
   2. Promote and Apply Stalk Solidification Fueling Technology

C. Feasibility Report on Centralized Processing of Domestic Solid Waste in Rural Areas

D. Technical Solutions to Stopping Urban Pollution from Spreading to Rural Areas
   1. Strengthen Urban Air Pollution Prevention and Management
   2. Strengthen Urban Sewage Treatment
   3. Improve Domestic Waste Treatment in Urban Areas

E. Practical Solutions to Rural Layout Optimization

F. Strategies for Land Circulation to Promote the Large-scale Farmland Operation
   1. Promote Land Circulation by Developing Industrialization
   2. Achieve Orderly Land Circulation by Standardizing the Market
   3. Cultivate Large-scale Farmers and Direct Land Circulation
   5. Promote Land Circulation by Increasing the Intensity of Support
   6. Promote Land Circulation by Developing Urban Economy

   1. Promote PPP for the Construction of Rural Water Conservancy Facilities
   2. Implement the Four Projects to Treat Rural Sewage

VI. SUGGESTIONS ON RELATED POLICIES OF ENVIRONMENTAL PROTECTION AND TREATMENT IN RURAL AREAS IN ANHUI PROVINCE

A. Construction and Modulation of Related Laws and Regulations in Support of Environmental Protection and Treatment in Rural Areas
   1. Issue Regulations on Environmental Protection and Treatment in Rural Areas
2. Publicize with Great Efforts Laws and Regulations about Rural Environmental Protection

3. Intensify Law Enforcement and Set up a Unified and Efficient Working System for Rural Environmental Protection

4. Be Judicially Strict and Improve Management Standards Laws and Regulations about Rural Environment Protection

B. Suggestions on Non-fiscal Policies in Support of Environmental Protection and Management in Rural Areas

1. Policies for Agriculture and Rural Areas

2. Environmental Policies

3. Land Policies

4. Energy Policies

5. Policies on Water Resources

6. Policies in General

C. The Suggestions on Fiscal Policies in Support of Rural Environmental Protection and Management

1. Policy Measures must be Taken to Ensure Constant Growth in Financial Investment for Rural Environmental Protection

2. Reforms must be Deepened to Define Government Funding in Terms of Its Environmental Responsibilities

3. Fiscal Expenditure must be Optimized to Enhance Fund Efficiency

4. Financial Support must be Built to Develop the Sustainability of Projects for Environmental Protection in Rural Areas

5. Financial Security must be Ensured to Improve Comprehensive Performance

D. The Budget in Improving the Eco-environment in Rural Area (for Five Years)

1. The Restrictions on the Measurement of the Cost Required for Rural Environment Protection

2. The Calculation of Financial Input in the Rural Environment Protection Based on the International Experience

3. The Correction of the Scale of Fiscal Input in Rural Environmental Protection Based on the Increase of Expenditure

E. Suggestions on Establishing Public Service System (with Governments at All Levels Taking Their Corresponding Responsibility)

1. A Public-service Function System of Rural Ecological Environment Protection must be Established with Clear Demarcation of Responsibilities.
2. Rural Ecological Protection must be Advanced on the Model of “Combination of Governments and Farmers”\textsuperscript{12}.

3. Construct Public-service Supply for Rural Ecological Protection with Diversified Investment\textsuperscript{13}.

4. Promote “Three Modes\textsuperscript{14}” of Pollution Treatment in Rural Areas

VII. REFERENCES
I. INTRODUCTION

A. General Introduction to Socioeconomic Conditions in Rural Areas in Anhui Province

1. Geographic Location and Socioeconomic Development of Anhui Province

a. Geographic Location

Located in East China, Anhui Province connects the Yangtze River Delta to the east and central China to the west. Spanning about 450 kilometers from east to west, 570 kilometers from north to south, it has a total area of 0.1396 million square kilometers with its land high in the southwest and low in the northeast. Flowing across the whole province from west to east, the Yangtze River and the Huaihe River divide the province into three regions: the region north of the Huaihe River, the region along the Yangtze River and the Huaihe River, and the region south of the Yangtze River. It can be roughly divided into five natural areas: the plain north of the Huaihe River, the mountainous areas along the Yangtze River and Huaihe River, Dabieshan mountainous area in western Anhui Province, the plain along the Yangtze River, and the mountainous area in southern Anhui Province.

There is a vast plain in the region north of the Huaihe River in Central China. The central region along the Yangtze River and the Huaihe River is mountainous with sloping hills while the Yangtze River-Huaihe River watershed areas and areas in between are downy. Flat along the banks of the Yangtze River and areas around Chaohu Lake, the Dabieshan mountainous area lies in the west, a plain along the middle-lower Yangtze River. Mountains and hills make up most of the southern Anhui Province.

The climate of Anhui Province ranges from warm temperate to subtropical zones. With the Huaihe River as the dividing line, the north has a warm temperate climate with semi-humid monsoon while the south is subtropical with humid monsoon. Generally, the climate of Anhui Province is warm with four distinct seasons, rich sunshine and monsoon.

b. The Overall Situation of Socioeconomic Development of Anhui Province

By 2011, the total population registered has reached 68.76 million, of which the non-agricultural population accounts for 22.93%. The permanent population was 59.68 million, 44.8% of which is urban population.

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In 2011, the GDP of Anhui Province amounted to 1,530.065 billion yuan, an increase of 13.51% over the previous year. The GDP per capita reached 25,659.31 yuan, an increase of 12.63% over the previous year. The GDP in the primary industry was 201.531 billion yuan, accounting for 13.17%; that in the secondary industry was 830.938 billion yuan, accounting for 54.31%; and that in the tertiary industry was 497.595 billion yuan, accounting for 32.52%.

In 2011, the fiscal revenue of Anhui Province reached 263.302 billion yuan, accounting for 17.2% of the total GDP. The per capita disposable income of urban residents was 18,606.13 yuan, increasing by 17.8% compared with the previous year. The net per capita income of rural residents was 6,232.21 yuan, increasing by 17.9%.

c. The Administrative Division and Key Economic Development Areas of Anhui Province

There are 16 prefecture-level cities, 43 municipal districts, 6 county-level cities and 56 counties. Chaohu, once a prefecture-level city, was officially disintegrated in August 2011, and the one district and four counties under its jurisdiction were respectively integrated into other three cities, Hefei, Wuhu and Ma’anshan. Chaohu has now become a county-level city. The key economic development areas include Wanjiang city belt (megalopolis) demonstration zone for industrial transfer, the planning area for developing the northern Anhui Province, the comprehensive experimental area for independent innovation encompassing Hefei, Wuhu, Bengbu, and the crucial area for poverty alleviation in Dabieshan mountainous area.

Wanjiang City Belt Demonstration Zone for Industrial Transfer. This part belongs to the Yangtze River basin in Anhui Province, including 59 counties (cities and districts): Hefei, Wuhu, Ma’anshan, Tongling, Anqing, Chizhou, Chaohu (which is now under the administration of Hefei, Wuhu and Ma’anshan), Chuzhou, Xuancheng and Jin’an District and Shucheng County in Lu’an, reaching out to the whole province and connecting the Yangtze River Delta. According to The Statistical Yearbook of Anhui Province 2012, in 2011, the GDP in the demonstration area reached 1034.853 billion yuan, accounting for 67.63% of the whole province. Fiscal revenue amounted to 168.562 billion yuan, accounting for 64.02% of the whole province. The per capita disposable income of urban residents was 20,978.00 yuan, 12.75% higher than the average of the whole province. The net per capita income of rural residents reached 7,329 yuan, 17.6% higher than the average of the whole province. It is the key area of implementing the strategy of promoting the development of central areas and also the closest area to undertake the industrial transfer from the Yangtze River Delta to the Midwest China.

Planning Area for Developing Northern Anhui Province. The northern Anhui Province includes six cities (Hualbei, Huainan, Fuyang, Bozhou, Suzhou and Bengbu) and five counties (Dingyuan County, Fengyang County, Mingguang County, Shouxian County and Huoqiu County), covering an area of over 53,000 km². In 2010, the total population there has reached 36.332 million, accounting for 53.5% of the whole province; and the GDP there was 410.22 billion yuan, accounting for 33.5% of the whole province, so the area is an important player in socioeconomic development of
Anhui Province. The development of the northern Anhui Province is crucial as a provincial strategic plan in exploiting comprehensive comparative advantages, accelerating the development of new-emerging economies, narrowing the development gap between different regions and promoting regional harmony.

Comprehensive Experimental Area for Independent Innovation Encompassing Hefei, Wuhu and Bengbu. Hefei, Wuhu and Bengbu in Anhui Province cluster with innovative resources, one of the areas endowed with science and technology talents in middle and western China. According to The Statistical Yearbook of Anhui Province 2012, in 2011, the GDP of the area amounted to 607.510 billion yuan, accounting for 39.70% of the whole province; fiscal revenue reached 104.66 billion yuan, accounting for 39.75%. The per capita disposable income of urban residents reached 21,345.00 yuan, 14.72% higher than the average in the whole province. The net per capita income of rural residents was 7,647.00 yuan, 22.70% higher than the average in the whole province.

Crucial Area for Poverty Alleviation in Dabieshan Mountainous Area. The Dabieshan mountainous area borders against Anhui Province, He’nan Province and Hubei Province, known as a revolutionary cradle and a major grain-producing area vulnerable to floods along the Huaihe River. It is the most thickly populated among all the national poverty alleviation areas. The Regional Development and Poverty Alleviation Plan in Dabieshan Mountainous Area (From 2011 to 2020) includes 12 counties in this area, including Qianshan County, Taihu County, Susong County, Yuexi County, Wangjiang County, Linquan County, Funan County, Yingshang County, Shouxian County, Huoqiu County, Jinzhai County and Lixin County.

2. Basic situation of socioeconomic development of Anhui Province

In 2011, the agricultural population registered in Anhui Province has reached 52.99 million, accounting for 77.07% of its total population. And the non-agricultural population reached 15.77 million, accounting for 22.93% of the total population. At present, with the current Household Contract Responsibility System in rural Anhui Province, family-based farmers rent contracted land from government authorities. In 1978, eighteen farmers in Xiaogang Village, Fengyang County in Anhui Province signed “a contract of life and death”, and contracted the fields in the village on a family basis, setting up the household contract responsibility system and opening a new era in the rural development.

Crops in Anhui Province are planted in five areas: the region north of the Huaihe River, the hilly areas along the Yangtze River and the Huaihe River, areas along the Yangtze River, Dabieshan mountainous area in western Anhui Province, and mountainous areas in southern Anhui Province. The crops grewed on the plains north of the Huaihe River are mainly wheat, beans, potato, and different kinds of minor

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cereals; wheat and rice dominate in the hilly areas along the Yangtze River and the Huaihe River. Rapes and peanuts are rich among all oil-bearing crops. The areas along the Yangtze River are famous for fish and rice. Double-cropping rice makes up the most in the planting structure of crops in Anhui Province. It is also the pivotal production area of cotton. Rapes are the main oil-bearing crops. Dabieshan mountainous area in western Anhui Province abounds with rice, with middle-season rice as the main crop and wheat as the complement in its planting structure. The main crop in the mountainous areas in southern Anhui Province is rice and in summer it is the wheat.

By the end of 2011, the arable field in Anhui Province has covered an area of 4.1843 million hectares, of which 1.8961 million hectares are paddy fields and 2.2882 million hectares are dry lands. In 2011, its grain yield has increased for the sixth year in a row with a steady rise. The agricultural production totaled to 160.51 billion yuan in value with sown area of 9.02299 million hectares, of which the sown areas of grains covered 6.62154 million hectares with an output of 31.355 million tons; sown areas of rapeseed covered 878.28 thousand hectares with an output of 2.1375 million tons; and sown areas of cotton 350.40 thousand hectares with an output of 0.376 million tons.

The farmland-to-forest reclamation area in Anhui Province has been greatly increased. In 2011, the total output in forestry was 14.75 billion yuan and the total area of forest was 968.917 thousand hectares, with 72,747 hectares of artificial forestation, 1,827 hectares of reforestation, 31,128 hectares of newly increased area fenced off for afforestation, 11,106 hectares of new seedlings, and 271,948 hectares of young forests as well as 579,261 hectares of grown forests.

The breeding industry in Anhui Province is in a stable development. In 2011, the total output of animal husbandry was 88.78 billion yuan, and that of fishing industry was 30.63 billion yuan. There were 14.6731 million live pigs on hand, an increase of 1.7%. Pigs in the market amounted to 27.2109 million, a decrease of 2.2%. The production of staple meat was 3.7547 million tons, a decrease of 0.9%, among which 2.3307 million tons was pork, a decrease of 2.4%; the production of eggs was 1.1965 million tons, an increase of 0.5%; the production of milk was 225,000 tons, an increase of 9.9%; and the production of fresh water products was 1.9955 million tons, an increase of 3.2%.

In 2011, 117,500 tons of pesticides and 3.2967 million tons of fertilizers were used. 86,100 tons of plastic films for agriculture were put into use. The mulch covered an area of 437,200 hectares. The benefit rate from water improvement in rural areas in Anhui Province reached 96.1%; the penetration rate of tap water was 50.4%; and that of sanitary toilets was 58.0%.

B. The Strategic Status of Anhui Province in the Socioeconomic Development of China
1. An Important Province Connecting the North and South and Linking the West to the East in China

Located in central China, Anhui Province neighbors Jiangsu Province and Zhejiang Province in the east, Hubei Province and He'nan Province in the west, Jiangxi Province in the south, and Shandong Province in the north. It is close to the economic zone in the Yangtze River Delta with Shanghai as the center, enjoying the unique advantage of connecting the north and south as well as linking the west with the east.

In terms of water transportation, Anhui Province is one of the most watered provinces with the Yangtze River, Huaihe River, and Xin'anjiang River. Originating from Hukou, Jiangxi Province, the Yangtze River is a golden waterway spreading across the province from southwest to northeast. Huaihe River originates from the Tongbo Mountains in He'nan Province, flows through Anhui, Jiangsu, and empties into the Yangtze River at Sanjiangying in Yangzhou, with good traffic conditions and a long history of shipping. Xin'anjiang River channel is located in the upper reach of the Qiantang River, and it is a tourist attraction of Anhui Province.

In terms of highway, Hurong Expressway connects Anhui Province and Hubei Province, and Changjiu Expressway connects with Hurong Expressway. There are other highways in other provinces in central China, which constitutes a highway network in this region. As to railway, Beijing-Kowloon Railway connects Anhui Province, Hubei Province, and Jiangxi Province; Longhai Railway connects He'nan Province and Anhui Province; Huainan Railway connects Anhui Province and Jiangsu Province with the Yangtze River Bridge in Wuhan as part of it. In terms of air transportation, there are airlines between provincial capitals and some tourist attractions such as Mount Huangshan.

2. A Fast-developing Province in Mid-China

In 2006, China included Wangjiang city belt (megalopolis) in the important development area in the strategy of developing central China to undertake industrial transfer from the east to the west. It serves as an important component of symbiotic circle of industrial development in the Yangtze River Delta, an extension of and supplement to its urban development system, and a link for further development in the region.

In 2012, the GDP of the six provinces in central China was 11.64879 trillion yuan, an increase from 22.1% in the previous year to 22.4%. Among them, Anhui ranked fourth with 1.72121 trillion yuan. The growth rate of Anhui Province ranked first in Mid-China at 12.1%, 4.3 percentage points higher than other provinces in China.\(^4\)

As a key area in promoting industrialization and urbanization with its great potential on domestic demand growth, Anhui Province plays a decisive strategic role in national and regional development in the new era.

3. **A Major Agricultural Province with the Climatic Features of Both Southern and Northern China**

Located in the mid-latitude region, Anhui Province has the features of both warm temperate zone and subtropical zone under the influence of solar radiation, general atmospheric circulation, and geographical environment. In the division of climate in China, the climate of areas north of the Huaihe River are categorized as a temperate semi-humid monsoon climate while that of the areas south of the Huaihe River a subtropical humid monsoon climate.

Agriculture in Anhui Province has the transitional characteristics. The areas north of the Huaihe River are rich in wheat and grains, which have developed into the base for commodity grain and live pigs. Famous as a land of fish and rice, areas between the Yangtze River and Huaihe River are rich in rice and rapes. Agricultural production of Anhui Province is characterized by both mountainous farming in Dabieshan and southern Anhui mountains and hilly farming between the Yangtze River and Huaihe River.

C. **Necessity and Significance of the Research**

1. **The Necessity of the Research**

In recent years, more and more efforts have been put in environmental protection in Anhui Province, and great progress has been made in environmental treatment. However, despite improved urban environment, the environmental problems in the rural areas are becoming increasingly direr.

With the rapid development of agricultural modernization, industrialization and urbanization, earth-shaking changes have taken place in the rural development, agricultural production, and the farmers' living conditions. But the fragmented management of farmlands under the Household Contract Responsibility System for a long time and the rapid development of urban and rural industry in this decade have also caused a variety of environmental problems such as the abuse of fertilizers, lack of management of domestic garbage, environmental degradation caused by the township industrial enterprises, spread of pollution from cities to rural areas and so on. And the situation is worsening. If effective measures are not taken to strengthen rural environmental protection and treatment, socioeconomic sustainable development in both rural and urban areas of Anhui Province could be massively undermined.

In recent years, all communities show high concerns for rural environmental protection and management, from the central to local governments, from the academic institutions to the media, and from government to farmers. But the research on the environmental protection and management in rural areas has been relatively inadequate. Therefore, it is of great necessity to have a comprehensive analysis of the current situation, harms, reasons, and possible negative impacts of rural environmental pollution on socioeconomic development in the future. It is of great
urgency to provide support and consultation for decision-makers and related government departments for formulating policies and countermeasures.

2. The Significance of the Research

Practical significance. The research will help fully understand and promote solutions to the existing problems in environmental treatment and ecological protection in the rural areas of Anhui Province, and it will assist in providing ideas to alleviate the excessive pressures from economic growth and environmental protection in the rural areas. Through the comprehensive analysis of the environmental situation in rural areas, it can reflect the necessity and urgency of the environmental protection and management in the rural areas to the government and the society. The study of environmental problems in rural areas in Anhui Province can provide decision-making references to improve ecological environment, promote economic development, and formulate fiscal policies in the rural areas in Anhui Province. With press conferences, the mass media and others, awareness and participation in the environmental protection and management in rural areas can be cultivated. The research can also provide valuable background for the Asian Development Bank to deal with related loans and technical assistance.

Theoretical significance. Firstly, this research can produce beneficial theoretical exploration into rural environmental protection and management. Secondly, a comprehensive analysis can be made from several levels such as agriculture, farmers' living conditions, rural resources, rural environmental protection system, process of industrialization, and urbanization, etc. Thirdly, this study can theoretically put forward some technical solutions and constructive ideas concerning laws and regulations.

In conclusion, a comprehensive, creative and systematic study is made on the current situation, problems and causes of Anhui rural environmental protection and management based on a combination of field investigation, text reading and empirical study with both qualitative and quantitative methodology, aiming at providing technical and policy support by drawing lessons from both home and abroad.

D. The Overall Framework of the Research

1. The Definition of Concepts and the Scope of the Research

The rural areas mean the areas at or below the county-level, with the agricultural industry (natural economy and primary industry) as the focus, including various farms (including livestock farms and aqua farms), forest farms (forestry production areas), gardening and vegetable production, etc. Compared with concentrated populations in towns and cities, residents in rural areas are scattered. Contrary to urban areas, rural areas are places where agricultural population live and are engaged in agricultural production, and have the specific natural landscape and socioeconomic conditions. Also, the rural environment is very distinct in five aspects: rural atmospheric
environment, rural water environment, rural solid waste environment, rural acoustic environment and rural ecological environment.

The environment has certain self-cleaning abilities and can bear a certain level of pollution. If the pollution can be treated by the environment itself, then the system is in balance. However, with intensified pollution, environmental pollution in some areas is beyond its self-cleaning ability. In order to keep the environmental balance and sustainable development, measures must be taken to reduce pollution or reinforce the treatment, so as to keep a balance between pollution emissions and environmental treatment.

The environment can be protected by taking measures from two aspects: environmental protection and environmental management in the rural areas. The environmental protection in rural areas includes: construction of public service mechanism, protection of water resources, construction of water conservancy facilities, prevention of urban pollution from spreading to the rural areas, reduction in agricultural pollution, reasonable administrative layout in rural areas, reduction in domestic waste, improvement of energy utilization, and reforms in fiscal policy, etc.. The environmental management in rural areas means control of the existing rural environmental pollution, such as treatment of agricultural pollution, industrial pollution, and domestic pollution in rural areas.

2. The Framework of the Research

This research mainly contains the following parts:

(1) The current situation and trend of rural environment in Anhui Province;
(2) The hazards of rural environmental pollution on socioeconomic development;
(3) Analysis of multiple factors causing the environmental pollution in rural areas;
(4) Feasibility study on the path and technologies for rural ecological environment improvement;
(5) Ratio analysis between the improvement of rural ecological environment and financial investment;
(6) Suggestions on system reform and policy support.

The research will be specifically formed by the following 13 sub-reports:

Sub-report 1, The Current Status, Hazard Analysis and Development Trend of Rural Environment, introduces current research endeavors on environmental protection and management, describes rural environment in detail, points out the hazards of rural environmental pollutions, and analyzes the factors which affect the rural environment in Anhui Province.

Sub-report 2-1, The Industrial Pollution Control in Rural Areas below the County-level, introduces current research endeavors on industrial pollution control in rural areas, analyzes industrial pollution source, describes and analyzes rural industrial pollutions and management, and puts forward policy recommendations on rural industrial pollution prevention and management.

Sub-report 2-2, Present Situation and Countermeasures of Urban Pollution Spreading to Rural Areas, introduces current research endeavors on urban pollution spreading to rural areas at home and abroad, describes in detail the current situation
in Anhui Province, points out the paths, causes, results, and trend of urban pollution spreading to rural areas and the challenges in controlling it, and puts forward applicable solutions and policy recommendations.

