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People's Republic of China: Sustainable Provincial Development Strategy for Guangdong Province Focused on Environmental Improvement in Rural Areas and Small Cities (Financed by ADB TA 7933-PRC)

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Preface

A. Program Background

The Asian Development Bank (ADB), as an international financial organization and a knowledge bank, has tremendous experience in promoting sustainable development and environmental safety. In 2011, ADB, the Ministry of Finance, and the Guangdong Province reached an agreement that ADB provides the Guangdong province government with a policy and advisory technical assistance (PATA) to study environmental improvement in rural areas and small cities (RASC). After the PATA was approved, ADB engaged a team of consultants that covered expertise in rural environmental protection, pollution controls for sewage and waste and prevention and control of industrial pollution. The consultant team worked closely with the Guangdong researchers. In addition to the meetings with the Guangdong provincial government officials and research fellows, the consultants visited the countryside in the vicinities of Guangzhou, Zhaoqing, Foshan, Shaoguan, Heyuan, Chaozhou, and Jieyang, to discuss with local farmers and officials.

The consultant team submitted to the Guangdong provincial government and ADB a main report, six subreports, and 19 policy notes. Among others, seven policy notes were highly appreciated by the province's senior officials, including Governor Zhu Xiaodan, Executive Vice Governor Xu Shaohua, and Vice Governor Liu Kun. Based on their guidance, these policy notes were distributed to all cities and counties in Guangdong for policy reference in making decisions.

B. Research Significance

Since the PRC (People's Republic of China) began to reform and open up, Guangdong has been a pioneering province, seeing fast economic and social development, achieving great results, and becoming a decisively important provincial economy. By 2011, annual GDP had increased to 5.3 trillion from CNY18.5 billion in 1978, while per capita GDP reached CNY50,500—or \$7,819 at the annual average US dollar exchange rate—putting the province in the middle-upper income bracket globally. With such rapid economic growth, urbanization in Guangdong has also been extraordinary, rising from 16.3% in 1978, increased to 66.5% in 2011. Of that, the Pearl River Delta (PRD) has seen urbanization on a greater and faster scale than anywhere else in the PRC, with urban areas contributing somewhere around 60–80% of the economy in the delta. However, over the long-term, high intensity development, high consumption, and the large-scale pollution that is a byproduct of this mode of development has directly led to punitive environmental costs, increasing pollution, and overall ecological fragility, becoming a serious problem for the province in terms of sustainable development. This has particularly been the case in recent years in RASC. Attracted by the low prices of land and labor forces, polluting industries have been moved to RASC and caused particularly conspicuous ecological and environmental problems. Furthermore, these areas often lack adequate environmental infrastructure and administration of industrial pollution, garbage, and sewage; treatment of pollution at source in rural and lightly urbanized areas is also still lagging.

The 18th National Congress of the Communist Party of the PRC enshrined ecologically sound development in its platform of socialism with Chinese characteristics. It proposed building a “beautiful” country, stating that environmental protection work in RASC was an important aspect of ecologically sound development. Indeed, improving environmental protection work in RASC is of extreme long-term significance and practical urgency. In the case of Guangdong Province, it is an essential requirement in terms of achieving the goal of “Transforming and Establishing a Happy and Prosperous Guangdong”, of assuring the impartiality of basic public services, the comprehensive

development and integration of rural and urban areas, of guaranteeing and improving people's livelihoods, all of which are urgently required in order to ensure harmony and stability. After years of experimentation and practice, Guangdong's urban and rural environmental protection work has made historic progress, achieving significant results, establishing practical experience, and institutional mechanisms that form the preliminary basis of an environmental legal system. However, on the whole, environmental protection in RASC remains one of the basic areas in which the entire province is still most weak, with many prominent problems that need solving. In order to comprehensively put a scientific concept of development into play, promoting the economic and social development of Guangdong, and coordinating that with its resources and its environment, there must be a determination to carry out the hard graft of environmental protection work in RASC. It is necessary to explore a new road for rural development—even providing fresh insights—so that both the people of Guangdong and elsewhere in other developing countries, and in other regions of the PRC, can achieve good livelihoods and have good living environments.

Contents

Executive Summary	1
I. Outlook and Challenges for Environmental Protection in Guangdong Province RASC	8
A. Historical Overview	8
B. Present Policies and Preliminary Results	10
1. Overall Policies and Measures	10
2. Existing Policies and Preliminary Outcomes in Protection of Living Environment	10
3. Current Rural Production and Environmental Protection Policies and Their Preliminary Outcomes	12
4. Industrialization and Urbanization: Current Pollution Prevention Policies and Their Preliminary Outcomes	12
C. Province-wide Rural living Environmental Problems	13
1. Relatively Low Treatment Levels of Rural Household Waste	14
2. Sewage Treatment is Insufficient.....	16
3. The System for Ensuring the Rural Drinking Water Security Requires Improvement	17
4. Mixing Human Waste and Livestock Manure Remains a Rural Problem	18
5. Disease Vector Control Work Still Required.....	18
D. Rural Production Environment Has Continuing Problems Province-wide	19
1. Chemical Fertilizer and Pesticide Pollution Difficult to Control	19
2. Large Areas Contaminated by Livestock and Poultry Waste	22
3. Heavy Metal Pollution Still an Outstanding Issue	23
4. Pollution from Aquaculture Cannot Be Ignored	23
5. The Disposal of Agricultural Plastic Sheeting Cannot Be Overlooked.....	23
6. Pollution from Burning Straw Remains Difficult to Control.....	24
E. Rural Pollution Problems Caused by Industrialization and Urbanization	24
1. The Overall Effects of Industrialization and Urbanization on the Rural Environment	24
2. Industrial Relocations Lead to a Certain Degree of Pollution Transfers	26
3. Despite Repeated Bans, Pollution from Small Traditional Industries in the Vicinity of Villages Cannot Be Stopped.....	26
4. Unregulated Exploitation of Minerals Has Seriously Harmed the Rural Environment.....	26
5. Pollution Resulting from the Burying and Incinerating Municipal Waste in the Countryside	27
6. Shockingly Unregulated Dismantling and Recycling of Electrical and Electronic Products.....	28
F. Regional Variations of Characteristics and Trends in Guangdong's RASC Environment	28
1. Environmental Differences Between RASC.....	28
2. Development Trends	31
II. Constraints to Improving Rural Environmental and Ecological Protection	33
A. Objective Constraints in Stages of Economic and Social Development	33
1. Rural Environmental Construction Has Failed to Keep Pace with Urbanization	33
2. Putting Economic Interests before Environmental Protection Still Exists in Less Developed Areas	33