Sub-report 3-1, *The Policy and Measures to Alleviate and Reduce the Pollution of Agricultural Production*, introduces the research background, significance and current situations at home and abroad, analyzes pollution sources, current situation, and trend in Anhui Province, conducts qualitative and quantitative study of agricultural pollution in Anhui Province and puts forward policy measures to alleviate agricultural production pollutions in rural areas.

Sub-report 3-2, *Technical Solutions to Alleviate and Reduce the Pollution of Agricultural Production*, introduces researches, measures and policies at home and abroad, points out ways of agricultural production pollution, analyzes the current situation and trend in Anhui Province and puts forward key technologies and solutions of alleviating and reducing agricultural production pollution.

Sub-report 4-1, *Research on the Characteristics of Spatial Distribution and the Planning Strategies of Villages in Rural Areas in Anhui Province*, introduces researches, measures and policy of reasonable layouts in rural areas at home and abroad, studies in detail the spatial distribution and its characteristics in rural areas in Anhui Province, analyzes affecting factors and puts forward the strategy on reasonable village layouts in rural areas.

Sub-report 4-2, *Report of Reasonable Circulation of Rural Land and Appropriate Scale of Agricultural Management*, introduces research at home and abroad on land circulation, and appropriate scale of agricultural management, describes the current situations of land circulation in Anhui Province, presents the research results on land circulation in rural areas in three counties including Guoyang, Dingyuan, and Zongyang County, analyzes in detail the influencing factors of land circulation and puts forward the necessity, measures and suggestions on accelerating land circulation.

Sub-report 5, *Feasibility Report of Centralized Treatment of Household Solid Waste in Rural Areas*, introduces researches, measures and policies at home and abroad on centralized treatment of domestic waste, describes the current situations and processing methods of domestic waste pollutions in rural areas in Anhui Province, analyzes its influence on rural ecological environment, and puts forward new ways to process domestic waste pollutions in rural areas with key technologies and governmental policies.

Sub-report 6, *Protection and Distribution of Water Resources and Construction of Small Water Conservancy Facilities in Rural Areas*, introduces research, measures and policies at home and abroad on protection and distribution of water resources, and construction of water facilities in rural areas, analyzes current situation and problems of water resources and facilities in Anhui Province, comprehensively evaluates the protection of water resources and facilities in rural areas in Anhui Province, describes the relationship between distribution and protection of water resources and eco-environmental protection in rural areas, studies new mechanism of construction and maintenance of water conservancy facilities in rural areas, puts
forward policy measures on protection of water resources, and construction and management of facilities in rural areas.

Sub-report 7, *The Status and Structural Improvement of Energy Usage in Rural Areas in Anhui Province*, introduces research, measures and policies at home and abroad on rural energy, analyzes the current situations and problems of rural energy in Anhui Province, summarizes the trend of the scale of rural energy consumption and structure evolution, describes the relationship between consumption mode of rural energy and environmental protection, and puts forward key technologies and governmental policies in leading the change on consumption mode and structure of rural energy.

Sub-report 8, *Research on the Public Service Mechanism Construction for Environmental Protection and Management in Rural Areas*, describes the significance of the construction of public service mechanisms on rural environmental protection, introduces research at home and abroad on the construction of public service mechanism on rural environmental protection, points out the failure in grassroots public service mechanism on environmental protection in rural areas, analyzes the needs of the trend of rural environment on public service, studies interaction and conflicts between the public service mechanisms on eco-environment and the current management mode in rural areas while presenting policy recommendations.

Sub-report 9, *Research into Fiscal Policy on Ecological Protection and Environmental Management in Rural Areas*, describes the significance of the research of fiscal policy on ecological protection and environmental management in rural areas, introduces research at home and abroad on fiscal policies on ecological protection and environmental protection in rural areas, analyzes the relationship between the current fiscal system and eco-environmental protection in rural areas, points out the shortage of current fiscal policies on rural environmental protection, predicts fiscal investment scale in the next five years, and points out fiscal policy recommendations.

Sub-report 10, *Analysis of Foreign Experience on Eco-environmental Protection and Management in Rural Areas*, describes three cases in the United States and Canada: the application of the trayless dinner service, sink and bathroom hardware with settings that allow less water discharge, and the best management measures in reducing water consumption, reducing water pollution, and improving agricultural management. These cases can provide advanced experience and operational methods for Anhui Province in water conservation and environmental protection, agricultural management, and other aspects.

3. The Originality of the Research

This study is original mainly in the following three aspects: firstly, this research is very systematic with a comprehensive study of environmental problems in rural areas of Anhui Province from multiple aspects, multiple levels, and multiple angles, while previous studies on environmental problems were just conducted from one aspect. Secondly, this study is typical to a certain degree, giving full consideration to the fact that Anhui Province has geographic characteristics of both northern and southern
China, and realizing that it plays a transitional role in economic development of eastern and western China. Thirdly, this research puts forward targeted solutions. By combining the current situation of rural areas in Anhui Province with mature technical schemes or policies at home and abroad, this report provides new technological solutions and policy recommendations.

II. THE CURRENT SITUATION OF ENVIRONMENTAL PROTECTION AND MANAGEMENT IN RURAL ANHUI PROVINCE

A. The Overall Environmental Quality in Anhui Province

1. Aquatic Environment

The surface water is mildly polluted. According to The Environmental Communiqué of Anhui Province, among 237 surface water monitoring stations in 2011, those in a quality of Level I to III accounted for 61.2%, meaning that they were in good quality; while those of Level V 12.6%, meant that they were with serious pollution. The overall water quality of surface water in Anhui Province was rated as mildly polluted5.

In addition, the survey of 324 villages in rural areas in Anhui Province revealed that up to 32% of the rural residents think that the quality of existing surface water is poor. Most of these villages have no drainage system, and part of the waters is in eutrophication, and the green color and the stench of the polluted water have already seriously influenced the nearby villagers (See Figure 2-1).

5 Environmental Protection Department of Anhui Province. 2011. The Environmental Communiqué of Anhui Province.
Main streams of Huaihe River and the Yangtze River in Anhui Province are in good quality, while tributaries are bad. Chaohu Lake is seriously polluted. According to The Environmental Communiqué of Anhui Province, in 2011 the main streams of Huaihe River in Anhui Province were in good quality while its tributaries were in poor quality. Chaohu Lake and the surrounding rivers were mildly polluted with light eutrophication. The main streams of the Yangtze River in Anhui Province were in good quality while parts of branches were in bad quality. Xin'anjiang River was in good quality. The main reservoirs were in good quality without eutrophication.

Underground water in such areas as Bengbu, Fuyang and Tongling is in poor quality. In 2011, 6 cities such as Hefei, Huaibei, Fuyang, Bengbu, Chuzhou and Tongling carried out the monitoring of underground water. Among 22 wells of underground water, 14 were in good quality, accounting for 63.6%. And 8 were in poorer quality, accounting for 36.4%. Some have been affected by point and non-point source pollution to different degrees. Underground water in Hefei, Huaibei, Chuzhou, downtown in Fuyang, and shallow underground water in Tongling are in good quality, while underground water in Bengbu, counties in Fuyang, and deep underground water in Tongling are in poor quality.

The quality of drinking water from centralized water sources in 7 cities like Bozhou and Chouhu fails to reach the standard. In 2011, 44 centralized drinking water sources in 14 cities and 5 county-level cities were monitored. 96.1% reached the standard, an increase of 2.7 percentage points compared with that in 2010. However, the water quality in some cities still failed to reach the standard. The water quality in Bozhou, Fuyang, Huainan and Lu'an among prefecture-level cities
exceeded the limit to different extents and that in Chaohu, Mingguang, and Tongcheng out of 5 county-level cities also exceeded the limit to different extents.

2. Atmospheric Environment

Atmospheric environment quality is generally in a steady situation. In 2011, there were 16 prefecture-level cities carrying out air quality monitoring. According to the data in *The Environmental Communiqué of Anhui Province*, air quality was generally good. The air quality in 14 cities reached the standard Grade II, and that in two cities reached Grade III. The annual average emission of sulfur dioxide in four cities reached the national standard Grade I, and that in 12 cities reached Grade II. The annual average emission of sulfur nitrogen in 16 prefecture-level cities reached Grade I of the national standard. The annual average emission of inhalable particles in 14 cities reached the national standard Grade II, except Hefei and Huaibei, which reached Grade III.

Rising frequency of acid rain in some areas deserves our attention. In 2011, the average frequency of acid rain in Anhui Province was 19.8%. Although the pollution of acid rain in Anhui Province has alleviated, acid rain still took place in eight cities in Anhui Province in 2011. The average frequency of acid rain in the areas controlling acid rain (including Wuhu, Ma’anshan, Tongling, Huangshan and Xuancheng) reached 24.8%, among which, the frequency of acid rain in Chizhou and Huangshan were respectively 79.2% and 70.1%.

<table>
<thead>
<tr>
<th>Frequency of Acid Rain (%)</th>
<th>0</th>
<th>0~25</th>
<th>25~50</th>
<th>50~75</th>
<th>≥75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of City</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Percentage of City (%)</td>
<td>50.0</td>
<td>31.3</td>
<td>6.3</td>
<td>6.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>

Emissions of waste gas continue to increase. According to *The Statistical Yearbook of Anhui Province*, in 2011, the emissions of industrial waste gas reached 3.0411 trillion cubic meters, increasing by 70.4%. From the emissions in 2011, the amount of sulfur dioxide reached 487,200 tons, with sulfur dioxide pollution in urban areas coming mainly from industrial pollution. The emission of industrial dusts amounted to 410,600 tons in 2011, decreasing by 12.9% from 2010, an indication that emissions of waste gas continue to increase and more efforts are needed in reduction. The main source of air pollution is dust pollution. Air pollution in Anhui Province mainly comes from industrial waste gas and domestic waste, including waste gas, sulfur dioxide, dust and so on. Urban air pollution is mainly caused by industrial waste gas. Anhui Province is the largest province in energy consumption in eastern China with many coal-fired power plants that consume a large amount of coal and discharge much industrial waste gas, exceeding national average level. The cities with large
amounts of emissions of waste gas include Ma'anshan, Huainan, Wuhu, and former Chaohu and Anqing, which are basically industrial cities. Less amount of industrial waste gas was produced in some tourist and traditional cities such as Huangshan, Lu'an, Chuzhou, and Bozhou, where industrial development is lagging behind. In January of 2013, haze and mist took place four times in Anhui Province, which, to some degree, reflected the results of the serious dust pollution.

3. Pollutant Emissions

The emissions of industrial solid waste are increasing. According to The Statistical Yearbook of Anhui Province, in 2011, the total amount of industrial solid waste was 114.73 million tons, an increase of 25.3%, and the amount comprehensively treated and utilized increased by a small amount, but the rate was 78.7%, a decrease of 6.9% over 2010.

The total amount of main pollutants is under control. According to The Environmental Communiqué of Anhui Province, in 2011, the total COD emission was 953,300 tons, a decrease of 2.05% over 2010, of which industrial and domestic emissions stood at 544,600 tons, agricultural emissions 398,800 tons, and emissions from solid waste processing facilities such as garbage disposal plants and medical waste disposal plants 9,900 tons. The amount of ammonia and nitrogen emissions was 109,800 tons, a decrease of 1.99% over 2010, of which industrial and domestic emissions stood at 69,600 tons, agricultural emissions 39,300 tons, and emissions from solid waste processing facilities such as garbage disposal plants and medical waste disposal plants 900 tons. The amount of sulfur dioxide emissions was 529,500 tons, a decrease of 1.63% over 2010. The amount of nitrogen oxide emissions was 959,100 tons, an increase of 5.48% over 2010, a little lower than the average of China.

4. Acoustic Environment

One third of the cities in Anhui Province are in mild noise pollution. In 2011, monitoring for acoustic environment was conducted in 2,219 monitoring sites for regional noise, 456 urban roads for urban traffic noise and 284 noise monitoring points in urban function zones of Anhui Province. According to the results, the average equivalent sound level of environmental noise in urban areas was 53.6 decibel (dB), and the weighted average equivalent sound level of urban traffic noise was 67.2 dB. The attainment rate of average sound level of the function zones in prefecture-level cities reached 71.3%, 85.2% in daytime and 57.4% at night. The attainment rates of the Class 0 function zones (special residential zones), the Class 1 function zones (the cultural and educational zones for residents), the Class 2 function zones (the mixed zones), the Class 3 function zones (the industrial zones) and the Class 4 function zones (the zones on both sides of arterial traffic) were 62.5%, 68.0%, 71.3%, 91.7% and 48.2% respectively. Among 16 prefecture-level cities, 5 were in
mild noise pollution and Bengbu has the highest equivalent sound level of regional environmental noise, with 58.1 dB.

Table 2-2 Noise Situation in Function Zones in Cities in Anhui Province in 2011

<table>
<thead>
<tr>
<th>Regional Noise Situation</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (≤50.0dB (A))</td>
<td>Chizhou</td>
</tr>
<tr>
<td>Average (50.1~55.0dB (A))</td>
<td>Huaibei, Bozhou, Suzhou, Fuyang, Huainan, Chuzhou, Lu’an, Tongling, Anqing, Huangshan</td>
</tr>
<tr>
<td>Mild Pollution (55.1~60.0dB (A))</td>
<td>Hefei, Bengbu, Ma’anshan, Wuhu, Xuancheng</td>
</tr>
</tbody>
</table>

5. Ecological Environment

The ecological environment is generally satisfactory. According to The Statistical Yearbook of Anhui Province, in 2011, the forestry land covered a total area of 4.4318 million hectares, forest covered 3.8042 million hectares with a coverage rate of 27.53% and standing trees covered 217.1012 million m³. Wetland covered a total area of 653,900 hectares, about 4.73% of the whole area of China. The area of natural reserves above city-level reached 432,000 hectares, about 3.1% of the whole area of China. Generally speaking, the ecological environment in Anhui Province is generally satisfactory with a steady eco-system.

B. The Current Situation of Environmental Pollution in Rural Anhui Province

During the “Eleventh Five-year Plan” period, although it has been listed into environmental planning to strengthen the rural eco-environmental protection in Anhui Province, and great progress has been made by gradually carrying out different tasks on the rural environment renovation, the problems of environmental pollution and rural ecological damage are still prominent, and the serious situations remain unchanged. Generally speaking, the deteriorating trend of rural environment in Anhui Province has not been controlled, and some new tendencies have appeared: ① The partial, small-scale ecological destruction and environmental pollution has evolved into regional, large-scale one with water pollution of Chaohu Lake and Huaihe River as a typical representative. ② The complicated factors destroying rural environment leads to the diversified sources of environmental pollution in rural areas. ③ The urban economic restructuring and other factors has led to the spreading of urban pollution to the rural areas. And the rural areas have become the shelters for the enterprises with heavy pollution and backward technology, causing a trend that the rural pollution circles around the urban areas. ④ Underdeveloped areas still follow the old pattern of economic development, namely, “Treatment after Pollution”, making environmental protection in rural areas even harder. Current situation of environmental pollution in rural areas in Anhui Province can be summarized into the following three aspects: the
current situations are not optimistic; the trend is still worsening; the pollution hazards are very serious, mainly manifested by rural industrial pollution, farming pollution, breeding pollution, domestic pollution in rural areas, and the spreading of urban pollution to rural areas.

1. **Industrial Pollution**

   In recent years, all cities in Anhui Province have attached great importance to the development of industrial economy, and many villages and towns have built their own industrial parks or industrial zones. With the fast development of township and village industries, the industrial pollution in rural areas is very serious. At present, the proportion of emissions of sewage, waste gas, and solid waste from China’s township and village industrial enterprises in the national industrial pollution emissions rose from 11% in the early stages of Reform and Opening-up to a present 50%. Industrial pollution in rural areas in Anhui Province increased with the rapid growth of rural industry, which has become increasingly serious, directly affecting the rural eco-environment. In 2002, the value of industrial output from enterprises in villages and towns in Anhui Province was only 155.4 billion yuan, while in 2010 it reached 412.2 billion yuan, 2.5 times of that in 2002. Along with the rapid development of township industry, industrial enterprises scattered in rural towns and villages in Anhui Province brought about more and more serious pollution, such as many quarrying enterprises, sand-mining enterprises, mining enterprises and those dealing with rough machining of agricultural products. Especially in the villages and towns which have established industrial zones, the lack of environmental protection facilities makes rural industrial pollution increase year by year. According to the survey in the Sub-report 1, 27% of the rural residents think that rural enterprises cause heavy pollution to their environment while 66% think it will have a slight influence. According to environmental complaints in 2011 from Environmental Protection Department of Anhui Province, of the 466 complaints about environmental pollution, 188 were about industrial pollution from enterprises in villages and towns, accounting for 40% of the whole.

   The small-scale township and village enterprises are low in output yet high in pollution, inadequate for pollution treatment and unaware of its potential harms. Since most of the rural enterprises are developed from the original family workshops or shops, the development scale is far inferior to that of urban industries. In 2010, the average industrial value of these enterprises only reached 1.96 million yuan. Small businesses have natural defects in pollution control and cannot reduce the cost in dealing with the pollution. So the high cost of pollution management presents an incentive to discharge more pollutants covertly.

2. **Farming Pollution**

   The increase of modern agricultural production directly increases the use of fertilizers, pesticides, and mulch. Farmers, who are decentralized, find it difficult to master new skills such as soil testing and formula fertilization, resulting in excessive use of fertilizers, pesticides and mulch. The excess uses of fertilizers, pesticides and
the abandoned films unable to be absorbed by plants have caused much soil and water pollution. According to the data released by the Environmental Protection Department of Anhui Province, in 2010, emissions of chemical oxygen demand (COD), and ammonia nitrogen in agricultural pollutants, respectively accounted for 42% and 36% of the whole, which were far more than that of industrial emissions and has became one of the major sources of pollution.

According to the data of *The Statistical Yearbook of Anhui Province*, from 2001 to 2010, the amount of fertilizers, plastic mulch and pesticides increased, from 2.6229 million tons, 65,000 tons, and 73,000 tons in 2001 respectively to 3.1977 million tons, 80,700 tons, and 116,300 tons in 2010, while the farmland area remained unchanged. At the same time, the agricultural investment increased by about 1.5 times (See Table 2-3). The average usage of fertilizers per hectare in Anhui Province in 2010 reached 766.61 kg, which was far beyond the safety limit of 225 kg per hectare set up by developed countries.

### Table 2-3  The Growing Tendency of Means of Agricultural Production in Anhui Province

<table>
<thead>
<tr>
<th>Year</th>
<th>The amount of fertilizers (10,000 tons)</th>
<th>The amount of agricultural plastic mulch (10,000 tons)</th>
<th>The amount of pesticides (10,000 tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>262.29</td>
<td>6.57</td>
<td>7.3</td>
</tr>
<tr>
<td>2002</td>
<td>270.33</td>
<td>6.55</td>
<td>7.43</td>
</tr>
<tr>
<td>2003</td>
<td>281.28</td>
<td>6.76</td>
<td>7.88</td>
</tr>
<tr>
<td>2004</td>
<td>277.56</td>
<td>7.28</td>
<td>8.46</td>
</tr>
<tr>
<td>2005</td>
<td>285.67</td>
<td>7.83</td>
<td>9.48</td>
</tr>
<tr>
<td>2006</td>
<td>294.29</td>
<td>7.62</td>
<td>9.54</td>
</tr>
<tr>
<td>2007</td>
<td>305.02</td>
<td>7.74</td>
<td>9.91</td>
</tr>
<tr>
<td>2008</td>
<td>307.37</td>
<td>7.17</td>
<td>11.15</td>
</tr>
<tr>
<td>2009</td>
<td>312.79</td>
<td>7.67</td>
<td>11.04</td>
</tr>
<tr>
<td>2010</td>
<td>319.77</td>
<td>8.07</td>
<td>11.63</td>
</tr>
</tbody>
</table>

The unreasonable overuse of fertilizers leads to the increasing runoff of soil nutrition, the decreasing utilization and the aggravating inorganic tendency of soil. As a result, environmental pollution is becoming more and more serious. According to Sub-report 1, effective utilization rate of fertilizers in Anhui Province is lower than 40% and about 70% of pesticide residues are left in the soil and eventually flow into the water system. In addition, there are prominent structural problems in the application of fertilizers and pesticides. For example, the amount of organic fertilizers applied in the whole province is less than 25%.

As well, with increased agricultural production, the amount of such by-products as straws also increases quickly. The amount of straws in Anhui Province in 2010 was
more than 39.49352 million tons. Most straws are scattered or incinerated in the open air, which leads to a low rate of utilization and serious environmental pollution.

3. Breeding Pollution

Since Anhui Province is a big agricultural province, breeding pollution here in rural areas is also very prominent. The data from *The Statistical Yearbook of Anhui Province 2012* shows that the output value of animal husbandry in Anhui Province in 2011 reached 108.35 billion yuan, increasing by about 25.26% compared with that of the previous year. The proportion of output value of animal husbandry in the whole also increased from 29.27% in 2010 to 31.32% in 2011. The number and scale of livestock and poultry breeding have increased significantly.

With the improvement of the breeding scale, breeding farmers are usually unable to treat pollution as required and excrement from intensive farming usually cannot be effectively utilized or be processed without causing harm to the environment. So the direct emissions exert great influence on the surrounding environment in the rural areas. And a great amount of livestock and poultry waste and sewerage are directly dumped into the water system without being treated, intensifying the eutrophication of rivers and lakes. It is estimated that the amount of the loss of nitrogen and phosphorus in excrement is larger than that in fertilizers, about 122% and 132% of that in fertilizers. Livestock and poultry waste have become one of the main sources of non-point source pollution in the rural areas of Anhui Province, even more serious than industrial pollution, which also causes serious damage to human health.