B. Environmental Protection Externalities Constrain Agencies back from Taking Initiative	35
C. Serious Shortages of Funds for Rural Environmental Protection	35
D. Rural Environmental Management and Mechanisms Still Not in Order	36
1. The Government Lacks Supervisory Power on the Rural Environment	36
2. Rural Environmental Management Lacks Mechanisms for Overall Planning and Coordination	37
3. Environmental Considerations Neglected in Rural Construction Planning	37
4. Lack of Effective Mechanisms to Provide Environmental Compensation	37
5. Lack of Environmental Supervisory and Assessment Mechanisms	37
E. Imperfect Policy and Regulatory System Makes It Difficult to Achieve Goals	38
1. Existing Environmental Policies for Rural Areas Are Imperfect	38
2. Existing Environmental Construction Policies and Regulations Cannot Be Executed	39
F. Rural Understanding of Environmental Issues Hazy	40
1. Unhealthy Rural Habits Are Hard to Completely Change in the Short Term	40
2. The Overall Quality of the Rural Workforce is Low	41
3. There is a Shortage of Publicity About Environmental Protection and Learning Channels are Limited	41
III. International Experience and Lessons on Environmental Improvement in RASC	41
A. South Korea: ‘The New Village Movement’ Significantly Improved the Economic and Environmental Outlook	41
B. Japan: First Implement Rural Pollution Laws and Regulations	42
C. US: The Solid-Waste Management Experience of San Diego County	42
D. Taiwan, China: Using Wetlands to Solve the Problem of Rural Sewage	43
E. Domestic and Foreign Experience of Rural Environmental Management	43
IV. Policy Recommendations for Environmental Improvement in Guangdong RASC	44
A. Establish rural ecological environment management systems and mechanisms	45
1. Improve the Management of Eco-Environmental Protection Organizations	45
2. Establish and Improve Regulatory Oversight Mechanisms for Rural and Township Environments	45
3. Establish and Improve Technological Support Mechanisms for RASC	45
B. Improve Rural Environmental Protection Policies and Regulations to Promote the Internalization of Environmental Costs	46
1. Improve the System of Rural Environmental Protection Policies and Regulations	46
2. Strengthen the Enforcement of Rural Environmental Laws, Promote Reforms of Pollution Discharge Fines, Implement ‘Polluter Pays’	46
3. Establish and Improve Environmental Compensation Mechanisms for RASC	46
C. Strengthen the Rural Environmental Planning, Promote Comprehensive Improvement of the Rural Environment	47
1. Integrate Urban and Rural Planning, Speed up Village Planning	47
2. Deepen the ‘Award Governance’ Policy, Promote Integrated Environmental Improvement and Establishment of Model Ecological Projects	47
D. Make Village Waste and Wastewater the Focus, Optimize the Village Living	

Environment	47
1. Increase the Treatment of Village Household Waste	47
2. Improve the Proper Treatment of Rural Wastewater	48
3. Strive to Establish Rural Water-supply Projects	48
4. Strengthen the Construction of Rural Public Toilet Facilities	49
E. In the Poultry and Livestock Industries, Make Pollution Prevention and Control the Focus, Improve Agricultural Production Methods	49
1. Strengthen Pollution Prevention and Control in the Poultry and Livestock Industry	49
2. Prevent Agricultural Surface Pollution	50
3. Promote Soil Pollution Prevention	50
F. In the Interests of Preventing Industry Pollution, Control the Effects of Industrialization and Urbanization on the Rural Environment	50
1. Strictly Control Environmental Pollution Arising from Industrial Relocations	50
2. Strengthen Environmental Monitoring of the Opening up of Mineral Resources	51
3. Prevent Damage to the Rural Environment from Burning Urban Landfill Waste	51
4. Implement Campaigns to Improve the Electrical and Electronic Products Recycling Industry	52
G. Improve Organizational Guarantees, Form a Positive Sense of Rural Environmental Protection	52
1. Strengthen Rural Environmental Protection Through Evaluation Mechanisms	52
2. Integrate and Optimize Financial Funds, Continue to Increase the Input of Public Funds	52
3. Develop ‘Green Financing,’ Explore Establishing a System of Multi-inputs	52
4. Implement the National Action Plan for Rural Environmental Protections	53
V. Suggestions and Recommendations for Projects Requiring ADB Support	53
A. Guiyu Town Waste Electrical and Electronic Equipment Recycling Sector Management Project Proposal	54
1. Project Demonstration and Innovation	54
2. Construction Contents and Objectives	54
3. The Scale of Investment	54
Guiyu Circular Economy Industrial Park Investing Plan	55
4. Loan Repayment Arrangement and Counterpart Fund Financing Plan	56
B. Proposal of Heavy Metal Contaminated Farmland Soil Restoration Demonstration Project	56
1. Project Demonstration and Innovation	56
2. Construction Contents and Objectives	56
3. The Scale of Investment	57
4. Loan Repayment Arrangement and Counterpart Fund Financing Plan	57
References	57

Executive Summary

I. Outlook and Challenges for Environmental Protection in Guangdong Province RASC

In recent years, Guangdong Province has placed increasing emphasis on ecological protection and improvement, promulgating related policies and measures, and increasingly utilizing capital investment and establishing a system of joint conferences for rural environmental protection. Guangdong has achieved initial outcomes in terms of environmental protection of the rural living environment and production, industrial pollution prevention and control etc. However, the situation of eco-environmental protection in RASC remains grim.

A. In terms of the rural living environment, household waste and sewage treatment is insufficient and the system for ensuring the rural drinking water security requires improvement

The first issue is relatively low treatment levels of rural household waste. Guangdong Province produces about 36,000 tons of household waste per day—the majority of which is not properly treated. By 2011, only 20 counties (cities) have resolved problems associated with the treatment of household waste, while 47 continue to use relatively unsophisticated treatment methods. **The second issue** is insufficient sewage treatment. In most small and medium-sized cities and towns, untreated sewage is discharged directly, resulting in serious pollution of agricultural environments. Meanwhile, rural sewage treatment rates are relatively low, and sewage treatment facilities are lagging. **The third issue** is the inadequate system for ensuring the security of rural drinking water. The province still has a rural population of around six million for whom drinking water safety remains an unresolved issue, with a portion of economically underdeveloped areas supplied with water that does not meet standards. **The fourth issue** is the mixing of human waste and livestock manure that remains a rural problem and necessary disease vector control work. With around one million people in Guangdong still unable to afford sanitary latrines, development in the region remains very uneven.

B. In terms of the rural production environment, environmental pollution caused by livestock and poultry waste is relatively severe, and heavy metal pollution of soil has become increasingly serious

The first issue is the large areas of contamination by livestock and poultry waste and aquaculture pollution. In livestock and poultry farms, the treatment of waste is crude, and the lack of effective treatment of sewage and waste from the livestock and poultry industries causes pollution that affects the entire province, making the issue one of the important factors affecting quality of the environment. In aquaculture, problems include too much feed, misuse of veterinary drugs and additives and worsening environmental pollution in aquatic farms. **The second issue** is outstanding heavy metal pollution. The soil in rural parts of Guangdong contains heavy metals that exceed limits, contaminating rice, vegetables, and other agricultural products, directly endangering the health of rural residents and also badly affecting the health of urban residents. **The third issue** is the difficulty to control chemical fertilizer and pesticide pollution. The efficiency of chemical fertilizer is low. For example, the utilization rate of nitrogen fertilizer is only 30%, which is around 20% lower than in developed countries. However, in 2010, the province's

average fertilizer application intensity was 554.31 kg per hectare; much higher than in developed countries, where usage on average is limited to 225 kg per hectare. **The fourth issue** is the disposal of agricultural plastic sheeting and pollution from burning straw. Guangdong usage of mulches and agricultural plastic sheeting per unit area was 2.35 and 2.62 times higher than the national average respectively, becoming the PRC's biggest consumer of both mulches and agricultural plastic sheeting per unit area.

C. In the process of industrialization and urbanization, industrial relocation, exploitation of mineral resources, waste burying and incineration and recycling of e-waste have led to relatively severe pollution in rural areas

The first issue is that industrial relocation has led to a certain degree of pollution transfer and pollution from small traditional industries in the vicinity of villages is unabated. As the Pearl River Delta (PRD)'s traditional industries continue to relocate to underdeveloped regions, problems associated with environmental pollution have become an issue. For instance, a considerable number of industrial relocation parks have been sited upstream from protected areas that are water sources, or adjacent to areas that supply grade I and II water, greatly increasing the pressure in terms of carrying out environmental protection work for water. **The second issue** is the unregulated exploitation of minerals that has seriously harmed the rural environment. According to 2008 statistical data, the most severely affected areas are mainly located in the east, west and north of Guangdong Province, and are scattered over a total area of about 1,813.31 sq km. **The third issue** is pollution resulting from burying and incinerating municipal waste in the countryside. The average distance from the city center for new or proposed incineration plants in Guangdong Province is 22.28 km. Most of the new waste treatment plants are built far from urban centers, with some located in rural hinterlands. **The fourth issue** is the shockingly unregulated dismantling and recycling of electrical and electronic products. Guangdong is located in the coastal People's Republic of China (PRC), and has built a sophisticated industrial e-waste recycling chain, especially in eastern parts of the province, such as Guiyu Township in Shantou, a "leading e-waste town". The simple dismantling of e-waste leads to dangerously contaminated areas with high levels of heavy metals and dioxin-like compounds where heavy metals, and lead, chromium, copper, and tin contaminants can be several hundred times—even thousands of times—higher than hazardous pollution standards, and polybrominated diphenyl ether (PBDEs) levels can be 30 times higher than in other areas, and dioxin levels 37-133 times higher, which poses serious threats to resident health.

D. Regional variations of characteristics and trends in Guangdong's RASC environment

Uneven development and differences in the measures undertaken to protect the environment have caused significant variations in terms of the environmental situation between the PRD, and eastern, western, and northern parts of the province. Air pollution levels are fair in northern Guangdong, worst in the PRD and about the same in the east and west. Water quality, in the Pearl River, Han River, and rivers in western Guangdong is relatively good, while that in rivers in eastern Guangdong is poor; pollution levels in smaller bodies of water (gullies, creeks, streams, ponds) in mountainous areas and northern parts of the province is lighter, whereas water contamination is relatively heavy in coastal regions and the plains. In terms of noise pollution, it is fair in the east, west and north of Guangdong and worst in the PRD. Soil pollution is common in the PRD, eastern and western regions of Guangdong Province. In terms of waste volume, it is worst in the PRD, about the same in the east and west, and lightest in the north.