4. Domestic Pollution

According to the data in *The Plan on Prevention and Management of Environmental Pollution in Rural Areas in Anhui Province*, in 2010, about 18 million tons of domestic garbage and more than 500 million tons of domestic sewage were produced in the rural areas of Anhui Province, while the processing rate of domestic garbage was only about 10%. The situation of domestic pollution in rural areas is worsening.

With rural urbanization, changes have taken place in rural domestic pollutants: the pollutants concentrate with an increasing amount; the composition becomes complicated since they were simple and easy to degrade in the past but now they are more complicated and more difficult to degrade; they are difficult to collect with a low processing rate. Domestic pollution in rural areas in Anhui Province is mainly composed of domestic sewage and domestic waste. There are two main sources. Firstly, in vast majority of rural areas domestic waste are piled up randomly, or poured into the rivers or ditches, causing water pollution. (See Figure 2-2) Secondly, in the process of rural agglomeration, the inadequate planning and inadequate supporting facilities with the lack of pollution treatment facilities lead to the low treatment rate of domestic sewage and domestic waste. In Anhui Province in 2010 the number of administrative villages with sewage treatment only accounted for 5.3%, while that of the administrative villages with collection sites for domestic waste only accounted for
24.4%. The administrative villages with treatment of domestic waste only accounted for 14.8%.

Besides, problems of drinking water, central processing of domestic waste and improvement of toilets are still very prominent in environmental protection in Anhui Province. According to the data in *The Statistical Yearbook of Anhui Province*, by the end of 2011, the coverage rate of tap water in Anhui Province reached 50%, and that of sanitary toilets in rural areas was 58.0%, which was much lower than the nation average, which is 70%.

Figure 2-2  The Current Situation of Garbage Treatment in Luoyang Village, Xinji Town, Fengtai County, Anhui Province

5. **Urban Pollution is Spreading to Rural Areas**

Despite the increasing efforts on pollution treatment in urban areas in recent years, the city scale and its population is still on the increase, while the total amount of pollutants also increases. The urban pollution does not stop spreading to rural areas. On the contrary, in some areas the urban pollution is expanding. In 2011, the urban sewage emissions of Anhui Province reached 1.724 billion tons, with a centralized disposal rate of 79.04%. Therefore, more than 300 million tons of urban sewage was directly discharged into the surrounding rivers and lakes in rural areas. In 2010, the amount of urban domestic waste cleared and removed in Anhui Province was about 4.35 million tons of which only about 2.81 million tons were disposed of with harmless treatment. Therefore, there was still about 1.54 million tons of domestic waste randomly dumped in landfills, or stacked up in the suburbs of the rural areas. In 2011, the gross emissions of industrial waste gas in Anhui Province amounted to 3.0411 trillion standard cubic meters, which was 1.7 times that of 2010, and thus the harmful material such as acid rain will cause more and more serious damages on the rural ecological environment.
There are three ways for urban pollution to spread to rural areas: pollution enterprise relocated, pollutants extended, and pollutive products transferred.

With more and more efforts put into the urban environmental management and stricter and stricter requirements of national policy and measures on environmental protection, especially since 2000 when it was implemented that the discharge of industrial pollution must meet the standards, underdeveloped industries in the eastern coastal areas have been eliminated and the central and western areas have undertaken industrial transfer from the eastern areas. Cities further adjust their industrial structure, and these enterprises with high pollution have been relocated to the suburbs or rural areas. Anhui Province has witnessed the development of rural economy as well as the worsening of pollution. Wanjiang city belt (megalopolis) undertakes industrial transfers from the eastern coastal areas on a large scale, thus it is now faced with the spreading of both pollution industries and industrial pollutants.

C. Basic Measures and Problems of Environmental Protection and Treatment in Rural Areas in Anhui Province

1. Basic Measures of Environmental Protection in Rural Areas in Anhui Province

a. More Efforts on Comprehensive Improvement

Special funds on environmental treatment have increased year by year. Anhui Province has adopted various effective measures in ecological environment protection and treatment in rural areas, and has made considerable progress. Anhui Province earnestly implemented the policy of “incentives adopted to promote treatment” and initial progress has been achieved. According to data released by Environmental Protection Department of Anhui Province, from 2008 to 2011, 99.75 million yuan from the central fund on environmental protection in rural areas was used in Anhui Province with a beneficiary population of 0.3 million in 128 towns and villages. A special fund of 0.135 billion yuan on environmental protection in Anhui Province has also been used in the project of pollution management in 540 villages. The living conditions and environment quality in villages and towns have improved.

The construction of ecological demonstration areas was carried out steadily and systematically. In 2010, 11 national villages and towns with a beautiful environment and four national ecological villages were built in Anhui Province, 38 provincial villages and towns with a beautiful environment and as well as 114 provincial ecological villages were named. By 2010, three national demonstration counties for eco-agriculture, 15 provincial demonstration counties for eco-agriculture, 110 provincial demonstration sites for eco-agriculture, and 57 demonstration villages for cleaning project were built and the task of creating a beautiful eco-environment in villages and towns has been promoted.
The indicators show remarkable effect. According to data from *The Statistical Yearbook of Anhui Province*, during the recent five years, all the indexes such as the popularity rate of tap water, that of sanitary toilets, methane users, the coverage of the water heater powered by solar energy in rural areas in Anhui Province have greatly improved. From 2006 to 2011, the popularity rate of tap water increased from 39.5% to 50.4%, and that of sanitary toilets also increased a little. The number of methane users increased from 376,400 to 790,800 households, and the water heater powered by solar energy area covered an area of 4.644 million square meters, increasing from 2.245 million square meters, doubling the number of 2006. By 2010, 1138 large-, mid- and small-scaled biogas projects were built and put into operation; 10,000 tons of waste were treated annually; 1,511 purification pools for domestic sewage in urban areas were built, and 3,000 tons of domestic sewage were treated; eight demonstration sites for central gas supply with straw gasification, and 2,510 households were supplied with gas and the total amount of gas supply reached 4,000 cubic meters.

b. Featured Management Based on Different Function Zones

Area-based management of eco-environment was conducted in four function zones, namely, the southern Anhui Province, the Dabieshan mountainous area, the northern Anhui Province, and areas along the Yangtze and Huaihe River. Anhui Province is divided into different function zones for better population distribution, economic planning, land development, and environment protection. Each zone, according to its own function and development direction, explored its own pathway in environmental protection. The rural areas in Anhui Province are divided into key ecological reserves in southern Anhui Province and Dabieshan mountainous area, ecologically fragile areas in northern Anhui Province and the watershed areas of Yangtze and Huaihe River.

Key ecological reserves in southern Anhui Province and Dabieshan mountainous area focus on the protection of the quality water resources and the construction of forests for water and soil conservation. The zones take various measures, such as sealing off mountainous areas to facilitate afforestation, reforestation, supplementary forestation, and afforestation in barren areas, etc., to recover and reconstruct the vegetation in forests, improve the ecological protection efficiency and forest quality, and construct the green ecological protection of water resources in southern Anhui Province and Dabieshan mountainous area.

The ecologically fragile zone in northern Anhui Province centers on the protection of farmland, focuses on the construction of demonstration project of green corridor and high-standard afforestation in plain regions, and promotes the afforestation along the roads, rivers, villages, and rocky mountains.

The ecologically fragile zone in watershed areas of Yangtze and Huaihe River centers on the demonstration project of green forests in a large area, focuses on the increase of forest resources, and sets up an efficient eco-system with ecological shelter forests, commercial forests, and fruit-bearing forests, forming a large area of
supportive shelter forest networks, canals and ditches, and afforestation around the towns and villages.

In addition, Anhui Province has developed specific environmental policies to adapt to different local conditions. For example, in order to comprehensively deal with tributaries with heavy pollution, the principle of "different policies for different rivers" was adopted, and the related cities are urged to conduct individualized improvement plans for remediation the heavy pollution of 11 rivers including Nanfeihe River, Shiwulihe River, Paihe River, Shuangqiaohe River, and Xianghe River.

c. **Conduct Cluster Development and Centralized Treatment**

Reasonable planning should be carried out to promote cluster development of the rural industries and animal husbandry and centralized management of the pollution. According to *The Plan on Prevention and Management of Environmental Pollution in Rural Areas in Anhui Province*, Anhui Province will guide towns and villages to divide environmental function zones, and reasonably plan industrial and husbandry districts in rural areas and realize reasonable planning of industrial enterprises, husbandry and centralized management of pollution according to the situation of resources and environment in rural areas.

d. **Promote the Treatment of Domestic Pollution in Rural Areas**

Promote the construction of cleaning projects and comprehensive treatment of domestic pollution in rural areas. According to *The Twelfth Five-year Planning of Anhui Province* and *Circular on Strengthening Environmental Protection in Rural Areas in Anhui Province*, during the "Twelfth Five-Year Plan" period, Anhui plans to establish a new mode of rural garbage disposal system by applying the method of "classification by families, collection by villages, transportation by towns, and processing by the counties" in 1,000 villages and towns in an efforts to gradually incorporate all towns and villages in Anhui Province in domestic waste disposal. Meanwhile, considerations are given to the different situations of different villages in building concentrated sewage facilities to dispose of sewage in qualified towns and villages. The sewage in surrounding towns and villages can be incorporated into the urban sewage collection networks. The combination of sparse and concentrated waste processing can be adopted in other towns and large-scale villages. Artificial and natural wetland systems can be used to increase the disposal rate of domestic sewage.

2. **Problems in Environmental Protection and Treatment in Rural Anhui Province**
a. Lack of Environmental Protection Agencies

There are not enough environmental protection agencies in Anhui Province. According to The Statistical Yearbook of Anhui Province, in 2010, there were only 21 township environmental protection agencies employing 110 workers in Anhui Province, accounting for 5.43% and 1.94% of the whole province, much lower than the national average of 14.72% and 3.69%. For example, on June 2, 2011, Dangtu County established its first environmental protection agency in Dalong Town. Though there are workers in charge of eco-environmental protection in a few villages, most of them are not regular employees, only working in their part time with few subsidies. Inadequate environmental protection agencies lead to the postponed treatment of pollution accidents and inconvenience of environmental consultations in rural areas.

In the rural areas of Anhui Province, the administrative responsibility of rural environmental protection agencies is sprawling among agriculture, forestry, water conservancy, and environmental protection agencies, causing overlapped functions and unclear accountabilities. It is a problem that the township governments and village committees in rural areas, without any specific institutions or environmental personnel, fail to function in environment inspection and supervision. Very few have set up environmental protection agencies with limited environmental experience and technical understanding.

b. Serious Shortage of Investment for Environmental Protection

The total investment in environmental protection of Anhui Province is inadequate and the support of most cities and counties for rural environmental protection also needs improvement. There is no financial support from the township governments and village committees as they have no fiscal revenue for doing that. According to The Twelfth Five-year Planning of Anhui Province, during the “Twelfth Five-Year Plan” period, Anhui plans to establish a new mode of rural garbage disposal in 1,000 villages and towns by applying the method of “classification by families, collection by villages, transportation by towns, and processing by the counties”. However, there is no clear solution regarding the maintenance and updating of the garbage disposal equipments and the payment of sanitation personnel. This is likely to render the plan a mere paperwork of no actions to be taken in advance. Even with the provincial financial appropriation coupled with financial support from counties, the annual investment is not sufficient to support such a complicated waste treatment mode from “classification by households” to “treatment at county level”. In Anhui Province in 2011, a total investment of 353 million yuan was placed in the projects of continuous improvement of rural environment, including 170 million yuan from the central government, and 183 million yuan from self-raised funds by the local governments at all levels. And ratio of fiscal investment from central government and local governments was 1:1.08. Also, another 30 million yuan was put into environmental improvements for villages with high pollution with a more than 1:1 ratio of counterpart
funds. According to the current financial revenue and expenditure in rural areas in Anhui Province, there are great difficulties in providing the costs.

The environmental infrastructure mainly includes water supply, sewage treatment, garbage disposal, and other public facilities, which is the material foundation to enhance the living environment and the quality of life. Over the years, investment for environmental infrastructure in rural areas in Anhui Province has been in serious shortage, the proportion of the administrative villages in centralized water supply, sewage treatment, and garbage disposal are all below the national average, as well as falling behind most others among the provinces in China. In 2010, there are only 5.3% administrative villages undertaking sewage disposal in Anhui Province, lower than the national average of 6%, ranking 12th in the country; only 24.4% having collection sites for domestic waste, far below the national average of 37.6%, ranking 21st in the country; only 14.8% disposing of domestic garbage, again below the national average of 20.8%, ranking 15th in the country.

Table 2-4 The Current Situation of Environmental Protection Infrastructure in Anhui Province

<table>
<thead>
<tr>
<th>Region</th>
<th>Administrative Villages with Central Water Supply</th>
<th>Administrative Villages Processing Domestic Sewage</th>
<th>Administrative Villages with Collection Sites for Domestic Waste</th>
<th>Administrative Villages Processing Domestic Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Percentage (%)</td>
<td>No.</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td>China</td>
<td>294749</td>
<td>52.3</td>
<td>33807</td>
<td>6</td>
</tr>
<tr>
<td>Anhui Province</td>
<td>5558</td>
<td>33.7</td>
<td>875</td>
<td>5.3</td>
</tr>
<tr>
<td>Rank in China</td>
<td>29</td>
<td>12</td>
<td>21</td>
<td>15</td>
</tr>
</tbody>
</table>

c. Fiscal Policy in Need of Systematical Planning

In the current centralized fiscal system, fiscal policies concerning rural environmental treatment and ecological protection in Anhui are mainly based on the requirements from the central authorities. The current fiscal policies on environmental conservation are usually delayed and are, none the less, inadequate to meet the actual demands of the rural environment. The inadequacy of the fiscal policy is characterized by a lack of systematic design of fiscal policies, imperfect taxation policies, weak capacity to secure expenditures, unavailability of local counterpart funds, the lack of incentives, weak public management and maintenance.

d. Inadequate Publicity of Environmental Protection

In rural areas, public exposure of environmental issues are not accomplished through normal media channels, such as television programs, newspapers, and Internet, but rather, by traditional approaches, such as mobilization meetings, village
radio stations, posters, signs and banners. Such activities are rare as a campaign of promoting health, selection villages with a sanitary environment, and family competition, which can educate and guide the farmers to know about related rights on environment such as knowing the present environmental situation and public participation, and can enhance the farmers’ consciousness in environmental protection in order to resist the damages to environment in rural areas.

In addition, farmers’ awareness on rural ecological environment protection is weak with less initiative for participation. Being a major agricultural province, Anhui Province has abundant young and middle-aged farmers migrated to cities for a work, leaving the elderly, women and children whose awareness on rural ecological environment protection is weak with less initiative for participation. In addition to the current system of "one problem at one time through discussion" and some village councils, no other incentive mechanisms of rewards or punishments are applied in these rural areas.

D. Hazards Caused by Ecological Imbalance in Rural Areas in Anhui Province

Currently, the hazards caused by ecological pollution in Anhui Province are:

1. Hazards Caused by Imbalance of Water Environment

① Water deterioration caused by the overuse of pesticides and fertilizers leads to water eutrophication when the residues flow into rivers and pools with water. ② Water pollution is also the result of “three industrial wastes”, posing danger to the drinking water of the surrounding residents by affecting the quality of the local water resources. ③ Without effective processing mechanisms, a large amount of excrement is discharged into surrounding rivers and ditches, polluting the water resources. ④ Domestic sewage. Some families randomly dump contaminated water into the fields and ditches, polluting surface water and underground water.

2. Hazards Caused by Imbalance of Soil Environment

Soil pollution is caused by the overuse of fertilizers. The overuse of phosphorus leads to soil acidification and the overuse of nitrogen leads to the decrease of soil fertility and soil hardening. White pollution is caused by a large number of agricultural plastic films and mulch abandoned and discarded in the fields. The polyethylene in mulch and plastic films is difficult to degrade, which reduces the production capacity of the soil. A large amount of domestic garbage is dumped randomly around the houses and in the fields in rural areas, polluting the soil nearby if without measures to prevent seepage.
3. Hazards Caused by Imbalance of Air Environment

At first, the emissions of industrial waste gas, dust, and domestic waste gas that release chemicals into the atmosphere cause the decline in air quality. Straw burning can directly kill the beneficial microorganism in the soil, influencing the crops’ mechanism of absorbing the soil nutrients. The three pollution indexes of $\text{SO}_2$, $\text{NO}_2$, and inhalable particles in the atmosphere are very high, polluting the air. The sprayed pesticide residues released into the air causes atmospheric pollution. Atmospheric pollutants, after inhaled by people, have shown to cause many respiratory diseases and even cancer, seriously affecting human health.

4. Hazards Caused by Overall Environmental Imbalance

First of all, the environmental imbalance of Anhui Province poses a great threat to the health of its urban and rural residents. Pollutants can be absorbed by human beings through water, soil, air, and food, causing damage to people’s health. In the long run, environmental problems will become the key factor that endangers the survival of the living. Secondly, environmental imbalance violates the basic principle of sustainable development that China seeks to achieve. Although excessive development of the ecosystem can promote economic development in the short term, in the long run, excessive use of resources will restrict the sustainable and healthy development of the economy in Anhui Province. Thirdly, the escalation of these health risks, along with the deterioration of the living environment from the environmental imbalances will be intensified to a degree that will trigger social instability, while potentially leading to numerous environmental incidents, and affecting the social harmony and stability of the country.

III. MAIN CAUSE OF ENVIRONMENTAL IMBALANCE IN RURAL AREAS IN ANHUI PROVINCE

A. Internal Factors in Rural Areas

1. Factors in Industrial Production

Industrial pollution sources include: various types of industrial parks (the number of industrial parks in Anhui Province in 2010 reached 351, and the number of enterprises within the parks reached 29,953)\(^6\), and industrial enterprises scattered in rural areas (e.g., mining, primary processing industry of agricultural products, and small workshops, etc.).

The main causes:

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a. The Local Governments Attach Importance to Attracting Investment, but Pay Little Attention to Environmental Protection

The strong desire to develop the economy dictates the local government to be GDP-oriented in dealing with the relations between economic development and environmental protection, ignoring the rural environmental endurance and anti-pollution ability to exchange the temporary economic growth at the cost of the ecological environment. The economical efficiency of projects is also a key indicator of investment; some local governments make a series of preferential policies to promote the county economy, which leads to the low level of environmental protection of the enterprises entering the parks, and the uselessness of the evaluation system of regional environment. The relation between local governments and enterprises is very complex, and the law enforcement of environmental protection agencies has been suppressed, which eventually leads to the difficult or even no implementation of environmental management.

b. The Enterprises Seek Economic Interests but are Lacking in Pollution Treatment Facilities

Industrial parks which are located in counties or even lower administrative regions are sometimes small in size, low in technology level, and poor in pollution treatment. The space layout of township industries is much dispersed, and the equipment is outdated. Most industrial parks at and below the county level are not equipped with unified sewage treatment facilities, and the enterprises are mainly low-level industries of resource-intensive, labor-intensive, or primary processing, with low environmental awareness, and setting profit maximization as the target, which is generally not in accordance with the requirements of "three simultaneities" of Environmental Protection Law (the measures of pollution prevention and the main project are simultaneously designed, constructed, and put into production and use) to construct the pollution treatment facilities. Instead, they partake in the illegal production and the illegal discharge of sewage over a long period of time. The enterprises distributed in rural areas are mostly private enterprises with limited money, and less advanced technology and equipments, resulting in low resource utilization efficiency and serious environmental pollution. The situation of scattered distribution and lack of unified planning of space layout further intensifies the difficulty in prevention and management of rural ecological environmental pollution.

c. The Farmers Lack Awareness of Self-Protection and Initiative of Environmental Supervision

Most rural areas in Anhui Province do not foster activities and education for environmental protection. With inadequate publicity of rural environmental protection, farmers generally lack the awareness of environmental protection, and lack a full understanding on the harm that environmental pollution brings to their health and their
life. Many cast a blind eye to the pollution of the surrounding environment, and are absent of any enthusiasm to participate in environmental supervision and protect themselves. According to the questionnaire survey of the Sub-report 2-1, only 20% of ordinary farmers choose to complain to the environmental protection bureau when they are aware of factories randomly and secretly discharging pollutants. This survey suggests that farmers in Anhui Province lack the initiative in participating in environmental supervision and assisting in environmental protection.

2. Factors in Agricultural Production

Pollution sources include: pesticides, fertilizers, agricultural film, straws, forage, and manure of livestock, poultry, and fish.

Main causes:

a. The Basic Provincial Conditions Restrict the Agricultural Development

As one of the major agricultural products suppliers for the whole nation, Anhui Province is prominent with a large population and small areas of cultivated land. In recent years, the rapid growth of the rural population with the decrease in cultivated lands makes the relationship between man and the environment more worrisome. Under the guidance of market economy, agriculture begins to pursue a modern growth pattern. The inputs of production material such as fertilizers, pesticides, and plastic films increase every year, causing soil and water pollution, as well as affecting the safety of the agricultural products. The rapid development of large-scale poultry, livestock, and fish farms produces large amounts of fecal matter that often cannot be effectively used or effectively disposed of, only to be discharged into the environment directly leading to the degradation of the water system. The ecological function of most large and medium-sized water systems in the province is gradually declining due to these developments.

b. The "Two-Type" Agriculture Not Yet Fully Promoted

It is put forward in the Third Plenary Session of the 17th Communist Party Congress that "the agricultural production system of 'resource saving type' and 'environment friendly type' will be basically established in the rural areas of China in 2020." The "two-type" agriculture mainly aims at saving agricultural production factors and reducing external negative effects brought by the agricultural production. However, in the current environment of the market economy, the price of agricultural products does not reflect the external diseconomy of agricultural production, and even does not possess the basic functions of adjusting supply and demand. Agricultural products with the heavy use of chemicals can obtain greater market profit and attract enterprises with factors of production flowing to the production of pesticide and fertilizers. With increasing rural labor flowing to the urban areas, the cost of "two-type" agriculture becomes more expensive. In addition, consumers can't distinguish
whether chemicals are added during the production process; currently, the production mode of the "two-type" agriculture may possibly have deficiencies. Besides, considering the limit of rural consumption level in Anhui and there is great potential for promotion and other factors, the implementation of “two-type” agriculture is not yet fully promoted.

c. The Agricultural Environmental Protection Lacks Incentive Mechanism

Many current agricultural environmental protection policies not only ignore the actual conditions and demand of the farmers, but also encroach on the interests of farmers to the contrary. For example, the popularization and application of rural straw gasification in Yingshang County has been stopped, because it has no price advantage compared with the traditional coal and liquefied petroleum gas. The poor quality of gas supply and the high cost of gas from straws also accelerate its being ended. This kind of project which turns agricultural waste into resource can play an important role in the rural environmental protection, but the reason why it can not be popularized in rural areas roots in the lack of appropriate economic and policy incentive mechanism in accordance with the interests of farmers.

d. The Promotion of Agricultural Technology Is Insufficient

For decades, the staff of the governments at both county and township level in Anhui Province take responsibilities for the scientific experiments, technological promotion, and direct guidance of agricultural production. The staff who are not qualified or can not fully complete their work actually badly affect the promotion of agricultural technology like soil testing and formulated fertilization. Ignoring these procedures leads to agricultural pollution. Most farmers blindly promote the excessive use of fertilizers and pesticides because they lack scientific knowledge and are given little guidance from the agricultural technicians. The “fertilizer dependence” creates deteriorating soil and vicious cycle which involves the increasing amount of fertilizer and pesticides and decreasing output of crops.

3. Rural Life Patterns

Pollution sources include: domestic waste, and livestock manure.
Main causes:

a. Limited Financial Resources in Local Governments and Insufficient Facilities for Rural Environmental Protection

Environmental protection infrastructure in rural areas is an important component of the construction of ecological environment, playing the role as social welfare which mainly relies on government investment. Because the financial resources at the local governments in Anhui Province are limited, the investment on the rural infrastructure
construction does not match its ambition. In the rural development, the limited resources focus mainly on road construction, housing, water sources, and power supply, while most of environmental protection construction facilities, such as drainage, sewage, and garbage disposal, smoke prevention, dust control, and noise isolation are not given enough attention. According to the data of *The Plan on Prevention and Management of Environmental Pollution in Rural Areas in Anhui Province*, the treatment rate of domestic waste and sewage is only around 10%, while the coverage rate of sanitation toilets is only 58%.

b. **Landfill and Incineration Is Given Priority for Garbage Disposal, Which Lacks Unified Planning**

According to the investigation of Sub-report 5, the treatment of rural domestic waste in Anhui Province is simply to collect, if not randomly discard for landfill and incineration. The manure of livestock and poultry raised by single farming households is usually collected to cast away without any treatment. It is suggested that beautiful villages which are suitable for living should be constructed according to *The Plan on the Construction of Beautiful Villages in Anhui Province (from 2012 to 2020)* recently issued by Anhui provincial government. However in the *Plan*, there is yet, no detailed planning on the disposal and management of rural domestic waste. In some remote rural areas far from the cities and towns, the sanitation facilities are backward; the management is ineffective; the garbage is exposed in a mess and domestic waste are in a state of "three withouts"-- without management, without centralized collection sites, and without disposal facilities.

c. **There Is a Lack of Planning on Village Construction and the Land Resources Are Severely Wasted**

Due to the limitation of financing, technology, and professional talents, at present most of the village construction in Anhui Province lacks reasonable planning, or the level of general planning is low. The random distribution of the rural construction layout, the scattered residential areas, the rapid growth of areas for residential areas and roads, and the random expansion of land occupied by township enterprises cause much waste of its land resources.

d. **Farmers Randomly Build Their Own Houses and the Village Layout Is Therefore in Disorder**

The construction of village planning lags behind what is expected. There is a lack of unified planning in the house building industry, which is very sporadic and scattered. New houses are built without the old ones being demolished. This not only brings about great difficulty to the rural infrastructure construction, but also makes it quite difficult to improve the farmers’ living environment, agricultural production and living conditions. What’s worse, it affects the general layout of villages.
4. Institutional Factors

Land system. After the Third Plenary Session of the 17th Central Committee, the scale and speed of rural land circulation in Anhui Province has been expanded, however, in general it is still not given much priority. The circulation method shifts from irregular to regular, but the leadership of government and participation of social capital may weaken farmers' role as the main body. Circulation platform is arranged step by step, but the perfect and mature circulation system has not yet been formed. (See Sub-report 4-2)

The small scale of land circulation is not conducive for the unified application of fertilizers and pesticides. Most of the farmers with scattered and small-scale land lack professional knowledge of agriculture, understanding of proper fertilizer dosage or the application of pesticides. With the theory of “the more is better,” there are often mistakes, resulting in the overuse of pesticides. The large amount of harmful pesticide residues in the soil causes soil hardening and will diminish production, and in turn, stimulate farmers to use more fertilizers to improve production, thus, perpetuating the vicious cycle.

Large-scale operations are beneficial to the intensive disposal of garbage and waste. Rural professional investors, leading enterprises of agricultural industrialization, and farmers' cooperatives are the main agents to concentrate on mechanized farming through the land circulation of farmers, helping to reduce improper fertilization, facilitating the supervision of government, so as to reduce pesticide residue of agricultural products and improve food safety. The centralized operation promotes the scientific methods to improve production as well as protect environment, the waste such as abandoned pesticides, agricultural films and plastic bags transported and disposed intensively. Take Guoyang County for example, big households adopting large-scale operation of land circulation often apply the technology of returning straws to the field after crushing. This enables the reuse of resources and assists in reducing the environmental pollution.

Rural system of sanitation and environmental protection. The main body of responsibility for the rural environmental protection is not clear. At present, the environmental protection agency in Anhui Province consists of professional personnel from the environmental protection departments at the county level, which is less than one in ten thousand of the total rural population. Environmental protection responsibilities are decentralized in departments for agriculture, forestry, water conservancy, and environmental protection. In the town government and the village committee who should take the responsibility of supervision and law enforcement, usually there is only one part-time commissioner in charge of environmental protection and inadequate attention has been paid to the supervision and management of pollution prevention and control in rural areas.

There is a long-term shortage of rural environmental protection input. There is also a long-term lack of financial support of rural environmental protection in Anhui Province, if not absent in most of the cities (counties). The fiscal revenue of grassroots government is very limited, making it difficult to bear the responsibility of rural ecological environment protection. With the deepening reform of rural taxes,
especially after the agricultural taxes and special products taxes were canceled, the grassroots financial support is withering, leading to small and unstable input in the rural ecological environmental protection.

The laws and regulations on rural environmental protection are flawed. With the lack of national laws and regulations on rural environmental protection, Anhui Province has not any relevant local regulations. In the construction of the new countryside, there is legislative vacancy in environmental planning and management of villages and in preventing the urban environment pollution from spreading to the rural area. In addition, there is a serious shortage of relative legislation on agricultural plastic film pollution, rural environment infrastructure construction, rural domestic waste, and sewage, resulting in no laws to be applied.

Due to the lack of a certain main body to take responsibility for the rural public service of environmental protection and the dual economic development structures of rural and urban areas, governmental policies in public finance and national investment for the prevention and control of agricultural pollution can’t be conducted successfully. Local governments at all levels are too GDP-oriented to be initiative in solving the rural environmental problems or preventing and treating agricultural pollution.

5. Factors in Resources and Energy Consumption

Water resources. Water resources are in shortage. Water resources per capita of permanent population in Anhui Province in 2010 were 1,352 m$^3$, but not balanced in the distribution of every city. Water resources per capita in Huangshan were 9,452 m$^3$, while in HuaiBei 272 m$^3$, less than the internationally recognized standard of 500 m$^3$. HuaiBei area has supported 50% of arable land and 43% of population of Anhui Province with 20% of the water resources, becoming one of the areas with most insufficient and highest level of development and utilization of water resources in Anhui Province as well as the Huaihe River basin$^7$.

The water conservation facilities are insufficient. The project of rural drinking water safety is very important to the 33 projects of improving people’s livelihood implemented in Anhui Province. Generally speaking, there are the problems including inadequate early planning, financing difficulties and mismanagement in the operation of the projects. For example, lack of complete development planning on regional rural water supply is likely to cause the repeated construction of many projects. In recent years, China has increased investment on water conservancy, such as the reinforcement projects of the reservoirs that are dangerously weak, and the projects to treat the Huaihe River. These projects have brought great pressure to underdeveloped counties. Water conservancy departments at all levels ignore the estimates of the overall cost and operation cost of the water price, lacking meticulous

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and thorough analysis, resulting in a lack of benign operation mechanism of water conservancy projects.

**Energy consumption.** The rural household energy consumption needs to be changed. At present, the rural household energy consumption structure in Anhui Province need be optimized and adjusted. As to biomass energy, there remains much to be further developed and utilized. The annual amount of rural straw resources available in the province can reach more than 40 million tons, accounting for about 50% of energy utilization, with potential to be utilized as energy-oriented resources. On the other hand, with the acceleration of urbanization, a large number of young labors work in cities, with the elderly, women, and children left at home, making it difficult to feed methane tanks and to get daily management, resulting in the out of service of methane tanks. And in large and medium-sized biogas projects for livestock and poultry farms, it is not clear for local governments whether to provide concentrated gas or to generate electricity for farmers with the biogas produced. Due to the lack of corresponding regulations and measures about the investment scale and supervision mechanism, most projects are used to generate electricity for enterprises or provide gas for their workers. Even there are some who randomly discharge the redundant biogas and biogas slurry, causing the secondary pollution.

The structure of energy used in agricultural production is unsustainable. For a long time the energy used in rural production of Anhui Province was dependent on coal, oil, and commercial electricity, while at the same time there was lack of any development or utilization of renewable energy. In the structure of energy used in rural production in 2011, coal, petroleum products, and electric power accounted for 89%, while renewable energy only accounted for 11%. This is due to the lack of investment on the development of science and technology, which few departments carry out because the social benefits are greater than the economic benefits in developing renewable energy under current social and economic conditions. On the other hand, some of rural energy management departments at county (city) level are struggling in work due to lack of personnel and financial resources, which is not beneficial to the adjustment of rural energy structure.

**6. Other Factors**

The rural population is large. Anhui Province supports 4.63% of the national population with 1.45% of the nation's land, and its proportion of rural population accounts for up to 6.56% of the national rural population. The large rural population makes its relationship with resources highly problematic, leading to the limited rural resources per capita. Farmers are faced with great pressure to make a living, unable to take environmental protection into account.

Farmers' awareness of environmental protection is weak. Influenced by the poor education and traditional living habits, farmers pay little attention to pollution of surrounding environment, allowing rural domestic waste to randomly pile up, which is endured as long as it does not pose direct threats to life in the short term. In underdeveloped areas, poverty forces farmers to "welcome" pollution-making enterprises to build factories, destroying the local ecological environment.
The rural labors migrate to cities. The rural labors in Anhui Province mainly provide short-term or seasonal work for cities at idle time and rush to hometown in the agriculturally busy seasons, presenting a flow style like "migratory birds". There are a considerable proportion of rural people working away, with 44.97%\(^8\) working away for more than one year (in 2010). The result is that fewer and fewer people are engaged in agriculture, and gradually the number of "hollow village" increases with a lot of land nearly deserted, houses unused, and weeds overgrown.

Traffic construction has an impact. At present, the highway network of Anhui Province is basically completed. Highway construction takes up much land, of which more than 80% is arable. At the same time, the implementation of the project of "Connection of Every Village through Roads" also takes up and destroys a large number of high-quality areas. Building highways in the mountainous and hilly areas needs to deforest and destroy vegetation, excavate mountain, and spoil the soil, which results in serious water loss and soil erosion. Anhui-Hangzhou Highway is located in the mountainous areas in southern Anhui Province, with a length of 90.5 km, destroying an area of 321 hm\(^2\), which were originally covered with vegetation, and adding an area of 343 hm\(^2\) of water loss and soil erosion\(^9\).

B. External Factors——Transfer of Urban Pollution

The proportion of urban population in permanent residents in Anhui Province increases year by year, from 28% in 2000 to 44.8% in 2011, which shows a quick urbanization process.

\[\begin{align*}
\text{The Proportion of Urban Population in Permanent Residents in Anhui Province} \\
\end{align*}\]

Figure 3-1 The Proportion of Urban Population in Permanent Residents in Anhui Province\(^{10}\)

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The acceleration of urbanization aggravates pollution transfer to rural areas. Industrialization dictates urbanization. With traditional manufacturing industries transferred to suburban and rural areas, urban pollution increases and spreads to the rural areas, making the rural environmental problems more and more serious.

**Pollution-inducing enterprises have been transferred from urban to rural areas.** Many cities transfer the high-pollution enterprises to the suburb or rural areas in order to protect and improve urban environment. The generated emissions of sewage, waste gas, and waste seriously pollute the rural ecological environment. Since the "Tenth Five-Year Plan" period, Anhui Province has carried out the reform of state-owned enterprises within a wide range, and at the same time moved the enterprises in the downtown areas to the development zones and industrial districts in suburban area, especially transferring the pollution-making enterprises out of the city, with some being moved to the remote rural areas or other cities, causing much pollution to the countryside. For example, during the "Eleventh Five-year Plan" period, Hefei City moved a chemical enterprise in urban areas to Cuo Town, Feidong County, establishing an industrial park with circular economy.

**The urban pollutants spread to rural areas.** The problem of "three waste" of urban industry spread to rural areas is also prominent, placing a great threat to the rural ecological environment. The pile-up of industrial solid waste will occupy a large amount of cultivated land, which is equal to the fact that pollution is transferred to the rural areas. Industrial waste water, after being dumped, may cause irritant gas which spreads and pollutes the surrounding land. In addition, some cities see the rural areas as a "natural waste treatment plant", randomly piling up urban domestic and construction waste in the rural area, leading to the reduction of cultivated land, the degradation of soil quality, and poor harvest. The result is that the sustainable development of agricultural production has been hindered.

**Pollution worsens in the process of industrial transfer.** Currently, the Wanjiang city belt (megalopolis) demonstration zone for industrial transfer is undertaking the large-scale industrial transfer from the eastern coastal areas, and industrial pollution from other provinces also spreads to the rural area in Anhui Province. In 2010, the demonstration zone utilized foreign capital of USD 3.79 billion, of which the capital utilized within the demonstration zone only accounted for one-third, and a large amount of the money was distributed to the industrial zones at county and township level or the rural areas.

According to the rule of industrial transfer, there are quite a number of outdated or pollution-making industries among the transferred ones, and thus Anhui Province may undertake the pollution in the process of industrial transfer. As the examination and approval procedures concerning environmental protection are strict, and there are pollution treatment facilities in development zones, the impact brought by the transferred industries on local environment is very limited. However, it is often hard for the governments at county and township level outside of the development zones to seriously focus on the environmental protection and to conduct environmental review due to lack of funds, projects and pollution treatment facilities. Therefore, some of the
investment projects with serious pollution have tremendously affected the local environment.

IV. IMPACTS OF ECO-ENVIRONMENTAL IMBALANCE ON ECONOMY AND SOCIETY IN RURAL ANHUI PROVINCE

A. Hinder Rural Economic Development

1. The Increasing Input-output Ratio in Agriculture

In recent years, the mass use of pesticides improves the drug resistance of pests and at the same time lowers soil fertility, leading to more application of pesticides and fertilizers and higher cost in agricultural production.

The mass use of pesticides not only raises the drug resistance of pests, but also kills their natural enemies and destructs the structure of biologic chain, causing a pest epidemic as well as decreasing agricultural production. Due to the increasing use of fertilizers, the soil fertility decrease and texture are degraded; the return rate and utilization rate of fertilizers are decreasing. The use of mulch leads to great residues, causing serious pollution and damage to the soil texture and quickening the soil aging process. As a result, the normal growth and output of crop are greatly impaired.

The imbalance of the eco-environment in rural areas is endangering agricultural infrastructure and causing damage to many farmers in Anhui Province. The reduction in agricultural products caused by water and soil pollution leads directly to economic loss of the farmers. With the increasing price of agricultural means of production and the increasing input of pesticides and fertilizers, the production cost and the input-output ratio in agriculture are also increasing every year, restricting the sustainable and healthy development of rural economy.

2. The Rising Cost in Environmental Management

The environmental imbalance and pollution in rural Anhui Province leads to a huge economic loss and management cost. To improve environmental management and protection, more human resources, materials, and capitals need to be put into environmental management in Anhui Province. Every year Anhui spends a large sum of money on environmental protection and management, putting more pressure on finance in Anhui Province. In 2011, financial expenditure on environmental protection in Anhui Province was 8.196 billion yuan, accounting for 2.48% of the total financial expenditure, 330.299 billion yuan. With a large rural area and a large population, there are many new and old environmental problems, demanding a large amount of financial expenditure on environmental protection and management in rural areas, thus making the policy on financial expenditure the major policy.
B. **Hinder Social Development in Rural Areas**

In recent years, pollution is becoming increasingly serious in rural areas of Anhui Province. The acceleration of rural modernization, the quick development of township industry, and the transfer of urban garbage to rural areas place great pressures on the rural eco-environment.

The imbalance of rural eco-environment seriously damages the interests of farmers. The mass use of fertilizers and mulch and the reduction of production caused by soil hardening cause direct economic loss of farmers, and damage to their health. Environmental pollution in rural areas is impacting agriculture and farmers as the vulnerable group, affecting much of the rural areas in Anhui Province. The imbalance of the environment is gradually threatening the infrastructure of agriculture and causing serious damage to the farmers in Anhui Province.

Although the government places much money in the protection and management of the rural environment every year, there exists an apparent discrimination in environmental protection between the urban and the rural areas for a long time. Different policies to protect eco-environment are adopted and implemented in urban and rural areas. Big cities, big industries, and big projects have been the focus of eco-environmental protection while rural areas have become neglected. Injustice between urban and rural areas used to lie in the economy, education, and public facilities, but now it has extended to the ecological environment.

With the increasing pollution and people’s awareness on environmental pollution, environmental issues increase every year, which causes harm to social stability to a certain degree. According to the survey, the quantity, scale and seriousness of the mass incidents in rural areas caused by environmental issues are all on the rise.

C. **Undermine Health of Urban and Rural Residents**

Poisonous chemicals and harmful bacteria are likely to find their way to water, soil and air in rural areas through pollution, sickening people through the drinking water of food chain and undermining people’s health.

1. **Water Pollution and Human Health**

The imbalance of the rural environment in Anhui Province poses a threat to the security of the drinking water in urban and rural areas. There are a number of factors causing this problem: domestic sewage, domestic garbage, and industrial waste in rural areas.

People will become sick by drinking water polluted by the poisonous chemicals. The polluted water will cause explosive populations of parasites, viruses, and bacteria, which can cause infectious diseases. Meanwhile, the excessive pollutants in water may lead to eutrophication, altering the self-cleaning capacity and hygiene. In addition, special substances in these pollutants may cause serious diseases such as AIDS and cancer.
Many areas in Anhui Province, especially those with high agricultural densities and overused dosages of nitrogenous fertilizers, are causing nitrates to seep into the underground water tables. According to a survey conducted by Anhui Agricultural Science Academy in Mengcheng County, underground fertilizer pollution in vegetable-producing areas is becoming very serious, with the nitrate-nitrogen compounds in over 60% of analyzed drinking water exceeding the maximum density approved by the authorities. The content of nitrate in groundwater is an important indicator when measuring the quality of the drinking water. Excesses amounts of nitrates in groundwater can increase the incidence of blue baby syndrome, or methaemoglobinemia, lung cancer, colorectal cancer and lymphoma. In Anhui Province, groundwater is an important source of drinking water in most of the villages and many of the cities. Nitrate pollution is a threat to the security of drinking water.

2. Solid Waste Pollution and Human Health

The source of solid waste pollution in rural areas in Anhui Province is mainly domestic waste. For a long time, there is no centralized area designated for domestic waste treatment in the rural areas. Some villagers stack the waste in large heaps, or place them beside a river, lake, or spread them directly in the farmland.

The domestic waste in rural areas pollutes the soil, takes up a large area of fields, affects crop growth, reduces crop production, lowers crop quality, and seriously affects the food security. With the dissolution of the organic substances and the leaching of rain, some pathogenic microorganism, organic pollutants, and poisonous heavy metals in the garbage will flow into the water system and percolate through the soil to pollute surface and groundwater, threatening farmers’ health.

The small particles and dust in the domestic waste can be carried by the wind. The poisonous and harmful waste through chemical reactions can produce toxic gases which are detrimental to human health if penetrated into the air. The haphazard stacking of domestic waste has a direct impact on the living environment of the surrounding villagers. Plastic bags and rugged clothes are thrown away in ponds or beside the road. When blown by the wind, they will probably silt up ditches, pools, and rivers, which will affect the living quality of the local people, threaten their health, and hinder the prevention and treatment of endemic.

3. Air Pollution and Human Health

The major source of air pollution in rural areas in Anhui Province is the emission of waste gas from urban and township industries and agricultural production. Waste gas from urban and township industries in Anhui Province mainly contains sulfur dioxide, smoke, and dust, which are the major pollutants in rural air pollution in recent years. Acid rain contains sulfur dioxide, which will pollute farmland and crops as well as posing a serious threat to the security of drinking water in rural areas. The industrial dust is mainly limited in the areas surrounding the plants which discharge dust. In those areas, the surface of crops adsorbed and is covered by thick dust,
which not only blocks photosynthesis but also leads to crops poisoning due to the heavy metals in the dust, thus posing grave threat to food security.