Overall, Guangdong's rural environmental protection and construction are at a tipping point. If immediate action and effective measures are undertaken, it will be possible to reverse the continuing deterioration. But, if action and decisive measures are not taken and the situation is left unchecked, environmental problems will proliferate and spread, and begin to seriously threaten people's health.

II. Constraints to Improving Rural Environmental and Ecological Protection

A. Some less developed areas continue to prioritize economic interests over environmental protection

Guangdong's total GDP is large, and the province is maintaining high-speed growth. But growth is lagging in the sprawling RASC, and there is a huge urban-rural gap. Rural environmental development cannot keep pace with the process of urbanization. Some regional governments in underdeveloped areas are still following the PRD path of "pollution first, clean up later" and simply pursuing GDP growth and lowering environment protection requirements.

B. Environmental protection externalities constrain agencies from taking initiative

The benefit spillover associated with investing in environmental protection and management make environment improvement difficult. For example, at a regional level, the northern mountains of Guangdong bear the responsibility for ecological protection while the other developed regions enjoy clear water due to insufficient ecological compensation made by developed areas to the northern mountains. At the level of individual economic agents, polluters only consider environmental issues from an individual cost-benefit point of view, and their gains from the pollution are far lower than public costs of containing it. Besides, existing environmental policies for rural areas in Guangdong remains inadequate and uniform policy and lack of coerciveness have resulted in weak protection. The lax implementation of urban planning and the poor enforcement of rural laws have not effectively promoted the internalization of environmental costs.

C. Rural environmental management system, supervisory and assessment mechanisms and development planning are yet to be improved

The situation in Guangdong's RASC in terms of ecological and environmental protection is the issue of "overlapping management", in which environmental work involves a number of departments at various levels of government, i.e. development and reform commission, environmental protection bureau, agriculture department, finance department, water resource department sanitation department, and housing construction department, but there is not a workable coordinating mechanism. Government also lacks supervisory power over the rural environment. In comparison with metropolitan systems for supervision and management of environmental protection, rural systems have seriously lagged. Guangdong's RASC development lacks scientific, rational and forward-looking planning that incorporates environmental considerations. Additionally, Guangdong's rural environmental compensation mechanisms are imperfect. The emission trading platform is evolving at a relatively slow pace. Local government assessments are still dominated by economic indicators, and environmental construction is not yet fully integrated into local government assessments.

D. Shortages of funds and awareness for rural environmental protection weaken environmental efforts

Most of the funding for environmental protection is focused on the province's cities, and the establishments of environmental protection in RASC receive far less overall investment, leading to poor infrastructure and limited capacity to treat contaminants. Additionally, unhealthy rural habits are hard to completely change in the short term. The overall quality of the rural workforce is low. There is a shortage of publicity about environmental protection and learning channels are limited.

III. International Experience and Lessons on Environmental Improvement in RASC

Advanced experience of rural environmental protection in Japan, South Korea, Taiwan, China and United States provide the following lessons for Guangdong. **The first** is to implement integrated urban and rural development and environmental protection strategies. The urban-rural dichotomy restricts rural development in the PRC, and also affects rural environmental protection. South Korea's "New Village Movement" strengthened rural infrastructure, while improving the rural environment. **The second** is to establish and improve rural environmental policies and regulations. Japan's environmental legal system and supporting policies and measures are very comprehensive, providing a strong impetus to rural environmental protection work. **The third** is that the government should increase investment in environmental protection in rural areas, through the establishment of diversified investment mechanisms. Rural environmental protection requires significant capital investment, with strong government support and a wide range of capital investment. South Korea's "New Village Movement", which combined government investment and rural methods for raising capital, was a good solution to funding problems. **The fourth** is to give full play to social organizations in terms of rural environmental protection. For instance, the United States Environmental Protection Agency, the Bureau of Indian Affairs, local governments, Native American peoples and other non-profit institutions jointly formed a solid-waste alliance which has actively brought together talent and resources, enhanced public advocacy and taken firm actions. The alliance cleaned up more than 20 illegal waste dumps in less than two years. **The fifth** is to mobilize farmers to carry out rural environmental protection through a sense of ownership. Mobilizing farmers' sense of ownership was a pioneering initiative by the South Korean government, which gave play to farmers' enthusiasm, initiative, creativity and potentials, so that they felt part of rebuilding the countryside.

IV. Policy Recommendations for Environmental Improvement in Guangdong RASC

Our main objective is that by 2015, the institutional mechanisms of RASC will be increasingly optimized; the environmental and living conditions will have been largely improved; production methods will have improved; industrial pollution will have effectively treated and prevented. These will improve the rural environment and achieve sustainable economic and social development in rural areas, leading to a continually improving overall situation.

A. Establish Ecological Environment Management Systems and Mechanisms in RASC

The first is to improve the management of eco-environmental protection institutions. Establish a system of joint conferences for environmental protection in RASC and gradually integrate environmental protection functions. **The second** is to establish and improve regulatory oversight mechanisms for the RASC environments. Improve the oversight capacity of county environmental agencies, and gradually establish environmental agencies in the village and the township levels for rural villages as well as a province-wide rural environmental pollution monitoring system. **The third** is to

establish and improve technological support mechanism for RASC. Universities, research institutions, businesses and many other forces need to join together to tackle key environmental technologies for rural areas. Reconstruct and improve the primary agricultural sciences and technology service systems.