Air pollution caused by agricultural production mainly results from the incineration of straws. In northern Anhui Province, the problem of incineration is very serious. The incineration of wheat straws in large quantities is in the summer season. Although local governments have issued “Incineration Bans” many times, the incineration does not cease. Statistics show that when incinerating straws, the pollution indexes of sulfur dioxide, nitrogen dioxide, and inhalable particles in the air will reach their maximums, where the density of sulfur dioxide is twice that of its normal level, and that of nitrogen dioxide and inhalable particles is four times that at the normal levels. When the density of inhalable particles reach a certain level, they will irritate people’s eyes, noses, and throats, causing coughing, chest choking and watering eyes if mild, and if serious, bronchitis. During the incineration time, fire accidents happen frequently due to the vast area, various incineration sites, and unstable wind direction, which threaten people’s security of life and property.

D. Affect Food Security in Urban and Rural Areas

Pollution from agriculture and industry has seriously affected the rural water, soil, and air. Some of the poisonous substances are absorbed by crops, which have raised serious health questions to the agricultural products and thus seriously impacting food security in the cities and villages. Most of the daily necessities like crops, vegetables, fruits, meat, and eggs for urban and rural residents come from villages. The quality and security of agricultural products is closely related with people’s livelihoods in Anhui Province. At present, the major pollutants of the agricultural products in Anhui Province derive from pesticide pollution, soil pollution, veterinary drug pollution, and forage pollution.

The pesticide applied will partly adhere to the crops and scatter about the soil, air, and water. Part of the residues will be absorbed by crops. Soil fertilization, irrigation with waste water, and stacking garbage on the ground will deliver the pollutants into the soil and harm the growth of crops, resulting in a large number of residues of poisonous substances in the crops and, again affecting food security.

In the process of raising stock in a large scale, agricultural products such as meat and dairy are polluted due to the inappropriate use of forage and veterinary drugs. For example, some farmers don’t comply with the withdrawal period, overuse antibiotics and steroids and fail to observe the dosage requirements, which will cause the veterinary drugs to remain in the animal tissue in large quantities.

The residues of pesticides in vegetables, the residues of veterinary drugs in poultry, and the overuse of antibiotics and heavy metal pollution in the agricultural products will be absorbed by human body and distributed throughout the body in different organs, especially the liver. These poisonous substances will do great harm to the human health, causing chronic poisoning, vomiting, nausea, dizziness, and even cancer.
E. Endanger Eco-environment in Big Rivers and Lakes

1. Chaohu Lake Region and the Surrounding Areas

The Chaohu Lake region, as well as the surrounding areas, is economically developed with dense industries and population. It is the political, economic, and cultural center of Anhui Province as well as the important base of agricultural products in the middle and lower reaches of the Yangtze River. In recent years, water quality in Chaohu Lake has improved due to years of better management practices. However, the overall water quality in Chaohu Lake and its surrounding lakes is mildly polluted, with some areas showing light eutrophication. At present, the major pollution in Chaohu Lake is organic, which mainly reflects in water pollution and serious eutrophication in surrounding lakes. According to The Environmental Communiqué of Anhui Province (2011), there is light eutrophication in Chaohu Lake, and the surrounding lakes are mildly polluted. The algae outbreak which affects water security hasn’t transpired yet.

For a long time, in the development of industry and agriculture and the construction of cities and towns, more emphasis is put on speed and production than on quality and environment. The emission of major pollutants in Chaohu Lake is far beyond its bearing capacity. The deterioration of the water eco-system in Chaohu Lake has seriously impaired its purifying capacity and the ecological function has disappeared gradually. Without timely management, Chaohu Lake will fall into a vicious circle of algal bloom, extinction of submerged plants, miniaturization of fishes, and deterioration of lakeside wetlands, all of which will interact and promote one another.

The total phosphor and nitrogen in Chaohu Lake is still exceeding the standards severely. The basic conditions causing algae outbreak has not been addressed, thereby posing a serious threat to drinking water security in the urban and rural areas along the lake. At the same time, the eco-environmental pollution in Chaohu Lake, an important ecological wetland and a land famous for its fish and rice, will seriously endanger food security in urban and rural areas.

2. Huaihe River Basin

During the “Ninth Five-year Plan” and “Tenth Five-year Plan” period of prevention and management of water pollution in Huaihe River basin, a series of measures have been adopted to prevent the increase of water pollution and some progress has been achieved. However, judging by the present situation, it is not so optimistic, and water pollution is still serious. According to The Environmental Communiqué of Anhui Province (2011), the overall quality of main streams of Huaihe River remains excellent. The water exiting from Huaihe River is of higher quality than of the water entering Huaihe River. Major tributaries are intermediately polluted with part of the tributaries heavily polluted.
Huaihe River basin is heavily populated, so its eco-environment has a direct connection with the drinking water and the food security for millions of its residents. The drinking water of many residents along the Huaihe River cannot meet the standards. The incidence of cancer, intestinal tract diseases, and complicated diseases is on the rise and the people’s health is under threat. Huaihe basin is the major crop-producing area of the province, and if environmental pollution is not handled effectively, it will impact food security in urban and rural areas severely. Even more serious is that trans-regional pollution will lead to conflicts among residents and contribute to various petitions, thereby affecting rural stability.

Extension of both rural and urban pollution has severely impaired the natural environment in Huaihe River basin. Many wild species are on the verge of extinction, which causes grave loss of genetic resources. The imbalance of eco-environment deprives the original resource value of Huaihe River basin and lowers the self-adjusting capacity of its eco-system as well as the conservation and adjusting capacity, which results in the ecological imbalance of water.

3. Yangtze River Basin

With a favorable geographical location, prosperous industry and agriculture with a dense population, Yangtze River basin enjoys an important position in the economic and social development of Anhui Province. According to The Environmental Communiqué of Anhui Province (2011), the overall water quality in main streams of Yangtze River and major tributaries remains good while some tributaries are seriously polluted.

Yangtze River basin in Anhui Province boasts an excellent geographical location and a favorable ecological environment, which provide a guarantee for major development strategies like the Wanjiang City Belt (Megalopolis) Demonstration Zone for Industrial Transfer and Hefei Economic Circle. If eco-environment is damaged, it will seriously restrict the sustainable development of the social economy in the basin. At the same time, environmental pollution in Yangtze River basin will pose a serious threat to the sustainable utilization of water resource as well as the ecological security in the Yangtze River Delta.

Ecological environment in the basin is closely related to people’s life and health. Water pollution threatens the drinking water security of residents alongside the Yangtze River and their health. A number of pathogenic bacteria, viruses, and parasites spread through polluted water, causing infectious diseases and even epidemics in some regions.

Water and soil loss in Yangtze River basin is very serious, causing sedimentation in the tributaries which leads to raised river beds and basins, a decrease in flood control capacity and in service life of projects, deteriorated eco-environment, and aggravating flood disaster. Environmental deterioration in Yangtze River basin changes its original living environment and impairs the biological diversity. Many flora and fauna are decreasing in large numbers while some are on the verge of extinction. The output of natural resources is decreasing year by year.
V. FEASIBILITY AND TECHNICAL PROPOSAL FOR ENVIRONMENTAL PROTECTION AND MANAGEMENT IN RURAL ANHUI PROVINCE

A. Technical Solutions to Remediating or Reducing Production Pollution in Agriculture

The prevention and management of agricultural non-point source pollution in developed countries are based on comprehensive legislation, economic incentives like fiscal subsidies and revenues and participatory management system and extensive guidance. Although China spends significant financial resources every year on the R&D and promotion of the agricultural non-point source pollution control technology, due to a variety of reasons—such as the inadequacy of legislation, the deficiency of economic incentives, and the ignorance of farmer participation—the results of agricultural non-point source pollution control have not been very satisfactory.

1. Implement “Four Savings and One Reduction” Project

To deal with such problems as low utilization of fertilizers, abuse of pesticides, mass residue in agricultural films and incineration of stalks, it is suggested that in the process of agricultural modernization, land circulation should be actively promoted to realize intensive management and establish modern circular agriculture demonstration pilot; agricultural mechanization should be gradually set up to promote formula fertilization by soil testing; reduction in the amount of pesticides, mechanization in crop cultivation and reaping, stalk returning to land as well as the development of renewable energies in all dimensions should be achieved; “Four Savings and One Reduction” Project should be applied comprehensively (“Four Savings and One Reduction” refers to adopting all kinds of well-established agricultural technologies to realize “Four Savings” of fertilizers, pesticides, water and energy and “One Reduction” of agricultural film and residue or stalk waste to minimize agricultural pollution).

Construct a recycling agricultural system. The scale of both horticultural plants with standard scope and the demonstration farms for livestock and aquatic products should be expanded, in order to promote the production of horticultural plants and the poultry-and-livestock industry to develop in an intensive, large-scale, healthy, eco-friendly and safe manner. More emphasis should be paid to the reduction of the greenhouse gas and the fecal pollution caused by poultry-and-livestock breeding, so as to promote the saving of resources, the clean treatment, the circulation of industry chains, and the recycling of waste, thus forming a circular mode of agricultural production within which agriculture, forestry, animal husbandry, and fishery can coexist, hence improving rural ecological environment and increasing the overall efficiency of agriculture.

Implement thoroughly formula fertilization by soil testing. The technology of formula fertilization by soil testing should be thoroughly popularized and applied, in
order to understand and grasp the nutrient preserving capability of the soil as well as the changing conditions of the soil fertility, to reasonably allocate fertilizer resources, to reduce the use of fertilizers, and to increase fertilizer efficiency; fiscal subsidies should be increased to expand the range of free technological services, to establish and perfect professional servicing organizations, to advance the merging of agricultural machinery and agronomy and the integration of water and fertilizer, to improve service quality, and to encourage the increase in grain output, agricultural efficiency, and peasants’ income, and to realize energy conservation and emission reduction.

**Carry out Fertile Soil Project comprehensively.** Subsidiary pilot programs should be established in Anhui Province to encourage the sustainable use of farmyard manure. A great support will be given to the facility constructions for the collecting and composting of organic fertilizers, and for the integration of water and fertilizer. The farmers should be encouraged to develop green fertilizer methods as well as the straw recycling method, to expand the use of farmyard manure for enriching the organic matters in the soil. The scope of these subsidiary pilot programs should be enlarged thus to support farmland conservation and prevent the soil-erosive fertilization.

2. **Apply “Ecological Energy” Project**

The poultry-and-livestock industry in the rural areas should be led by the development of circular economy; meanwhile, a scientific planning and designing of the breeding environment and management should be taken into serious consideration, pursuing the kind of cultivation characterized by clean, eco-friendly production, comprehensive development and resource utilization. According to the principle of “scientific planning, prevention and treatment with the emphasis on prevention”, the development of the farms should be intensified and limited in number when necessary. In localities where certain conditions are satisfied, a new environmental pig-keeping technology can be popularized, which is based on the use of fermentation beds (made of sawdust and crushed straws) and which can free the breeding process from cleaning the stools and urine of the pigs. In the management of livestock and poultry breeding, the circular developing idea of “reduction and recycling” must be followed. The waste resources on the farms should be made the most of in the construction of the “energy-ecology” project. The project uses the feces, sewage, and organic refuses produced from the breeding as raw materials, carries out medium and large-scale biogas projects while adjusting measures to local conditions. The feces and sewage could produce biogas (high-quality energy) by means of the anaerobic fermentation devices. And the biogas is used to provide energy not only for the production (electricity generation or firing boilers) of the farms, but also for the daily use of the nearby residents. The biogas slurry (harmless organic fluid fertilizer) discharged can be used as manure to water and fertilize the organic fodder and forage grass planted in the surrounding tracts of farmland. In the meantime, the biogas residue can make its contribution in the production, processing and selling of a harmless and efficient organic fertilizer (commercialization), which
would promote the development of ecological agriculture and to the greatest degree reduce the solid, liquid, and gas pollution generated in the breeding process. Therefore, a virtuous circle of “livestock and poultry—biogas—grain (forage)” is formed with relatively positive eco-friendly effect and social effect. Specific implementation plans can be traced in Sub-report 3.

B. Technical Solutions to Increasing Renewable Resource Consumption

In rural energy utilization, the project of renewable energy should be vigorously implemented and the supply of clean energy be increased to protect rural eco-environment and reduce its pollution. In the process of developing and utilizing rural energy, the development policy of “adjustable, complementary, comprehensive and effective development” should be strictly followed. In rural areas, the development of biogas methods should be directed according to the features of different areas, and the renewable energies such as biomass energy, solar energy, small-scale hydropower stations, and wind energy should be popularized. During the “Twelfth Five-Year Plan” period, the following two projects are to be promoted as key projects.

1. Steadily Carry out Large-scale Stalk Biomass Biogas Project

Taking advantage of crop stalks as ferment material to produce biogas is an effective method to develop clean energy and at the same time solve the problems of hazardous and useless incinerating of stalks. The gasification of stalks and central gas supply should be combined with the construction of the new rural concentrated settlements, and with the rural rice and oil crops processing factories, in order to intensively provide gas and electricity to the residents.

Stalk biomass biogas projects take crop stalks, household organic garbage, and human as well as livestock stool as its major source materials, using anaerobic digestion technology to produce biogas and acquire high quality energy and organic fertilizer. It has a positive effect on the development of new energy, on energy conservation and emission reduction, on the prevention of the ineffective incineration of crop stalks, and on the development of ecological agriculture. This project uses crop stalks, household organic garbage, human and livestock stool as its major materials. With the help of the medium-temperature anaerobic fermentation technology, biogas is produced, and in the similar way are high-quality energy and organic fertilizers acquired. The basic technical flow chart of this project can be seen in Table 5-1.
This type of projects generally tends to be conducted in a rather large scale. With the production of 2m³/m³.d and the heat value of 5,000-7,000 kcal/m³, which are both rather high, the processed biogas can substitute for natural gas, fuel oil and coal and can be widely applied in rural residents’ daily life and production (biogas can be directly used as fuel to provide heating energy for power generation or fuel of boilers; purified biogas can be canned in the condensed or liquefied form to substitute for gasoline used in cars, tractor, etc.). The utilization of biogas is an important approach to increase the supply of high-quality and clean energy. In the meanwhile, the large amount of biogas residue produced in the process, harmless, yet rich in organic matter and microelement, can be made use of in the production and selling of commercial organic fertilizer and organic compound fertilizer. Through such projects, positive influences would be exerted on the exploitation and utilization of clean energy, the comprehensive utilization of rural crop stalks, the promotion of rural energy conservation and emission reduction, and the development of rural ecological and organic agriculture. Specific technical plans can be traced in Sub-report 7.

2. Promote and Apply Stalk Solidification Fueling Technology

Stalk solidification fuel should be encouraged to be substituted for coal. This will promote energy savings and emission reductions, as well as contribute to low-carbon life. Stalk solidification fueling technology is a new mechanical processing technology process that compresses crop stalk into the shape of a stick, bar, or particle through compression and molding machines under specific temperatures and pressures. After compressing, the size of stalks is six to eight times smaller than the original, which will improve the transportation and restoration ability effectively and would broaden the scope of application. This fuel is 0.8-1.2t/m³ in density and 3200-6000 kcal/kg in heat value; its ash content is around 5% with the sulfur content below 5‰; its incineration rate is above 95%; its density is equal to intermediate-quality coal and its incineration features are improved significantly. When incinerating, it can generate lasting fires with high temperature in the furnace. This fuel is clean and renewable, which can provide heating and cooking gas for rural residents instead of wood and coal, and can

Table 5-1  Basic Technical Flow Chart of Stalk Biomass Biogas Project

![Diagram of Basic Technical Flow Chart of Stalk Biomass Biogas Project]

<table>
<thead>
<tr>
<th>stalk</th>
<th>pre-processing</th>
<th>adjustment</th>
<th>Anaerobic fermentation</th>
<th>Biogas purifying and storage</th>
<th>Electricity; furnaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human and livestock stool</td>
<td>Waste water pool</td>
<td>Solid-liquid separation</td>
<td>Purifying and canning</td>
<td>selling</td>
<td></td>
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<tr>
<td>Catering waste</td>
<td>Fertilizer production with residues</td>
<td>Fertilizer production with residues</td>
<td>selling</td>
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<td>farmland</td>
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be used as furnace fuel in urban and rural industries instead of natural gas, gasoline, coal, and electricity.

C. Feasibility Report on Centralized Processing of Domestic Solid Waste in Rural Areas

Any single method of processing rural solid household garbage could cause a series of problems such as the high construction and operating cost, the heavy burdens on the peasants, the implementation difficulty, and the unsatisfactory effects. Investigations and researches find out that after simple classification and concentration of garbage, the comprehensive method which combines composting, incineration and landfill can be applied to deal with household garbage. Mathematical models are adopted to carry out benefit analysis of the rural household garbage and the comprehensive processing mode is established to optimize the integration of landfill, incineration, and composting. At the moment, this comprehensive method proves to be an ideal one. This report suggests that the authorities involved in Anhui provincial government should combine the construction of “Beautiful Village” with rural clean project, and arrange a special fund to broaden the demonstration pilots of “2+5” solid household garbage concentrative processing mode.

Environmental Protection Bureau of Feixi County has implemented “2+5” Project in Shishugang Village (2 refers to two behavioral agents and 5 refers to five methods to process three kinds of garbage). The concentrative processing mode of rural solid household garbage has shown significant effect. The main content and operating procedure is that farmers and cleaners as two behavioral agents adopting five methods to deal with three kinds of common garbage in rural areas (organic garbage, non-organic garbage and building waste) on the spot in a harmless way. The five methods are as follows: first, used as biogas source material; second, stored in cellar cavern as waterlogged compost (these two methods are adopted to deal with organic garbage); third, recycled for other purposes; fourth, burnt in furnace (these two methods are adopted to deal with non-organic garbage); and fifth, used as source material in filling pond, flattening ground, repairing and paving road by farmers in the villages (this method is adopted to deal with building waste). Garbage filling site is chosen by the village council as the designated site for filling. This mode can recycle materials and resources effectively, treat waste with processes of waste against one another and realize the intensification, reclamation, professionalization and eco-safety of household garbage processing in order to acquire better environmental-protection effect and social effect. Specific technical plans can be traced in Sub-report 5.

D. Technical Solutions to Stopping Urban Pollution from Spreading to Rural Areas

Urban pollution spreading to rural areas should be controlled from the point source, and the pollution treatment in the cities should be strengthened. At present, urban pollution treatment technologies are mature enough. However, due to
insufficient awareness, limited funds and high cost, urban pollution treatment technologies are not put into effective use.

1. **Strengthen Urban Air Pollution Prevention and Control**

   Procedures include: First is to improve the mechanism that controls the cities’ total quantity of the major air pollutants, to formulate a goal for controlling the total quantity of the regional sulfur dioxide, to bring nitrogen oxide into total quantity control, and to finish the denitrification of the thermal power plants in the key areas during “the 12th Five Year” plan. Second is to strengthen the prevention and treatment of particle pollution and to adopt effective dust removal technology such as bag-type in cement and thermal electricity industries as well as industrial furnaces. Third is to establish coordinated controlling demonstrative project on desulfurization, denitration, dust removal, and mercury removal of the thermal power units.

2. **Strengthen Urban Sewage Treatment**

   **a. Upgrade Existing Waste Water Treatment Plants**

   In 2010, there were 45 waste water treatment plants in Anhui Province, among which five were of first-class standard, and 35 were of second and third class, most of which could realize secondary sewage treatment, which means pollutants discharged from these plants can only reach Level B of Class I rather than Level A of Class I, and there were also a few plants which could only reach Class II levels. According to “Pollutants Emission Standard of Urban Waste Water Treatment Plants” revised by National Environmental Protection Bureau in 2006, water discharged into national or provincial key waters, lakes, reservoirs, closed or semi-closed waters must reach A level of class I. A number of urban waste water treatment plants in Anhui Province discharge water into Chaohu Lake, Huaihe River, several reservoirs and some other key rivers. Efforts must be paid to strengthen urban sewage treatment and upgrade existing sewage plants. In particular, all sewage treatment plants in Hefei, Chaohu, Lu’an, Huaibei and Bengbu must be improved to Class III treatment level.

   **b. Raise Urban Sewage Pipe Network Coverage Rate**

   Seen from the current conditions in Anhui Province, the construction of sewage treatment plants in some cities is quicker than that of the sewage pipe network. Especially in some inner cities, different kinds of complicated relationships can lead to difficulties in the construction of a sewage pipe network. Due to the reasons listed above, even though the sewage treatment plants are constructed, they cannot operate smoothly. At present, the sewage pipe networks in some big cities and economically advanced cities of Anhui Province are working well with the use rate of more than 80% because of their sufficiency in funds. In the small cities and the under-developed cities, due to the lack of money, the construction of pipe networks
relatively lags behind, and the use rate of the sewage treatment plants is less than 50%, thus causing a huge waste of resources. Therefore, when building sewage treatment plants, the government should reinforce the supporting construction of sewage pipe networks.

c. **Strengthen Advanced Treatment of Tail Water in Sewage Treatment Plant Through Artificial Wetland Technology**

Currently, it is not possible to guarantee that the sewage will reach the water quality of Class III and Class IV after treated by the plants on a large scale due to the high cost. If the tail water discharged from sewage treatment plants can be dealt with by artificial wetlands, its quality will be much improved. In some regions in the country, the sewage water treated by artificial wetland can reach Class IV level. Artificial wetland sewage treatment technology is a complicated technique combining natural purifying and manual treatment with such advantages as small associated costs, easy operation, and low maintenance and operation fees. This technology can not only directly process sewage and carry out advanced treatments to the treated sewage, but also adopt appropriate scales and designs adapted to the sewage conditions. Therefore, the application of this technology has provided an alternative choice for solving the above problem. In addition, artificial wetland technology can be used to process tail water from the first class or second-class waste water treatment plants to improve water quality.

d. **Properly Dispose of the Sludge of the Sewage Treatment Plants**

Sludge is the byproduct of the sewage treatment plants. About 1/3 of organics in sewage is transformed into sludge. In China, most sludge is dealt with incorrectly, and the pollution caused by randomly sludge throwing and dumping cannot be overlooked. To some extent, it has counteracted the effects achieved by reducing pollution and emissions. The most effective way to dispose of sludge is to have it incinerated after being dehydrated considering the high rate of organic matter contained in it and its heat value. From a technological point of view, sludge incineration is easier than garbage incineration, and is more like the combustion of low-quality coal. Environmental departments should supervise sewage treatment plants as they incinerate the sludge. The temperature of sludge incineration should be higher than 850°C so as to eliminate the production of poisonous gases, like dioxin.

e. **Handle Industrial Transfer by Matching Supportive Pollution Treatment Facilities**

Currently, a state-level industrial transfer demonstration zone has been established in Wanjiang city belt (megalopolis), in which the large-scale operations are being undertaken everywhere. However, the pollution still spreads to rural areas with the transfer, especially to many of the economically undeveloped counties and
towns where the desire to develop is so intense that check and balancing procedures are usually lacking so as to attract foreign capital and investments. Much attention should be focused to these problems.

Counties and towns inside the demonstration zone should strictly check the projects while assisting the pollution treatment facilities. Industries that could cause serious pollution must be prohibited rather than introduced, in order to prevent the transfer of the high-pollution enterprises and the obsolete projects, technology and equipment to the rural area. Some enterprises that have already been transferred to the rural area pay attention only to manufacturing and neglect the environmental protection in the process. Their cost input is poured into industrial manufacture with little attention to the equipment of environment protection; therefore, the phenomena of discharging substandard sewage are quite common. Those enterprises that directly discharge sewage and tail gas without any treatment must be banned. Environmental monitoring must be strengthened when it comes to rural industrial enterprises, and national industrial policies must as well be strictly implemented. Enterprises against national industrial policies should be eliminated in accordance with certain relevant rules, in order to prevent some notorious polluting enterprises from resurgence. In the rural areas, the construction of Eco-Industrial Parks should be encouraged. Enterprises should be introduced into the parks so as to increase the aggregation extent of the industrial space. Pollution treatment facilities in the parks require unified configuration, so as to intensively control pollution, and to offer help to those enterprises which are unable to purchase pollution treatment facilities on their own.

3. Improve Domestic Waste Treatment in Urban Areas

a. Implement Garbage Classification and Comprehensive Disposal

Garbage classification can assist in the recycling of some useful resources from the garbage. After the classification, useless garbage can be disposed of harmlessly and the amount of garbage to be disposed is reduced greatly. Anhui Province has made efforts in garbage classification by formulating standards although with unsatisfying results. The lacks of few positive results were due to the limited amount of attention from the government departments and from citizen’s weak awareness of the garbage classification system. In many cities, household garbage is still mixed with primary garbage. Garbage classification is an arduous task with many advantages, so more focus needs to be made by the government along with the support of the citizens. For Anhui Province, pilot work can be carried out in some cities to formulate garbage classification plans and to implement proposals, to publicize the significance of garbage classification so as to improve public awareness of garbage classification and participation, to increase fiscal support to purchase assisting construction facilities, and at the same time, to draw up punishment regulations and utilize economic incentives (price mechanism, financial subsidy and economic reward) to reinforce public positivity and activity.
b. High Standard Application of Garbage Incineration Power Generation Technology

Incineration plants have been built in some cities of Anhui Province, such as Wuhu, Anqing, Tongling and Huaibei. Due to the shortage of land, difficulty in site choosing and the increasing trend of urban garbage, during the “12th Five Year Plan” period, many more prefecture-level cities will build incineration plants, which will undoubtedly create outlets for garbage disposal. At present, domestic garbage incineration power generation technology is developing unevenly with both imported and domestic equipment and technology. Anhui Province should strictly check garbage generation projects, adhere to dioxin emission standard, reinforce the management of garbage incineration plants, and strengthen supervision to prevent loss caused by the loosening of standard and the reduction in cost and investment. According to the investigations of Anhui Province garbage incineration generation projects, project teams believes that the new type of dry cement kiln combined with gasified incineration stove in Tongling can completely dispose garbage with only 1/30 of the dioxin emission standards and 1/3 of the emission standard of the cement industries, which deserves promotion and application in cities with cement industries.

E. Practical Solutions to Rural Layout Optimization

According to the differences in geography, culture, and economic development level, Anhui Province can be divided into four areas---northern Anhui, central Anhui and regions along the Yangtze River, eastern Anhui, and southern and western Anhui. These divisions help to guide the rural layout in accordance with local diversities.

As there are very few central villages in Northern Anhui, and the rank and scale of the villages are quite imbalanced, measures should be taken to reasonably integrate and reorganize the natural villages, in order to help form a proper system of central-natural villages. Besides, more attention should be paid to village reorganization, living environment, land management, and ecological environment protection for the successful construction of new rural community. According to the comparative analysis of the villages’ spatial layout in different regions, the population of a planned central village is about 2,000 to 3,000 with the average population at about 2,414. In a grassroots village, the overall population is about 1,000 to 2,000 with the average population at about 1,360. The hierarchical structure of a planned village is 1:2 and the planned spatial distribution pattern is mainly the annular balanced type (fig 5-2).
Although village distribution in central Anhui and regions along the Yangtze River is quite concentrated, the village hierarchy is out of order and there are too many small natural villages, it is necessary to properly guide the villages’ spatial layout and hierarchy, to strengthen the management of the villages and the land, and to improve environmental management, concentrated land use, and rural industry development. According to the comparative analysis of the villages’ spatial layout in different places, the population of a planned central village is about 1,000 to 2,000, and the average population is about 1,500. In planned grassroots villages the average population is about 620. The hierarchical structure of a planned village is 1:5 and the planned spatial distribution pattern is mainly of the annularly imbalanced and mixed type (Figure 5-3).

As village spatial layout in eastern Anhui differs greatly in different regions as well as the unbalance in village hierarchy, it is necessary to remove villages which are of small-scale and have inconvenient transportation to reduce the number of administrative villages and, to increase accordingly the population scale of central villages, and to optimize the hierarchical structure of the villages. According to the comparative analysis of different study cases, the population of a planned central village is about 1,500 to 2,000, with the average population at about 2,147. The population is about 500 to 1,500 with the average population at about 1,013 in the planned grassroots villages. The hierarchical structure of a planned village is 1:4 and

Figure 5-2 Planned Village’s Spatial Layout Pattern in Northern Anhui Province

Figure 5-3 Planned Village’s Spatial Layout Pattern in Central Anhui Province and Regions along the Yangtze River
the planned villages are in balanced cricoid radiated, mixed or imbalanced cricoid radiated spatial distribution pattern (Figure 5-4).

As villages in southern and western Anhui are sparsely distributed with small densities of population and the village spatial layout is greatly imbalanced---sparse in mountainous areas yet dense in hilly grounds, more villages should be guided to develop proper spatial layout for the village’s further construction and development. It’s necessary to increase the population scale of central and the grassroots villages accordingly to promote their concentration and development. Efforts should be paid to the construction of facilities in accordance with human settlement, to highlight the texture of the villages and to manifest traditional styles and features. According to the comparative analysis of different study cases of the villages’ spatial layout, the population is about 500 to 1,000, with the average population at about 745 in the planned central villages. The population is about 200 to 400 with the average population at about 258 in the planned grassroots villages. The hierarchical structure of a planned village is 1:5 and the planned villages are in linear balanced, linear imbalanced and mixed distribution patterns (Figure 5-5). Specific information can be found in Sub-report 4-1.

F. Strategies for Land Circulation to Promote the Large-scale Farmland Operation
1. **Promote Land Circulation by Developing Industrialization**

Provincial documents and instructions focus on building the economic zones of agricultural products with local characteristics, encouraging farmers to develop leading industries, and adopt scale operation in their contracted lands, inspiring large intensive farming and mechanized operations, transferring individual farmer labors from the land farming to secondary and tertiary industries. Land use rights should be centralized by means of enterprises and other economic cooperation organizations to realize large scope of grouped exploitation. Meanwhile, farmers can also join the organizations, taking the land use rights as stakes, composing cooperative agricultural enterprises, which would create a win-win situation for both enterprises and farmers.

2. **Achieve Orderly Land Circulation by Standardizing the Market**

Unwearied efforts must be paid to establish fair and effective land circulation mechanism, which should go in line with the market size to guide the circulation of land management rights. First, negotiation must be conducted fairly with farmers based on their willingness and the quality of lands to determine certain issues such as the subcontract, rent, and circulation fees. And the negotiators should try to avoid the market fluctuations’ negative impact on farmers’ income. Secondly, the contracted land can be exchanged freely among the farmers whose production operation area lies relatively scattered and hence very difficult to manage. Furthermore, if necessary, land exchange across villages and towns are also encouraged.

3. **Cultivate Large-scale Farmers and Direct Land Circulation**

We can take the establishment of agricultural science and technology demonstration zone as the key factor in cultivating the large-scale farmers and facilitate the land circulation. The demonstration effect can promote the large-scale farming, which can then promote the circulation of land, and thus forming an effective virtuous cycle system. The cultivation works can also focus on the village cadres in particular. Encourage village cadres, especially agricultural grassroots ones to actively participate in the land circulation by means of demonstration.

4. **Guide Land Circulation by Engaging in Typical Pilots**

In land circulation processes, the effective methods and experience should be widely publicized. Pilot projects of “the flowing of contracted land management rights” should be actively developed. Peasants should be guided and encouraged to realize the flowing of rural lands in various forms and methods, to explore new approaches as references for the promotion of the moderate scale of agricultural operation, and to accelerate the transformation of modes in agricultural operation.
5. Promote Land Circulation by Increasing the Intensity of Support

On the one hand, the supporting policies must be carried out to encourage the rural land circulation in a variety of forms and with the involvement of multi-agents and to encourage the subcontract, lease, exchange, transfer, share cooperation and other forms of circulation to promote the optimal distribution of the land. On the other hand, the policies must encourage the scientific and technical personnel to set good examples by working with the grassroots, and offer scientific and technical knowledge to farmers. The national policies should integrate financial and human resources so as to speed up the construction of the infrastructure such as roads, water, electricity, and so on. The government should establish characteristic agriculture to attract more large-scale growers and township enterprises, vigorously promote the establishment of family farms, nurture and develop industrial parks with distinct advantages and distinguished features, help cultivate brands, and create industries of local features, with the final aim of putting the transfer of land in motion. In addition, the government should set up an award fund, giving certain economic incentives to large land circulation farmers and providing preferential utilities in water and electricity, finance, insurance, taxes and other concessions to large land contracted operators. The government should also support vigorously the corporate champion in agricultural industrialization scale operation which would greatly promote land circulation and availability, to establish preferential policies, to actively encourage the creativity of land circulation modes, to give financial compensation to farmers for giving up lands and to promote financial support.

6. Promote Land Circulation by Developing Urban Economy

Measures should be taken to accelerate the development of small towns, and to enhance their aggregation function, in order to attract more labor force, to accelerate the transferring speed of surplus labor to other places, and to achieve trans-regional development. Meanwhile, in order to develop the labor economy, there should be active training for workers to improve their practical skills to better adapt to the city life.


1. Promote PPP for the Construction of Rural Water Conservancy Facilities

PPP refers to an agreement between private enterprises and the government sectors, in which the private enterprises take part in the cooperation and management of basic facilities, supply the expected services and shoulder the corresponding risks (Deng Xiaopeng, 2007). As for the profits, the private enterprises can charge the service costs according to specific service standards while the government will retain supervision over the enterprises. The PPP financing model is based on a structure
that all parties can receive profits. When adopting the PPP model in rural water conservancy facilities, the private sector (including water users) can charge water-using fees to increase its investment activity, and the public sector involving in investment management can supervise cooperative organizations effectively and help farmers more efficiently. But governmental departments do not get economic benefits in the process. What they value is social and environmental effects brought by water facilities. Therefore, the PPP model can achieve the win-win situation for all and give rise in value between the public and private sectors which not only can lower water-using costs and promote the creativity of all kinds of water-saving technologies but improve the effectiveness of water facilities which in turn can create more benefits.

Due to the fact that rural water infrastructures are natural monopolic public goods, so they bear the nature of quasi-public goods, which means that they can gain part of the reward by charging fees. However, it is quite difficult to take investment funds back by merely relying on charging fees owing to its difficulties in management, especially in Anhui Province, where most of the rural areas are poor and backward. The government should consider providing some financial support to attract private investors. Therefore, to adopt the PPP model in the construction of rural water conservancy facilities in Anhui Province where one can guarantee the profits of both private and public investors, enhance the effectiveness of capital and solve the backwardness of the construction of rural conservancy facilities effectively. Besides, the PPP model focuses on receiving for the government highly effective and qualified private enterprises to participate in the construction and management of infrastructure so as to improve its efficiency and standard of managing. Furthermore, the PPP model is a kind of financing tool in which all parties may profit. But owing to the fact that the application patterns differ in various countries and regions without a standard tactic form, only by choosing proper projects in practical use can this financing mode exploit its advantages to the full.

One of the top agenda for the construction and maintenance of Anhui Province’s rural water infrastructure is to solve the problem of capital shortage. To choose financing models specifically according to the different types of rural water conservancy projects can not only introduce capital to the construction of rural water conservancy facilities and speed up its completion, but also enhance the capital effectiveness and arouse farmers’ activity.

PPP not only solves the investing and financing models of the construction and management of rural water conservancy infrastructure but changes the managing model of these water facilities which traditionally are managed solely by public service sectors. But PPP will turn administration body into receivers who specifically participate in trying out rural water resources, which will greatly improve the administrators’ management and maintenance activity, since only through the qualified management and maintenance of water conservancy facilities can they receive larger profits. Therefore, the application of the PPP model solves the difficult problem of the diversification of the investment subjects for the construction of rural water conservancy facilities in Anhui Province, lessens the pressure of government
investment, and effectively enhances the standards of the construction, operation and management of rural water conservancy facilities as well as decrease the maintenance cost of projects operating. This basic principle of multi-type investment and privatization of management is able to increase investment in the construction of rural water conservancy facilities, promote the construction and management standards, lower everyday maintenance cost, and enhance the effectiveness of water resources.

There are three modes of PPP in the infrastructure construction of rural water conservancy villages: micro-projects for the own use of farmers, small facilities benefiting more farmers, and small-scale water supply projects for business-use. Specific information can be found in Sub-report 6.

2. Implement the Four Projects to Treat Rural Sewage

Rural water resources protection requires not only to prevent agricultural non-point source pollution but also to reduce the spreading rate of the urban sewage to the countryside and to develop sewage treatment systems in small townships and rural areas. In general, it's necessary to implement successfully the Four Projects.

The upgrading project of urban sewage treatment plants. Processed urban sewage would eventually flow into the rivers and lakes in rural areas, which could have rather serious influence on the rural environment. The processed water’s quality largely depends on the processing ability and technology of the sewage treatment plants. In 2010, there were 45 sewage treatment plants in Anhui Province, among which only five were of first level, and most of them are at the secondary or tertiary level. Upgrades are needed at all of the secondary plants to convert them to first-level plants within five years. Based on preliminary estimates, the annual capital needed for the reconstruction of sewage treatment plants is 50 million yuan and the total capital recommended is about 2 billion yuan.

The full-coverage project of urban sewage pipe network. At present, the construction of urban sewage treatment plants outnumbers that of the urban sewage pipe network, especially in some very old areas where it is difficult to construct sewage pipes because of the presence of too many complicated interest groups. Though the sewage treatment plants have been built successfully, it can never be put into operation. Therefore, it's necessary to carry out the full-coverage project of urban sewage pipe network, and the investment capital in the whole province is about 1.6 billion yuan.

The sewage treatment plant project in major townships. As rural living sewage is mainly from small towns, especially the developed ones, the key to the perfect protection of rural water resources is to treat the sewage of all the small towns. Increase the processing ability and build small-scale sewage treatment plants in townships, especially those with a population of over 20,000. The first step is to build 200 small-scale sewage treatment plants across the province and each with an investment of 50 million yuan and the total amount is in the neighborhood of 10 billion yuan.
The supporting projects for processing plants in rural industrial parks. The primary solution to rural industrial pollution is to have centralized production and sewage processing to achieve standard sewage emission and to reduce pollution to the surrounding environment. At present only a small number of rural industrial centers have sewage treatment plants, so it is necessary to set up the facilities in every rural industrial park. It is estimated that a total of 100 sewage treatment plants for the rural industrial parks is needed, and the overall capital investment is about 10 billion yuan.

VI. SUGGESTIONS ON RELATED POLICIES OF ENVIRONMENTAL PROTECTION AND TREATMENT IN RURAL AREAS IN ANHUI PROVINCE

A. Construction and Modulation of Related Laws and Regulations in Support of Environmental Protection and Treatment in Rural Areas

In consideration of providing comprehensive law guarantee for Anhui rural environment protection and pollution control priority is demanded to the following four aspects:

1. Amendment and Improvement of Regulations on Environmental Protection and Treatment in Rural Areas

Strengthen legislation and reorganization of existing laws and regulations about rural environmental protection, amend and improve Regulations on Environmental Protection and Treatment in Rural Areas. At present, in China the rules about rural environmental protection and pollution control are only scattered with very few administrative laws, such as Suggestions to Intensify Rural Ecological Environmental Protection, The State Council's Decisions to Practice Scientific Development Outlook, and Intensify Environmental Protection and Suggestions to Intensify Rural Environmental Protection. Worst of all, the legislations are of low-level, with very limited resources, and there are no operational regulations. Besides, restricted by complicated rural environment, many relevant regulations on rural environmental protection and treatment are difficult to be implemented or the results fail to reach the expected level. Therefore, China should reorganize the existing laws and regulations about rural environmental protection and further improve regulations for the protection of rural environment as well as the whole institutional environment to make it conducive to the implementation of laws and regulations.

In addition, Anhui's Environmental Protection Regulations have insufficient regulations specifically for rural environmental protection. That will influence the protection and management of rural environment to some extent. Therefore, the government of Anhui Province should revise its existing laws and regulations immediately according to its own environmental conditions and integrate those which overlap in content to perfect the legal and institutional system of rural environment
Firstly, revise Environmental Protection Laws and the Air Pollution Control and Treatment Laws, etc. Increase regulations about the subjects, responsibility and requirements of rural environmental protection. Secondly, improve regulations specifically for environmental protection of rural areas; as the major relevant regulations include Soil Pollution Control and Treatment Rules, Pesticides Management and Use Regulations, Eco-compensation Rules and Poultry Industry Pollution Control and Treatment Rules. Thirdly, revise environmental standards for rural ecological and environmental protection on the basis of the current conditions of Anhui Province, such as Rural Industrial Sewage, Waste Gas and Solid Waste Emission Standards and Pollution-free Agricultural Products Quality Identification Standards. Fourthly, integrate laws, regulations and measures for rural environmental protection with overlapping contents. We suggest integrating environmental protection laws such as Anhui Pesticides Management Approaches, Anhui Drought-fighting Rules and Rural Clean Projects Management Approaches into Anhui Agricultural Ecological Environmental Protection Rules.

2. Publicize with Great Efforts Laws and Regulations about Rural Environmental Protection

Better efforts are needed to publicize the laws and regulations concerning the rural environment protection of farmers as well as for the village and township enterprises. And to achieve this purpose, it is necessary to establish mobile teams to travel between the countryside and the enterprises based on the principle of “publicizing point by point and covering the whole province”. Besides, the publicity of these laws and regulations should be adapted to specific problems in specific areas. And such mobile teams are responsible with the rights of supervision and examination so as to improve the legal consciousness of environmental protection of farmers and the village and township enterprises in Anhui Province.

3. Intensify Law Enforcement and Set up a Unified and Efficient Working System for Rural Environmental Protection

At present, rural environmental protection involves many departments which sometimes are fragmented with conflicting policies, lacking systematic and strategic planning. On the one hand, there are no institutions and personnel about rural environmental protection in the township and village levels, so rural environmental protection and treatment remains completely ignored. On the other hand, the enforcement of rural environmental protection should be strengthened extensively and a unified and efficient working system must be set up as soon as possible. First, according to the requirements of the “Super-ministry System” reform, all duties concerning the protection of rural environment should be incorporated into the environment protection bureau for their unified management. Secondly, set up rural environmental protection stations in the township level and choose specialists from local villages to take charge of environmental protection. Strengthen the environmental protection agenda at the township and village levels. Thirdly, promote
the popularity of rural environmental protection. Establish an evaluation index system for rural environmental protection and treatment, and intensify the inspection procedures.

4. **Be Judicially Strict and Improve Management Standards Laws and Regulations about Rural Environment Protection**

On the one hand, the judicial and administrative institutions at all levels such as Department of Justice, the Justice Office, and the Branch and judicial assistants should focus attention to the supervision of the enforcement of laws of rural environment protection. Meanwhile, top leaders of the judiciary branch should keep their key inspection on their subordinate departments' work in the supervision of the enforcement of rural environment protection laws.

On the other hand, People's Court at all levels should put cases of rural environment pollution on record in time, hear them with great caution, and improve the ability to mediate civil disputes about rural environment pollution.

B. **Suggestions on Non-fiscal Policies in Support of Environmental Protection and Management in Rural Areas**

1. **Policies for Agriculture and Rural Areas**

Implement garbage classification by establishing strict rules of reward and punishment to promote recycling and utilization of domestic garbage. The scientific classification of garbage in daily life is the foundation of its recycling and reuse, and also the premise of finally disposing them in scientific ways such as burning, composting, and dumping, etc. Domestic waste such as leftover food, peel and leaves of vegetables can be directly composted for organic fertilizers without further processing. Villagers should be encouraged to collect and classify garbage to reduce subsequent workload in order to save money. Villagers who take the lead in garbage classification and recycling are immediately rewarded while those who discard garbage randomly in non-designated places receive penalties and fines.