B. Improve rural environmental protection policies and regulations to promote the internalization of environmental costs and benefits

The first is to improve the system of rural environmental protection policies and regulations. Amend and improve the “Guangdong Agricultural Environmental Protection Ordinance”, and formulates laws and regulations on prevention and control of rural soil pollution, prevention and control of water resource pollution, etc. **The second** is to strengthen the enforcement of rural environmental laws, promote reforms of pollution discharge fines and implement “polluter pays”. Carry out thorough investigations according to the law, improve the coordination mechanisms for regional watershed environmental enforcement and establish and improve the convergence of administrative law enforcement and the judicial system. Gradually increase fines for emissions of major pollutants and actively promote reforming the system of fines for discharges of ammonia nitrogen, nitrogen oxides, oil and gas, and other pollutants. **The third** is to establish and improve environmental compensation mechanisms for RASC. Execute “Methods for Providing Ecological Compensation in Guangdong Province”, constantly improve the ecological compensation calculation standards and gradually establish a multi-participatory compensation system in which government, society, enterprises, and other parties involved all play a role.

C. Strengthen the rural environmental planning, promote comprehensive improvement of the rural environment

The first is to integrate urban and rural planning and speed up village planning. In the PRD and in other regions, with rich financial resources, achieve “unified urban and rural planning, unified management, and unified assessment” as the goal of environmental construction planning. It is also necessary to continue to promote province-level pilot village planning work. **The second** is to deepen the “Award Governance” Policy and promote integrated environmental improvement and the establishment of model ecological projects. Actively establish a movement to create livable villages and townships. Promote historic towns and villages, and the planning and development of model villages and townships, as well as development in historic townships.

D. Make village waste and wastewater the focus, improve the village living environment

The first is to increase the treatment of village household waste. Continue to promote and improve the “family gathering, village collection point, transit town, county processing” waste treatment model, while encouraging other economical and safe methods of treatment. Raise funds for waste treatment and gradually establish a system of rural sanitation services. Carry out an experimental pilot to promote rural waste sorting. **The second** is to improve the proper treatment of rural wastewater. Accelerate the installation of township-level sewage treatment facilities. Focus on building sewage treatment facilities for townships in water source conservation areas and in the vicinity of key reservoirs that supply drinking water. PRD cities in developed areas should expedite and promote the construction of centralized pollution control facilities and supporting pipe networks in the villages and townships in their urban peripheries. Townships in the north, east and west regions of Guangdong can adopt a combination of decentralized

and centralized sewage treatment facilities to encourage rain and sewage diversion. Using appropriate households, and draw up a village sewage treatment technology map. Choose an appropriate sewage drainage system. **The third** is to strive to establish rural water-supply projects. Continue to complete construction projects associated with safe rural drinking water. Strive to promote the construction of tap-water projects for every rural village. Developed areas in the PRD need to integrate within the scope of urban drinking-water supply converge and other areas need to basically build a system of guaranteed safe rural water supply, so as to ensure that by 2015 the entirety of the province's rural areas have access to safe drinking water. Strengthen the development of rural drinking water quality monitoring networks. **The fourth** is to strengthen the construction of rural public toilet facilities. The mountainous regions of northern Guangdong, and the east and west of the province are seeing an accelerating pace of improvement in terms of rural lavatories, increasing the dissemination of hygienic toilets.

E. In the poultry and livestock industries, make pollution prevention the focus, improve agricultural production methods

The first is to strengthen pollution prevention and control in the poultry and livestock industry. Focus on the key large-scale pig and poultry farms under close monitoring and strive to improve their pollution prevention and control and emissions of main pollutants. It is recommended that policies and regulations be drawn up in order to prevent the random introduction of toxic chemicals into the food chain at source. It is also recommended that the Development and Reform Commission and other departments include environmental cost estimates at the feasibility study stage of industrial, mining, and farming projects. **The second** is to prevent and control agricultural surface pollution. Demonstrably propagate pesticide-toxicity-reduction technologies, establish a complete pesticide-packaging waste recycling system and continue to promote soil testing and fertilizer recommendations. Prevent straw, plastic sheeting, and other similar kinds of pollution. Encourage leading agricultural enterprises to develop branded and ecological agriculture. Establish incentives for environmental agriculture and explore avenues of funding for fertilizer subsidies through raising prices for gains and cereals or through measuring the work involved in applying fertilizer to land. **The third** is to promote soil pollution prevention. Establish monitoring and risk assessment for basic farmland and important agricultural products. Develop trial models for restoring farming fields with contaminated soil. Gradually establish a hierarchical system for management for using soil in agricultural production areas; classify, formulate and implement countermeasures for contaminated soil management.

F. In the interests of preventing industry pollution, control the effects of industrialization and urbanization on the rural environment

The first is to strictly control environmental pollution arising from industrial transfers. Make scientific plans to develop space for rural living and production and require strict environmental approvals for construction projects in rural areas. Strengthen environmental regulation of industrial enterprises in rural areas and gradually implement monitoring of emissions of pollutants from enterprises. Guide underdeveloped areas to develop ecological industries, ecological agriculture, eco-tourism and other specialist industries. **The second** is to strengthen environmental monitoring of the opening up of mineral resources. Strengthen mining and resources development. Put strict environmental controls on the development of mineral resources and strengthen supervision of the development of mineral resources. Take initial steps to establish a monitoring system at national, local and mining area geological levels. Implement a mining financial deposit system for environmental remediation. Promote geological

environmental recovery works at mine sites. Develop a “three areas, two lines” greening of mines operation. Guide and use market leverage to accelerate mine governance. **The third** is to prevent damage to the rural environment from burning urban landfill waste. Adhere to making waste a resource so as to reduce total volume. Promote waste treatment technological innovation. Sites for incineration facilities should be scientifically investigated. Further improve the system for public participation and conduct appropriate compensation. **The fourth** is to implement campaigns to improve the electrical and electronic products recycling industry. Manage waste electrical and electronic products from source and make it clear that producers bear partial responsibilities for promoting green production and mandatory recycling. Strictly control the flow of waste electrical goods and electronics. Through financial subsidies and other incentives, encourage the industry to carry out technological innovation. The government should take the initiative to invest in industrial consolidation and address linkages for the public good, including promoting industrial upgrading.