Improve the management system through rural property management. Rural waste management institutions should be defined and empowered to make the waste management more standardized and institutionalized. In the new rural construction, rural property management is a new model put forward by the Science and Technology Department of Ministry of Agriculture in carrying out the Rural Sanitation Pilot Project, focusing on rural waste treatment and management of its utilization as resources. For separate communities in rural areas, a model based on household will be built on the basis of the village's property station, with waste classification as the key. Classified domestic waste, agricultural by-products and a small amount of straws will be processed together to produce organic fertilizers. A system of property service will be established with the village as the basic unit, farmers as the basic service recipient, and technicians of property service as the basic team. In the new socialist
countryside, domestic waste should be disposed eco-friendly by being transported carefully in clean and airtight containers with harmless processing. In this way, the perfect system of garbage collection, transportation, and processing will be set up.

Promote comprehensive disposal suitable for rural waste, and realize garbage industrialization. The promotion of comprehensive garbage disposal should be based on the following five conditions: mature and reliable technology; simple disposal facilities; small investment; convenient operation and maintenance; low cost. At the same time, establish a licensing system and a market-oriented operation system of environmental sanitation. The investment construction and operational management will be adopted which mainly deal with garbage disposal. It will operate as a professional company with a "BOT" investment mode to promote garbage industrialization, in order to promote the facility construction and operation in garbage disposal in society.

Carry out the agricultural economies of scale. Agricultural economies of scale contribute to agricultural mechanization and productivity. This will relieve the random use of fertilizers by individual farmers, thus reducing pesticide residues, producing green food, which is pollution-free, and benefiting cultivation of regional brand. The large-scale grain growers would take a more environmentally friendly and scientific way to recycle the resources and transport and destruct the waste that cannot be recycled, thus reducing rural environmental pollution caused by non-grain leaders’ careless disposal. This will prevent the "phenomenon of junk surrounding rural areas" from occurring.

Popularize advanced technology to achieve high agricultural productivity. With the development of agricultural science and technology, the traditional farming method has been unable to meet the need of modern agricultural production. The agricultural departments at all levels should vigorously promote advanced agricultural technology and coordinate these technological breakthroughs with a rural environmental protection plan.

As for the agricultural production near the water sources such as lakes and reservoirs, the government should implement stricter projects to restrict the overuse of fertilizers and pesticides, strengthen current policies and increase technical assistance, which includes promoting the use of organic fertilizers and high-efficient pesticides, and earnestly carrying out ecological agriculture.

In the mountainous areas of Anhui Province, the farmers raising livestock and poultry are scattered. The duck dropping, which is wet-manure, contributes to the pollution of the surrounding waters. It is suggested that raising ducks be forbidden in the mountainous areas, advocating instead for choosing mainly chickens and pigs which produce dry-manure easy to be cleaned.

As economic plants (like mountain walnuts, tea, etc.) tend to cause water and soil erosion, it is advisable to take effective measures (both economic and compulsory measures) to control it.

2. Environmental Policies
a. Improve the Environmental Supervision and Management System

Most villages and towns in Anhui Province are without an environmental protection agency. The environmental protection agencies in counties are in charge of the environmental supervision and management in rural areas, who cannot fulfill their tasks with inadequate regular workers or workers without enough knowledge and skills.

What is worse, the administrative department of environmental protection at the county level is ruled by government at the same level and environmental protection department at the higher level. The most important personnel appointment rights and financial power belongs to the local governments, so it is impossible for the administrative department of environmental protection at the county level to properly perform its role.

Immediate attention is needed to establish a rural environmental supervision and management system. In townships and rural areas concentrated with industrial enterprises, special environmental supervision and administration institutions should be set up with professional, qualified personnel. Environmental protection offices should be established in suitable areas to observe the change in rural environment, gradually completing an integrated system of urban and rural environmental supervision and management. A special system of environmental protection agency should be set up with unified and vertical management to raise the independency of environmental supervision and management system, referring to departments like CBRC, customs and tax, etc..

b. Perfect the Environmental Compensation System

In view of environmental economics, ecosystem is a rare and shared resource. In order to prevent "unnecessary tragedies", polluters must shoulder the cost of pollution treatment and control, which is in accordance with the internationally popular principle of "polluters pay". Simply put, the polluter bears the responsibility and cost of pollution control.

China has started ecological compensation and implemented emission trade, and it is about to levy environmental taxes. However, it is still far from satisfactory. For a long time, Chinese's underdeveloped rural areas have sacrificed large amounts of environmental resources for financial gains, which are not enjoyed by farmers, and turning into high profit and beautiful environment in urban areas. So, a complete regional ecological compensation system should be set up. The procedure includes collecting environmental compensation taxes from those who benefit from the urban areas and eliminating the possible benefit from pollution transfer. Also, governmental transfer payments need to be made use of to treat rural ecological environment and assist in curbing urban pollution transfer into rural areas.

A taxation and penalty system must be implemented to improve the rural ecological environment and compensate farmers. The government should build large pollution treatment facilities for the disposal of the so-called "three wastes" (waste gas,
waste water and waste residues). Small township and village enterprises, which are unable to purchase the anti-pollution equipment, can procure a loan from the government and pay for the pollution fee according to their emission amounts.

In addition, the developed areas should compensate for the environmental cost of under-developed areas. For example, Lu’an is the water source for Hefei, but because of its undeveloped economy, it would lack the ability to treat environment pollution if without the environmental compensation mechanism.

c. **Promote the Establishment of Environmental Construction Project**

The environmental protection and treatment of Anhui Province can be divided in accordance with regions, while the projects are to be approved on the basis of regional division according to pollution category. They must be applied by enterprises and government agencies to Anhui Provincial Environmental Protection Bureau and Anhui Provincial Department of Finance. The projects should be assessed by the technology experts organized by the Anhui Provincial Environmental Protection Bureau and the Anhui Provincial Department of Finance. Moreover, opinions of all involved should be heard and documented and public supervision be accepted in order to evaluate the projects and make public the evaluation results.

Anhui Province can be divided into three water basins (Xin'anjiang River basin, Huaihe River basin, and Chaohu Lake basin), each having its own pollution degrees and characteristics. Enterprises and government agencies can apply for projects according to local conditions. For example, in Chang’an Town, Ji’xi County, projects such as comprehensive environmental control in Feng village and sewage treatment with new micro solar power in Xixi’nan and township garbage disposal and operation can be applied respectively by town government and Housing Construction Committee, etc. Thus pollution control can be carried out with clear pertinence and responsibility, in order to enhance rural environmental pollution prevention and control.

d. **Innovate New Environmental Planning Policies and Remove the Divided Urban-rural Environmental Management System**

In dealing with the environmental problems, China has been adopting the dual system characterized by “government-oriented in cities while farmers-oriented in rural areas”. Guided by the thought of “the integration of urban and rural development” put forward at the 18th National Congress, related governments should unify urban and rural environmental management system to make all subjects equal in the use and protection of environmental resources and enjoy the same rights and responsibilities and take the same responsibility in preventing environmental pollution and improving environment.

The government should perfect environmental compensation system and ensure that those affected by environmental pollution can receive timely help and ecological
environment can be recovered effectively, carry out unified urban and rural environmental standards and set up unified environmental certification system and increase the transaction cost for industries to treat rural environmental pollution and ensure that urban and rural areas enjoy the same restrictions and supervision from laws. To achieve this purpose, it is necessary to set up and perfect rural environmental protection institutions and in those above county or district levels there must be specific departments to take charge of the cause, while the village level should be equipped with full-time or part-time personnel of environmental protection and management to increase the ability in rural environmental protection. Besides, it needs to set up and perfect the foundation of rural environmental supervision and statistics, intensify environmental evaluation during the process of rural industrialization, cultivate civil environmental protection organizations in rural areas, and give full play to social intermediary organizations and promote environmental control and supervision.

3. **Land Policies**

   a. **Speed up Land Circulation**

   China's long-standing agricultural development mode based on small-scale decentralized management will no longer suit the needs of sustainable development. Anhui Province is no exception. Speeding up the rural land circulation and achieving economies of scale has become the inevitable choice of China's agricultural development. Not only is it important in solving the problems of the rural land and the advancement of the economic development in Anhui Province, but also in alleviating the rural ecological destruction and environmental pollution with benefits as follows: reducing the waste of resources and soil erosion; cutting pesticide residues to improve food safety; facilitating concentrated disposal of waste; lowering air pollution to promote the recycling of renewable resources; reducing land abandonment to improve land utilization; and promoting advanced technologies to save water for irrigation. Therefore, as for Anhui rural environmental protection and management, the first thing to do in land policies is to speed up land circulation. The suggestions are as follows.

   (1) The policy document No. 1 of 2013 from the central government of China should be strictly implemented to encourage land transfer from contracted farmers to specialists, family farms, and farmer cooperatives to develop the operation in multiple forms. Public media ought to be utilized to further publicize the spirits of CPC’s 18th National Congress in land circulation to gain popular support. Special attention should be paid to improve the awareness of grassroots civil servants, making them realize that land circulation is the useful approach to develop modern agriculture, increase income and broaden employment channels.

   (2) Fiscal support should be increased to explore various forms of land circulation. Specific ways need to be explored to achieve a sustainable and everlasting land contraction relationship. Specific funds need to be established and
subsidies should be increased according to the construction of farmlands. Financial awards can be given to farmers and operators involving in rural land circulation. Encourage farmers to take part in land circulation through subcontracting, transferring, leasing, exchanging, and becoming shareholders, so as to solve the problem of fragmentary contracted land. Agricultural scale management needs advancing and modern agriculture needs developing. Agricultural non-point source pollution should be controlled to improve the quality of agricultural products.

(3) The licensing system should be set up in order to guide industrial and commercial enterprises and social capital to take part in land circulation. Industrial and commercial capital can be encouraged to promote land circulation in forms like “leading enterprises + cooperatives + farmers” and “leading enterprises + bases + farmers”. Industrial and commercial capital should be guided to play an active role in promoting agricultural transformation, broadening farmers' employment channels and increasing their income. In this way, farmers’ land rights will be secured, land functions unchanged and the comprehensive agricultural productivity unimpaired.

(4) The transaction platform of land circulation should be established and its procedure needs standardization through perfecting the service network of land circulation at the township, county, and village levels and exploring the construction of trading platforms as well as a series of supporting services such as information release, price evaluation, rent index, and trade intermediary. Communication, policy consultation, contract signing, and price evaluation should be strengthened. The procedure of land circulation should be normalized. The construction of a mediation and arbitration system should be enforced to solve conflicts and ensure a harmonious and healthy development of a system of land circulation.

(5) The social security system should be improved and population transfer should be quickened. The social security system in rural areas involving governments, collectives and individuals should be improved, which includes pension, employment and living allowances of farmers. The social security standard needs to be improved to lessen the anxiety brought about by the transfer of the management rights of the contracted lands. Secondary and tertiary industries in rural areas should be developed vigorously. The training of the transferred labors should be strengthened and the ability to transfer to other industries needs improving. More agricultural population should be encouraged to work and live in urban areas in order to create advantageous conditions for land circulation.

b. Promote the Rural Land Remediation

Rural land remediation is an important platform and breakthrough to promote urbanization, industrialization, and agricultural modernization. Anhui Province should pay great attention to the rural land remediation and the construction of high-standard farmlands, and further strengthen the protection of cultivated land. Therefore, suggestions for specific policies are as follows.

(1) Governments at all levels must, in accordance with the principles set up by Anhui Provincial Government, build a leading team to promote, plan and coordinate rural land remediation with well-defined objectives and clear-cut responsibilities to
establish a system in which the government give guidance, Ministry of Land and Resources lays the foundation, related departments and villages and towns cooperate, and farmers participate.

(2) A scientific plan should be made for land to be regulated. At present, Anhui Province has made several plans to guide the rural land remediation in the whole province such as The Plan on Land Remediation Project in Rural Areas in Anhui Province (2010-2020), The Plan on Land Remediation to Promote Agriculture in Anhui Province, and The Plan on Land Remediation in Anhui Province (2011-2015). Quanjiao County, Chuzhou invests nearly five million yuan to compile The Plan on Distribution of Villages in Quanjiao County, planning 80 permanent residential areas and some transitional residential areas. The governments of other counties and cities should do some similar planning based on the needs with appropriate adjustments to form a complete system.

(3) The planning of industrial parks in counties should be made to stop urban pollution from spreading to the rural areas. The related government should follow the development concept of ecological circular economy and the agglomeration effect to plan scientifically the distribution of industrial parks in counties to completely solve the problems of scattered distribution, large areas of pollution, and difficulty in management. Also, it needs to adopt the new type of industrialization and put into effect the national policy of industrial development. Those enterprises should be eliminated which have the potential to cause excessive waste, environmental pollution, products with poor quality, and which lack the equipment for clean production. The related government should accelerate the technical transformation of traditional industries, adjust and optimize industrial structure, reduce the number of labor-intensive, energy-consuming and pollution-inducing primary industries. The technology-intensive industries with low energy consumption and pollution should be developed. Strengthen the infrastructure construction in industrial parks and stop urban pollution from spreading to the rural areas. Allocate and perfect the infrastructure and pollution treatment facilities to achieve a centralized supply of water, power, and heat and to improve the efficiency of energy utilization. We need to adhere to the policy that the measures of pollution prevention and the main project are simultaneously designed, constructed, and put into production in regional economic development.

4. Energy Policies

a. Policy Suggestions on Transforming the Rural Energy Consumption Pattern

According to The Comprehensive Plan on Ecological Construction in Anhui Province and The Plan on Development of Clean Energy in Anhui Province, new energy and renewable energy should be developed and high-efficient and clean energy should be actively promoted. Energy structure should be adjusted to increase the percentage of clean energy with high quality in energy consumption in rural areas,
from 16% in 2011 to 30% in 2015. The policy suggestions are as follows.

(1) Improve the feasibility, consistency, authority, seriousness of development planning, and avoid conflicting regulations from different departments to make sure that the plans are unified. Gradually carry out different rural energy projects according to different situations in different areas. Plan and guide different projects according to different natural and economic conditions in different areas to avoid eagerness for quick success and instant benefits. The government should integrate the project funds in similar projects with unified policies, subsidiary standard, and management measures.

The annual development plans should be connected to mid-term plans to make clear and practical procedures. According to the goals, while implementing the project, related departments in charge should put great emphasis on deployment and organize the experts to evaluate the effect. In some areas which need to change the plan due to the limitations in objective conditions, the authority should be decentralized to local governments in order to finish the annual plan to the best.

(2) Encourage the development and application of efficient energy by social forces and enterprises. According to the issued plans and requirements on development and application of rural biomass energy, related provincial departments should enact specific implementing ideas and management methods according to local conditions as a performance standard for local governments. Improve and implement related preferential policies on finance, taxation, and price, and encourage the social forces and enterprises to participate in the construction of biogas projects and utilization of straw as energy. Explore actively the modes of market operation and push forward the efficient development of biomass energies such as straws to increase the supply of clean energy.

In biogas construction in rural areas, the development mode of feces as the focus of materials for fermentation should be changed in order to promote a new mode with straw, water grass, and organic domestic waste as the focus of materials for fermentation and give full play to methane tanks in rural areas. Besides, solar energy and water energy should be encouraged to use and corresponding implementation plans should be issued to strengthen the comprehensive utilization of solar energy in rural areas, such as the project of using solar energy for hot-water. At the same time, water conservancy projects should be built in Xin'anjian River basin and Huaihe River basin with the local conditions taken into consideration to take advantage of the hydraulic energy and improve the energy utilization in rural areas.

b. Policy Suggestions on Changing Rural Energy Consumption Structure

According to the requirements and goals of *The Plan on Energy Development during the Twelfth Five-year Plan Period in Anhui Province*, the suggestions on changing rural energy consumption structure are as follows.

(1) Speed up the development of wind power generation. Grasp every opportunity brought by the support from central government on the advanced technology and development of wind power and strive for national projects and funds
to build large and medium-sized wind power factories. It is suggested to provincial financial departments arrange special funds to develop small pilots for wind power application in rural areas where there are rich wind resources along the mountains, rivers, and lakes. The government should support the demonstration projects of small wind power generation to increase electricity supply in rural areas.

(2) Popularize and promote the rural solar water heater. The activities like Household Appliances to the Countryside launched in November 2012 by both Department of Commerce and Department of Finance will end soon. Such activities can provide subsidies to farmers who buy solar water heaters. It is suggested to similar policies should be launched more to promote the rural solar water heater.

(3) Establish and improve the service system of rural energy technology. It is suggested to increase the coverage of the service on the basis of the original system. Strengthen the construction of technical service team, and improve related incentive policies. Strengthen the capacity of the rural energy management department at the county level to assist in solving the bottleneck problems of human and financial resources shortage. Make sure that the renewable energy should be developed and utilized in a sustained and healthy way.

c. Positively Provide Policy Support for Renewable Energy Bureau

Xuancheng, Anhui Province has set up Rural Ecological Energy Bureau developed from the original Rural Energy Office. In the bureau there are three administrations that assist at the middle-level: office, department of rural energy, department of agricultural environmental protection. Their main responsibilities are as follows. First, implement strategies on the construction and development of rural energy, construction of agricultural circular economy, and protection and management of agricultural ecological environment and make mid-term, long-term and annual plans. The rural areas should be led to comprehensively develop and utilize renewable energy and be given directions on the development of the biomass industry and rural energy. Secondly, implement strictly policies of rural energy, agricultural ecological environment protection, and circular economy. Thirdly, organize and guide the treatment of agricultural non-point source pollution and energy conservation with emission reduction. The government should take the responsibility of doing investigation and research on the construction of such issues as rural energy, agricultural ecological environment, and agricultural circular economy. Implement and supervise the construction of relevant projects.

Anhui Province should promote the construction of rural ecological energy bureaus in rural areas and encourage cooperation within the whole province. It should also strengthen the coordination and cooperation based on fulfilling the respective roles to regulate appropriately rural energy utilization within the whole province.

5. Policies on Water Resources
a. Policy Measures on Rural Water Resource Protection

Sustainable development of the water resources in rural areas is a prerequisite for stable development of agriculture. Following the guideline of optimal allocation and the principle of rational utilization and scientific management, the government should strengthen the utilization efficiency of water resources and guarantee the sustainable development of agriculture in Anhui Province. The sustainable development of water resources in rural areas should focus on the following aspects.

Embrace sustainable development of water resources. Compared with cities, publicity on saving water in rural areas is inadequate. The relevant departments should focus on publicizing saving water in daily life and production and extensive education must be achieved on the knowledge of rural water resources in rural areas.

Improve the traditional agricultural irrigation facilities. Update the out-of-date water conservancy facilities. The seepage control or the use of tubes instead of the drainages must be undertaken. The technologies of spray irrigation, micro-irrigation, drip irrigation, and other water-saving technologies must be adopted.

Protect the current water resources in Anhui Province. Adopt a combined method of water conservation and water pollution treatment. Firstly, the sand exploitation in nearby rivers and over-exploitation of water resources by village enterprises should be strictly controlled to prevent the dropping of the underground water table. Secondly, the release of the pollutants must be controlled to prevent water pollution.

Develop water-saving crops according to local conditions. Different crops require different amount and demanding regularities of water. According to different conditions of water resources in different areas, reasonably arrange different crops and optimize the water resources to achieve the best effect.

Make full use of natural precipitation. Certain engineering measures can be taken to collect rain runoffs, such as increasing the infiltration by retaining (as in the case of terrace) or reducing evaporation with the aid of covers and mulches. The rainwater can also be stored through convergence, which can be put into active use in the critical period of crops when they need water.

b. Policy Measures on the Construction and Management of Rural Water Conservancy Project

Considering the current problems, in the design, construction, construction management and operation of new rural water conservancy projects, the following points should be noted:

Make long-term plans and strictly guarantee the quality. Early in the project construction, there should be a unified design with long-term goals, combining the new construction with existing structures to maximize the benefits. From the initiation of the project to the management after its completion, quality must be strictly guaranteed in every period.

Establish farmer-participatory management mode and ensure sustainable use of the project. "Participation" reflects the empowerment for grass-roots groups, so
farmers' participation in management is to play their role as the main body. It is a very effective way to realize the sustainable and profitable development and to solve problems produced in management system in rural areas.

Strengthen the understanding and implementation of engineering management. The assets of small-scale water conservancy projects must be transferred in time to the relevant units and individuals. These units and individuals should be issued with certificates of title or certificates of the right of use. The management can be realized in many forms such as professional management, auction management, and individual contract to form effective mode of operation, management and protection suitable for local conditions and types of projects. Once completed, the new and old water conservancy projects rotate around a benign orbit.

Develop human resources of rural water conservancy project management. In order to meet the requirements posed by the job position and the market, plans should be drawn step by step to choose talented people to pursue further advanced studies. Workers should be encouraged to do on-the-job learning to improve the overall quality of the human resources. Appropriate technical division of water and technical personnel in county (district) need to be carried out to make clear the respective areas where one should focus on. Try to make experts as soon as possible out of current staff members in water conservancy, soil and water conservation, water resource management, geology and underground water, executive enforcement of water law, and financial management. At the same time, the training of township water conservancy technical staff must be enhanced, too.

Improve the monitoring methods to assist and enhance observations. In order to improve the monitoring methods, the purchase of new, updated inspection instruments and testing equipment is necessary. The quality of materials and construction must be inspected via comprehensive inspection or sampling inspection. By different inspecting methods such as actual measurement and actual tapping, the accurate, objective, impartial monitoring data must be obtained to make the quality monitoring more convincing and reduce or avoid errors, disputes, and conflicts in the evaluation.

Establish and apply diversified rural water conservancy engineering. Individuals are encouraged to invest in and benefit from small water conservancy projects. The committee should deal with one problem at one time through discussion.

Construct and manage water conservancy associations. Water conservancy associations are "owners" who manage small water conservancy projects during the construction of new socialist countryside. Farmers can join the water conservancy association voluntarily. Through the management of the associations, farmers' enthusiasm can be promoted and their abilities in management of small water conservancy projects in rural areas are strengthened.

6. Policies in General

What the policy suggestions on agriculture, environment, energy, water resources and land have in common are called policies in general, which are as follows.
a. Incorporate the Rural Ecological Protection into the Performance Evaluation Index of Government at All Levels

Anhui rural economic and social development lags far behind that in the urban area, demanding faster development. However, it cannot be achieved at the expense of the environment. We must embrace sustainable designs to keep a balance between economic development and ecological protection and reduce the damage caused by economic development.

In addition, it is necessary to develop the target system of Anhui rural ecological construction and incorporate it into the performance evaluation system of people's governments at all levels of Anhui Province. The evaluation results will be considered as an important part of the overall evaluation of its leaders and must be taken into serious consideration when deciding on the appointment, management, and supervision of the leaders. The One-Vote-Veto principle should be adopted for environmental protection. For those areas which fail to fulfill the tasks of environmental protection and management, regional restrictions should be imposed to suspend the examination and approval of all the projects except livelihood projects, projects of energy conservation and emission reduction and projects of eco-environmental protection. Leaders involved should be held responsible.

b. Strengthen the Training and Popularization of Rural Environmental Protection to Improve Farmers' Environmental Awareness

The rural environmental protection calls for active participation of farmers who should play a major role in the pollution prevention and control. With Hefei as the center, mass media such as radio, television, and the Internet must be employed to effectively promote environmental protection, to raise the people's awareness on pollution controls, rules and regulations towards the rural environmental protection, and to promote agricultural science and technology.

Altogether there are 31 undergraduate academies, 11 independent colleges, and 68 high vocational (junior) colleges in Anhui Province. The human resources in those colleges and universities should be actively utilized. Campaigns should be carried out in a large scale to encourage college students to go to the rural areas to publicize the rural environmental protection in order to increase the consciousness and awareness of residents and students in rural areas of the significance of rural environmental protection.

c. Strengthen the Public Supervision of Rural Environment

The public supervision network of environmental protection and pollution control needs to be established and perfected.

Environmental legislation should guarantee the legitimacy, supervision and reporting information to the public.
Effective, transparent, and open channels must be developed for the public to solicit opinions and give feedback.

The role of mass media must be utilized to assist in the supervision of rural environmental protection.

C. The Suggestions on Fiscal Policies in Support of Rural Environmental Protection and Management

In the new circumstances, in order to better protect and treat the rural environment with the fiscal support, innovations in the ideas must be made and comprehensive measures must be taken in both the system and the policy to bring the finance into full play. Judging from Anhui's actual situation in the “12th Five-year Plan” period, the fiscal support in the rural ecology protection and environmental management should be based on its own situation and gain support of central reform in fiscal and tax system. Besides, the government should guide more social investment and form the coordination situation. The detailed work should be as follows.

1. Policy Measures must be Taken to Ensure Constant Growth in Financial Investment for Rural Environmental Protection

The preservation of a beautiful and clean rural environment is a typical public resource shared by all members of society. Thus government should be the major source of financial funds, which are spent on the protection and management of the rural environment. In recent years, the funds are small in scale with limited coverage. A systematic, standard, and guaranteed mechanism of fiscal support has not been established.

For the rural environmental protection and management, consistent financial input must be a foundation. The improvement of the rural environmental fiscal and tax policies, the tax reform on rural environment, and the broadening channels of rural environment input are the three basic steps necessary to build a steady mechanism of fiscal support in rural environmental protection.

Set up special funds and incorporate rural environmental protection into the people's livelihood. For example, set up items on expenditures of rural environmental protection and management. Increase the investment. Establish a mechanism ensures simultaneous growth of the expenditure with the GDP. To fully carry out The Decisions on Promoting the Construction of Beautiful Villages in Anhui Province, Anhui provincial government has set up special funds for the construction of beautiful villages, which will guarantee the input of one billion yuan with an increase every year for the next five years from 2013. All cities, counties and districts should also establish special funds. In principle, each city should invest no less than 50 million yuan and each county and district should invest no less than 10 million yuan. The rural environment protection and management is of prime importance in the construction of beautiful villages. So it is suggested to set up an item for environmental protection in special funds for the construction of beautiful villages and guarantee the investment in
rural environmental protection.

Broaden the financing channels of rural environmental protection through inviting social capital investment. Measures such as subsidies on interest payments, rewarding and guaranteeing can be taken to encourage financial institutions to increase input should be invested into rural environmental protection and management, such as the project of important infrastructure in rural environment, industrialization of agriculture with large scale, rural circular economy and agriculture with ecological tourism to attract more social capitals.

The current financial input in Anhui Province mainly relies on fiscal support from the government. The lack of diversity in the source of investment means the failure to cover every aspect of rural environmental protection. Fiscal measures must be improved. The financial participation and social investment are needed to broaden the financial resources. Financial participation involves two aspects. On the one hand, the functions of rural policy banks should be strengthened and the guarantee system of investing and financing should be built. Also, bonds of the infrastructure construction of rural environmental protection can be issued to some extent. On the other hand, Anhui needs to strengthen its cooperation with international financial organizations and actively apply for projects to strive for support from these organizations. Social investment includes industrial and commercial capitals as well as nongovernmental capitals, which should be developed in the form of investment, donations, and constructions.

Carry out the reform of rural environment taxation and establish the system of rural ecological compensation transfer payment. According to The Development Outline and Fiscal Development during the Twelfth Five-year Plan Period of China and the current situation of rural environment, Anhui Province should set up the system of rural environment taxation. The feasibility of the system on the protection and management should be studied in accordance with the principle of “polluters pay”. Taxes on environmental protection should be charged in an appropriate time, focusing on rural environmental protection and management. The sewage fee system should be perfected in industrial and agricultural production, as well as the daily lives of the farmers. Study the system of fee for pollution treatment, such as the overuse of fertilizers and pesticides, the discharge of excrement of livestock and poultry, and special domestic waste, and perfect the system of pollution prevention and management in rural areas.

At the same time, the horizontal system of rural ecological compensation transfer payment should be established within Anhui Province. The vertical transference payment needs to be advanced towards the rural areas with large populations, major agricultural province, and underdeveloped provinces. The transfer payment system in key ecological function zones should be improved. Attempts should be made to build a horizontal system of rural ecological compensation transfer payment between the provinces and within Anhui Province. For example, the transference payment system of Zhejiang Province towards southern Anhui Province, Hefei towards Dabieshan mountainous areas in southern Anhui Province, the significant zones for conservation of drinking water sources like Chaohu Lake, and ecological preservation areas in
southern Anhui Province and Dabieshan mountainous areas. In this way, people there can be compensated for their sacrifices and needs of life.

Based on those reforms mentioned, Anhui Province also needs to actively accelerate experimental reform of taxation system in pilot areas to strive for technological and financial support from the central government.

2. **Reforms must be Deepened to Define Government Funding in Terms of Its Environmental Responsibilities**

The establishment of scientific and reasonable tax sharing system to define government funding in terms of its environmental responsibilities is the key to making clear-cut fiscal responsibilities of governments at all levels and the financial responsibilities of governments at all levels and ensuring the smooth operation of ecological protection and environmental management in rural areas. According to the Anhui Province should make efforts to promote the reforms from the following two aspects.

Firstly, clearly define the responsibilities of the governments at all levels and the responsibility of fiscal expenditure, and perfect the grassroots financial mechanism to make sure that the fiscal expenditure is transferred to the grassroots and the right of property is adjusted appropriately to the administrative power. The responsibility of the rural environmental protection and management should be mainly assigned to three levels of the county, town, and village. According to the principles of “governments at each level possess the authority and the right of property and take the responsibility at each corresponding level” and the principles of profitability, ranks, and economic externalities, Anhui Province should reasonably divide the responsibilities of the governments at each level. As for the division of responsibilities in rural environment protection between central and local governments, it is commended that the central government should take the full responsibilities of the protection and management of the large rivers such as the Yangtze River, the Huaihe River, and the Xin'anjiang River, as well as the ecological protection of the mountainous areas in southern Anhui and the Dabieshan Mountain. While Anhui Provincial Government should be in charge of the protection of such large lakes as Chaohu Lake and other environmental tasks that can’t be handled by municipal government. Then each municipal government should be in charge of the environmental protection in the rural areas of each city and it can also decentralize its responsibilities to districts and counties in the city. For the tasks of rural environmental protection assigned by the provincial government, the provincial government should assume more than 90% of expenditure to alleviate the financial pressures of the grassroots and take active measures to ensure grassroots financial security and try to get the rewards from the Ministry of Finance to Anhui Province in tax system, the proportion of tax sharing, and tax returns. At the same time, Department of Finance in Anhui Province should ensure the fiscal resources of every city, district, and county and establish a comprehensive system of financial incentive rewards.

Secondly, establish incentive mechanisms. As the main body of the market, enterprises and farmers are both the polluters of rural environment and the direct
beneficiaries of rural environmental protection. Since the main body is very special, enterprises should allocate a certain amount of capitals from the sales revenue in order to treat the pollution caused by resource exploitation and the discharge of waste gas, smoke, sewage and waste residues to realize zero emission according to the principle of “saving the costs”. On the other hand, farmers should pay the fees for rural environmental protection and a certain amount of property management fees, which are learnt from urban management, in order to protect the rural environment and treat the pollution according to the principles of “paying by polluters and suitable responsibilities of farmers”.

3. Fiscal Expenditure must be Optimized to Enhance Fund Efficiency

The fiscal input and the finance-leading input are both faced with great pressure since a large amount of money are needed in rural environmental protection and pollution treatment. So it is important in fiscal expenditure to optimize the use of funds by improving the efficiency as well as broaden the sources and enlarge the financial input.

Firstly, highlight investment for rural environmental protection. Anhui’s fiscal input toward the rural environmental protection should comply with the principles of “orderly channels, unchanged usage, respective contribution and integrated strength”. Integrate the investment for rural environmental protection and other agriculture-related funds with a larger scale to make a more planned, targeted, and operable system for fund integration. Then, according to the principles of “comprehensive consideration, highlighted focus, and combination of short-term and long-terms needs”, the annual plan about how to use the funds for rural environmental protection, with the capital investments as the focus. In the next five years, according to different methods and contents of rural environmental protection and management, Anhui Province should put the projects as the investment focus such as safe drinking water, clean villages, tidy villages, continuous management of rural environment, management of non-point source pollution and key rivers in Anhui Province, and ecological protection of forests. Establish the relevant system of special fiscal expenditure to promote the measures in environmental protection and management in rural areas and improve the efficiency of use of funds.

Secondly, innovate expenditure mode of rural environmental protection funds. According to the requirements of public finance, Anhui Province should establish clear-cut systems to sharply define the relationship between the governments’ fiscal input and the inputs from farmers as well as other social groups and make clear the investment scope for each. As for construction of large rural environmental infrastructure that covers different areas, the government can directly invest with the fiscal input. As for small- or medium-sized projects for rural environmental protection, discounted loans, guaranteeing, BOT (Build-Operate-Transfer), TOT (Transfer-Operate-Transfer), PPP (Public-private partnership), and PFI (Private Finance Initiative) should be chosen to conduct the construction. With the innovation of expenditure mode, the sources of financial capital can be broadened, its utilization
efficiency can be improved and the construction mode of infrastructure of environmental protection in rural areas can be enriched, thus improving its comprehensive efficiency.

4. **Financial Support must be Built to Develop the Sustainability of Projects for Environmental Protection in Rural Areas**

   During the “Twelfth Five-year Plan” period, Anhui Province needs to further perfect the supportive fiscal policies. Put more emphasis on “construction and management” based on the construction of new projects. Make full use of and develop the sustainability of current projects for environmental protection in rural areas to reduce the repeated expenditure of fiscal investment and guarantee the quality of the projects.

   Firstly, support policy measures that can improve the quality of project construction. With increasing prices and wages in recent years, the material and labor costs needed in the construction of projects for rural environmental protection have been experiencing continuous increases. The investment standards, fiscal input, and punishment and reward systems need to be increased accordingly so as to reduce grassroots and farmers' financial burden and avoid "jerry-built" or "uncompleted" project due to shortage of capital. With the premise of adequate investment in the construction of projects for rural environmental protection and guiding principles of perfection, enhancement and improvement, the width, depth and time of the projects should be expanded to improve the quality of the projects for rural environmental protection.

   Secondly, establish effective system of long-term management of funds for rural environmental protection. Department of Finance of Anhui Province should enhance the measure of the funds needed in management and protection of the projects for rural environmental protection to solve the problem of shortage of funds in current projects. The government should appropriately arrange funds in fiscal management and protection and funds guiding subsidy according to the principles of “act actively, realistically and separately” and set up effective system of long-term management with shared fiscal responsibility and public participation. At the same time, the mode of “market-orientation and socialized operation” should be established and various forms can be taken such as rent, auction, and contracting. Those with the rights to use and operate should fulfill the tasks of management and protection, thus establishing a service system of management and protection of the projects with public participation, which is special and social.

5. **Financial Security must be Ensured to Improve Comprehensive Performance**

   Anhui Province has formed and will further form a series of fiscal policies supporting the rural environmental protection, which will form a complete system of fiscal policies. As a result, the effective supportive measures are a strong guarantee for fully playing the role of various policy measures.
Firstly, implement a performance evaluation of the use of policy capital. The system of the performance evaluation of investment in rural environmental protection should be set up according to the requirements of promoting the budget management of fiscal performance. The pilot of performance evaluation of projects of environmental protection and management in rural areas should be implemented and the results should be an important basis for the budget and project application of the provincial departments in the future. The methods to evaluate the performance of investment in rural environmental protection should be developed, taking capital investment, capital integration, capital management, implementation effect and organization guarantee into consideration. Then the results should be taken as an important factor in capital transfer and money paid from provincial government to local governments, and in arranging capitals and rewards from “using rewards to replace subsidies”.

Secondly, perfect supervision and inspection mechanisms. The provincial finance should strengthen the supervision and inspection with regular or irregular standardized management and inspection. The grassroots fiscal departments, especially those in towns and villages, should be given authority to fully play their role in supervising and inspecting the nearby areas. Get monitoring departments, audit departments, and social intermediaries into the supervision and inspection and perfect the mechanisms of publicizing the use of policy capital and peoples’ participation. Accept public supervision to form the supervision systems including daily fiscal supervision, special supervision from monitoring and audit departments, and the democratic supervision. The whole process should be supervised where the misconduct will be seriously punished to guarantee that the policies have been fully implemented and the budget put into good use.

D. The Budget for Improving the Eco-environment in Rural Area (for Five Years)

According to the basic principles of economics, the equilibrium point of supply and demand is the reasonable scale of the investment in forecasting the scale of financial contributions on environmental protection and management in rural areas in Anhui Province. Due to the theoretical and practical restrictions, however, only a simplified forecast will be made.

1. The Restrictions on the Measurement of the Cost Required for Rural Environment Protection

Theoretically speaking, the cost required for the rural environment protection and the damage compensation to the ecology constitute the total demand of the financial inputs in protection of the rural environment. However, now the international researches are only conducted on the cost of the whole ecological environment, with no detailed studies on rural environment protection. In March of 2004, the Environmental Protection Administration and Statistics Bureau of China carried out the estimation of the losses due to pollution in the investigation of the green national
economic accounting protocols, with the results published in *Study Report 2004 for Green National Economic Accounting* for the first time in 2006. Adopting the assessment methods of measuring management costs and losses due to pollution, the study took the virtual management costs and ecological digression costs into its consideration. However, the study didn’t cover the depletion of the natural resources and the losses from ecological digression costs due to environmental loss, due to the limitations from the basic data and technology. As for the cost from the environmental loss, the study only accounted 10 items with underestimation. Therefore this research does not take into account the measurement of environment protection costs in rural areas.

2. The Calculation of Financial Input in the Rural Environment Protection Based on the International Experience

Simon Kuznets’ Inverted U-Theory holds that, at the beginning of economic development, the environment deterioration correlates positively with the GDP per capita; but when GDP per capita increases to a certain level, the two begin to correlate inversely. The World Bank, in 1997, put forward its international empirical experience: when the proportion of the input in treating environmental pollution in GDP reaches 1% to 1.5%, the deteriorating trend of the environment can be controlled; while it reaches 2% to 3%, the environment quality can still be improved. At present, the proportion in Anhui Province reaches 1.6% and the deterioration trend is still controllable. According to *The Plan on Making Anhui Province A Major Ecological Province*, fundamental improvement in rural environment must be achieved by 2016. According to *The Plan on National Economy in Anhui Province During the Twelfth Five-year Plan Period*, Anhui’s GDP should reach 2450 billion yuan, achieving the goal of doubling GDP by 2015. Meanwhile, judging from international experience, the investment in treating environmental pollution in Anhui Province must reach 2% of the GDP, namely over 49 billion yuan. If dividing the inputs half and half between urban and rural areas, the rural areas will get 24.5 billion yuan in 2015. If mainly calculating fiscal input, that is, the financial input is accounted for about 70% to 80% of the whole input in rural environmental protection, the fiscal input in rural environmental protection will reach 17 to 19 billion yuan in Anhui Province in 2015.

3. The Correction of the Scale of Fiscal Input in Rural Environmental Protection Based on the Increase of Expenditure

The increase of financial expenditure available is the fundamental guarantee in increasing expenditure on rural environmental protection. According to the requirements of building a major ecological province and beautiful villages, as well as the target of rural eco-environmental protection and investment in environmental management during the “Twelfth Five-year Plan” period, the ratio of fiscal expenditure on environmental protection in the whole fiscal expenditure and that of fiscal expenditure on environmental protection in rural areas in the whole fiscal expenditure on environmental protection should increase a lot. According to it, three
hypotheses are proposed in calculating the plan assessment. The first plan is relatively steady. The second will be moderately active. The third is very active.

Table 6-1: Calculation of Three Plans of Fiscal Input in Rural Environmental Protection in Anhui Province in 2015

<table>
<thead>
<tr>
<th>Plan</th>
<th>Fiscal Expenditure</th>
<th>2010</th>
<th>The Ratio of Fiscal Expenditure on Environmental Protection in the Whole Fiscal Expenditure</th>
<th>Fiscal Expenditure</th>
<th>2015</th>
<th>The Ratio of Fiscal Expenditure on Environmental Protection in the Whole Fiscal Expenditure</th>
<th>The Ratio of Expenditure on Rural Environmental Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady Plan</td>
<td>2566.9</td>
<td>2.52</td>
<td>5000</td>
<td>5</td>
<td>50</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>Moderately Active Plan</td>
<td>2566.9</td>
<td>2.52</td>
<td>5000</td>
<td>6</td>
<td>55</td>
<td></td>
<td>165</td>
</tr>
<tr>
<td>Active Plan</td>
<td>2566.9</td>
<td>2.52</td>
<td>5000</td>
<td>7</td>
<td>60</td>
<td></td>
<td>210</td>
</tr>
</tbody>
</table>

Note: due to the lack of statistics, the data of fiscal input in rural environment protection is not used for calculations of the plans.
From the above analysis, it can be assumed that the fiscal input in rural environmental protection and management in Anhui Province will have been about 16.5 to 20 billion yuan by 2015.

E. The Suggestions on Establishing Public Service System (with Governments at All Levels Taking Their Corresponding Responsibility)\(^\text{11}\)

Supporting Environmental Protection and Management in Rural Areas

1. A Public-service Function System of Rural Ecological Environment Protection must be Established with Clear Demarcation of Responsibilities.

   Firstly, set up environmental protection bureaus with professional environmental workers in governments at township level in Anhui Province and incorporate them as civil servants. Secondly, establish environmental protection offices with professional environmental workers at each village. Thirdly, build rural environment monitoring stations in every town with full-time personnel and monitoring equipment. Fourthly, reallocate idle staff in sprawling environmental protection departments to town’s environmental protection bureaus and village’s environmental protection offices.

2. Rural Ecological Protection must be Advanced on the Model of “Combination of Governments and Farmers”\(^\text{12}\).

   Firstly, based on “problem-based democratic discussion” of village councils, set up the participation mode of “one person from each family” in rural environmental protection. Secondly, grassroots environmental protection agencies must assume corresponding responsibilities in actively promoting rural environmental investment, supervision, and infrastructure building as well as legislation.

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\(^{11}\) With Governments at All Levels Taking Their Corresponding Responsibility: A vertical system of division of responsibility with governments at all Levels taking their corresponding responsibility as the focus.

\(^{12}\) Combination of Governments and Farmers: Combination of guidance by governments and farmers’ needs.
3. **Construct Public-service Supply for Rural Ecological Protection with Diversified Investment**\(^{13}\).

Firstly, establish long-term transfer mechanism of rural ecological environment in Anhui Province. Secondly, levy pollution fees on rural pollution enterprises and farmers according to varying degrees of pollution and punish those with serious pollution. Thirdly, charge a minimal sanitation fee according to the population of each household. Fourthly, gain social donation from non-profit organizations. Fifthly, levy environmental protection tax in order to guarantee sustainability of the rural environmental protection fund.

4. **Promote “Three Modes” of Pollution Treatment in Rural Areas**

Since rural areas in Anhui Province focuses on agriculture with comparatively backward economic development and scattered population, three modes should be adopted. Firstly, fully implement in rural areas diversified treatment modes of domestic garbage in line with the actual conditions of rural areas. Secondly, accelerate the construction of rural infrastructure, especially the construction of rural sewage plumbing networks. Collect domestic sewage in rural areas and implement the mode of “centralized processing by towns”. Thirdly, industrial pollutants should be treated under the basic principle of “whoever pollutes must pay for treatment” so as to urge rural industrial enterprises to take responsibilities for their pollution control.

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\(^{13}\) Diversified investment: diversified investment such as charging on pollution, health fee, and tax on environmental protection, donation from non-profit organizations, etc..
VII. REFERENCES


87