G. Improve organizational guarantees and form a positive sense of rural environmental protection

The first is to gradually shift from a performance evaluation system that places undue emphasis on economic development indicators and establish a new performance evaluation with sustainable development goals, including environmental quality. **The second** is to integrate and gradually increase all available funds related to rural environmental protection, continue to implement and improve the “Governance Award” system and explore allocations of competitive funding. **The third** is to strive to gradually build a system of “financial allocation-market funds-social subsidies-villager self-help”, and other multi-channel funding avenues to provide a system of guarantees for rural environmental protection. Encourage the development of green credits and explore financial innovation in rural environmental protection, including the development of green trust funds and green insurance. Compete for assistance from international financial institutions such as the World Bank and ADB. Encourage rural villagers in some areas to explore a system of self-financing. **The fourth** is to implement the national action plan for rural environmental protection. Improve villager awareness of rural environmental protection. Place importance on the role of autonomous grassroots organizations for environmental protection. Support environmental social organizations that play a role in strengthening regulation of rural environmental protection. Support the news media and public opinion and guarantee the public rights to disclosure and supervision.

I. Outlook and Challenges for Environmental Protection in Guangdong Province RASC

A. Historical Overview

Environmental protection in RASC in Guangdong Province has been a continuing and ever-deepening process, but it basically comprises four historical phases:

Phase I (pre-1978): The “inaction phase.” Before the reform era, due to limited economic and social development, Guangdong’s rural environmental protection systems, public awareness of environmental protection, and environmental protection facilities were so lacking, there is no harm in referring to the era as a “phase of inaction.” Pre-1978, people basically followed traditional rural agricultural lifestyles. Household utensils were made from easily degradable raw materials and leftovers were turned into feed for livestock and poultry, while livestock and human excrement was used as fertilizer, resulting in next to no impact on the natural environment. All traditional agricultural production, its tools, and its waste could be digested and absorbed by the natural environment. In addition, during this period, there was little in the way of rural industry or mining, which did not start to appear until the reforms and opening up of the economy. The government and the public went about “environmental protection” in a spontaneous, unconscious way, making the description of the period as an “inaction phase” undoubtedly very appropriate.

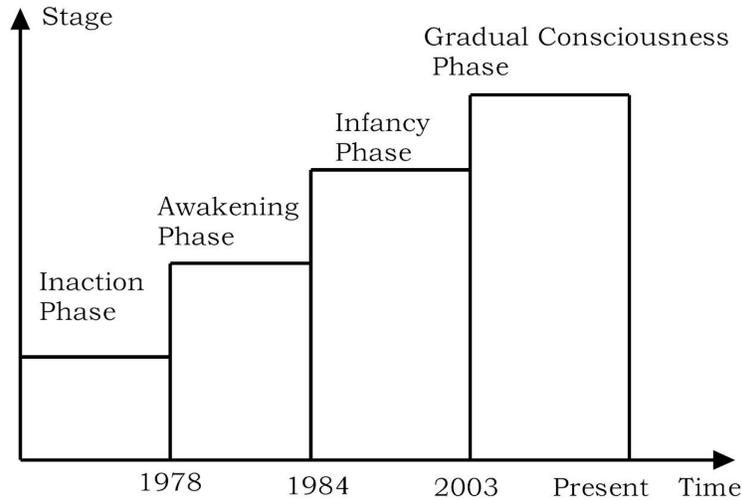
Phase II (1978–1984): The “awakening phase.” After the reforms and opening up got underway, some rural areas in the PRD region started to industrialize. The rapid development of township and village enterprises gave rise to the expression “every village belching smoke, and everywhere fire,” (cuncun maoyan, chuchu dianhuo). Rural environmental problems, in other words, were starting to emerge, but they were still far from being in obvious need of attention. But as environmental accidents began to take place with increasing frequency, the provincial government realized the importance and urgency of rural environmental protection, and farmers’ health and environmental awareness also began to increase. In April 1980, the provincial government upgraded the Guangdong Provincial Environmental Protection Office to bureau status—renaming it the Guangdong Provincial Environmental Protection Bureau. Environmental authorities embarked on local environmental legislation, promulgated the “Provisional Regulations on Protection for the Dongjiang River,” and the “Provisional Regulations on Preventing and Controlling Electroplating Industrial Pollution in Guangdong,” among other environmental initiatives. However, due to the short time span that executing agencies had been operating, when it came to dealing with rural pollution problems, and what methods could be applied, environmental protection departments at all levels were lacking in specific ideas and methods. For this reason we call this period “the awakening phase.”

Phase III (1984–2003): The “infancy phase.” In the years after 1984, the pace of industrialization and urbanization in Guangdong began to accelerate, and industrial pollution also increasingly began to spread to rural areas, in a trend that started to become relatively severe. But great efforts continued to be put into environmental protection. In 1984, the Guangdong Provincial Environmental Protection Commission was established. In 1992 (in the wake of the Rio Declaration), the implementation of

“China Agenda 21” in Guangdong was the subject of research reports. Legislative moves to accelerate the pace of environmental protection took place in 1998, with the promulgation of the “Guangdong Agricultural Environmental Protection Regulations.” This enhanced the prevention and control of industrial pollution, but overall this phase remained predominantly focused on urban environmental protection. In other words, environmental protection in rural areas was still basically in its “infancy.”

Phase IV (2003–present): The “gradual consciousness phase.” In 2003, the central government began promoting the “Scientific Development Concept,” a major strategic plan that proposed overall planning to balance urban and rural development, overall planning for regional development, overall planning for economic and social development, and overall planning to achieve harmony in human and environmental development, leading governments at every level to begin to substantially increase their attention to rural environmental protection. On the national level, the result was the publication of a number of important documents on rural environmental protection. Meanwhile, in 2008 the State Council held the first ever televised, phone-in national rural environmental protection conference. In Guangdong, in order to implement the concept of scientific development, a program of environmentally sound construction and protection was carried out, and the province also built a number of ecological demonstration villages to develop ecological agriculture in an effort to solve the industrial pollution problems being faced in some RASC. In this phase, Guangdong Province began to turn to the World Bank, ADB, the Global Environment Facility, and other international financial institutions for their capital, technology, and management experience in promoting rural environmental protection work. Examples include a World Bank loan of \$128 million for comprehensive management of the Pearl River Basin in 2004, a World Bank loan of \$100 million for agricultural nonpoint-source pollution control projects during 2012 to 2014 that is still under negotiation, and an ADB loan of \$100 million for a water resources development and protection demonstration project in Chaonan District, Shantou Municipality, Guangdong Province in 2012. Meanwhile, in 2011, Guangdong held a provincial conference on environmental protection, under the banner of “Establishing environmental awareness, building an ecological society”. This, along with the Guangdong provincial government’s decision to “further strengthen rural environmental protection and promote an ecological society,” signifies that rural environmental protection work in Guangdong has entered a new stage.

Graph 1-1: Historical stages of eco-environmental protection in RASC in Guangdong



B. Present Policies and Preliminary Results

1. Overall Policies and Measures

In recent years, Guangdong Province has put increasing emphasis on rural environmental protection. In terms of policies and measures, the Guangdong provincial government and relevant government departments have formulated and promulgated a number of papers, including the “Guangdong Province Rural Environmental Protection 12th Five-Year Plan,” the “Guangdong Province Rural Environmental Action Plan (2011–2013),” and the “Guangdong’s Joint Conference Mechanisms on Rural Environmental Protection.” In terms of capital investment, from 2008 onwards, under the “Governance Award” scheme, Guangdong has repeatedly competed for the Central Government’s special fund of more than CNY70 million (\$11.4 million) for rural environmental protection, while the provincial level environmental protection fund has CNY300 million (\$48.9 million). In 2011, Guangdong added CNY50 million in a special fund for rural environmental protection in rural areas, and in 2012 the fund reached CNY100 million (\$16.3 million). In terms of institutional mechanisms, in October 2011 Guangdong established rules for the deputy provincial governor to convene joint conferences on rural environmental protection with the Provincial Environmental Protection Bureau, the Provincial Agriculture Department and eight other provincial department heads.

2. Existing Policies and Preliminary Outcomes in Protection of Living Environment

In recent years, all levels of government in Guangdong have attached a high degree of importance on environmental protection work and pollution control in rural areas, promulgating a number of rural life environmental protection policies that have had a significant effect. The most important of these policies include:

The first is rural household waste policy. In recent years, Guangdong Province has vastly increased its efforts in the area of rural household waste disposal, with the responsibility for dealing with waste in rural areas identified at all levels of housing and urban-rural development departments—a situation that was not clearly identified in the past. “Views on How to Further Improve Provincial Disposal of Urban and Rural Household Waste” was promulgated, along with “A Comprehensive Rural Household Waste Management Action Plan,” and other documents. The aim was to implement a provincial system of rural household waste disposal through “household collection, village aggregation, transit to townships, and county processing.” The province also

formulated the "The 12th Five-Year Plan Guangdong Waste Treatment Facilities Program," which set overall plans and goals for the construction of waste-treatment facilities. The "Guide to Technology for Gathering and Disposal of Rural Household Waste in Guangdong Province" was also issued to provide guidance on the development of rural household waste treatment facilities.

The second is solid-waste management policy. During the Eleventh Five-Year Plan, Guangdong drafted and implemented a series of policies, including "Guangdong Standards for Controlling Pollution by Enterprises Engaged in the Processing of Imported Waste Plastics," "The Guangdong Province Directory of Highly Toxic Waste Materials," "Implementing Administrative Permission for Strictly Controlled Wastes in Guangdong Province." It also publicized "Views on How to Improve the Supervision and Management of Solid Wastes." All of the above were part of Guangdong Province's complete set of so-called 1 + 6 policies, which also included the publication of "Views on Further Improving Sludge Treatment and Disposal at Urban Sewage Treatment Plants." Meanwhile, cities such as Guangzhou and Shenzhen have also promulgated regulations, including, "Plans for the Prevention of Solid Waste Pollution," and "Management Practices for Toxic Waste." In short, a system of legal requirements for the treatment of solid wastes appropriate to the situation in Guangdong Province is being put in place.

The third is policy governing the safety of rural drinking water. In 2008, the "Guangdong Implementation Plans for Construction of Safe Rural Drinking Water" was announced, with the aim of providing an overall scheme for the safe provision of drinking water throughout the province. Soon after, the "Detailed Regulations for Project Construction and Fund Management for Guangdong Safe Rural Drinking Water," and the "Guangdong Rural Tap Water Project Construction Plan," among other documents, were published. The provincial Department of Finance earmarked more than CNY2.7 billion (\$440 million), in an unprecedented effort to support rural drinking water safety projects. Meanwhile, all city and county administrations are also trying to increase their financial inputs. These have greatly improved the supply of safe drinking water in Guangdong.

The fourth is the policy of building sanitary rural latrines. Guangdong has always attached great importance to the work of building rural lavatories. Since 2000, the province has invested about CNY125 million (\$20.4 million) on improving lavatories, subsidizing sanitary latrines for around 310,000 rural households, and pushing the province-wide number of newly built sanitary latrines to 3.5 million. In 2009, the improvement of rural lavatories was appointed one of six major public health services as part of medical reforms that aimed to improve general sanitation, and improve the environment of rural inhabitants.

The fifth is policy for disease vector control. In 1989, the State Council promulgated "Regarding Resolutions Concerning the Strengthening of Patriotic Sanitary Work." In 2003, Guangdong Province promulgated the "Regulations for Patriotic Sanitary Work," which required that governments at all levels adopt comprehensive prevention and control measures aimed at transforming the health environment, including the elimination of rats, flies, mosquitoes, cockroaches, and other pest species, and their breeding conditions. Subsequent regulations include "Guangdong Provincial Standards on Hygienic City", "Guangdong Provincial Standards on Hygienic Towns (County Towns)", "Guangdong Provincial Standards on Hygienic Villages", along with guidance on the application, assessment and management. In March 2012, Guangdong issued "Regulations on the Control and Prevention of Biological Disease Vectors" with specific

requirements on the prevention and control of biological disease vectors. Also promulgated at the same time was the “Notification of the Guangdong Department of Health’s System of Paid Services for the Prevention and Control of Biological Disease Vectors,” for guidance on managing pest control companies and operators (PCOs), strictly regulating the scope and activities of PCOs so as to maintain market order and guarantee results in the control of biological disease vectors.

3. Current Rural Production and Environmental Protection Policies and Their Preliminary Outcomes

In recent years, Guangdong Province has put increasing emphasis on environmental protection in rural production, formulating and releasing the “Emergency Plans for Guangdong Agricultural Pollution Events,” “Guangdong 2006 Soil Tests for Fertilizers Program,” “On Strengthening the Prevention and Control of Pollution from Large-scale Livestock and Poultry Farming in Order to Promote the Development of Ecological Health,” the “Standards for Guangdong Livestock and Poultry Emissions (DB44/613–2009)” and other policy measures to effectively promote rural production and ensure that environmental protection work is carried out smoothly. One aspect of these measures is strengthening the prevention and control of pollution associated with large-scale livestock and poultry farming and the livestock and poultry industry in order to reduce pollution. In 2010, the relevant departments of the Guangdong Provincial Government increased legal enforcement efforts to carry out a total shut down of illegal livestock and Poultry enterprises, closing 2,085 operations, and temporarily closing 1,140 operations that failed to meet pollution standards, which greatly promoted healthy development of livestock and poultry industry. The second aspect of the above measures is to develop sanitary production, and reduce agricultural nonpoint source pollution. At present, the number of counties that have carried out soil testing for fertilizer in Guangdong has reached 96, with an implementation area of 40 million mu. Meanwhile, promotion of integrated pest-management techniques has resulted in basic pest-management coverage for all crops in the province, while strong efforts to use water economically has led to water savings in Guangdong Province of over 1.5 billion cubic meters per year. A third area of improvement is the construction of biogas facilities to promote healthy eco-farming. Guangdong has greatly increased financial support for rural biogas construction, using a livestock and vegetable eco-agriculture model. As of October 2011, Guangdong had constructed biogas pits for 419,300 rural households, while also constructing 922 large-and-medium-sized biogas pits—all of which have had significant economic and ecological benefits. The fourth area of importance is pollution-free agricultural products, which includes production bases for green food, and certification, gradually improving the quality of agricultural products. As of the end of 2011, Guangdong had already identified 1,676 pollution-free agricultural production bases, 1,808 certified green products, and 284 companies with a total of 614 products that were effectively using green labeling. Meanwhile, 48 companies produced altogether 360 kinds of certified organic food products, and there were seven production bases for standardized green raw food materials, with a total planting area of more than 900,000 mu¹.

4. Industrialization and Urbanization: Current Pollution Prevention Policies and Their Preliminary Outcomes

Policies and measures formulated and publicized by the Guangdong provincial authorities include the “Guangdong Integrated Rural Environmental Management and

¹ Data source: Agriculture Department of Guangdong province.

Planning (2009–2015),” the “Guangdong Prolonged Organic Pollution Prevention Plan (2011–2015),” “Implementing Views on Comprehensive Efforts to Strengthen Urban and Rural Development through Solid Agricultural Rural Development,” and “On the Implementation of Views on Constructing Livable Urban and Rural Areas.” All such policies and measures have imposed a certain degree of control over rural pollution associated with industrialization and urbanization. This is the case, firstly, in terms of imposing strict environmental entry requirements, spurring the orderly, gradual development of township and village enterprises. In accordance with zoning requirements in terms of both the industry in question and in terms of the environment, it is necessary to gradually develop overarching standards for electroplating, printing and dyeing, paper-making, and other heavy polluting industries. At present, Guangdong has established 38 appointed park bases for heavily polluting industries to operate, with unified management, and centralized pollution controls, reversing the disorderly development that led to the saying, “Every village belching smoke, and everywhere fire.” The second issue is strengthening the enforcement of environmental laws to solve outstanding environmental problems in rural areas. In recent years, the Guangdong provincial authorities have continued to carry out special environmental protection actions, with a particular focus on supervision. Since the 11th Five-Year Plan, authorities have inspected over 1.12 million enterprises, and taken action against 52,463 that were breaking the law, required 42,037 to take environmental remedies within a prescribed period of time, and permanently shutting down 14,793, effectively preventing heavy polluting enterprises from moving from the cities to remote rural and mountainous areas. The third issue is increasing surveying and research, making steady progress on controlling soil and mining pollution. Guangdong has developed mineral resource environmental projects, thoroughly investigating the environmental conditions in terms of mineral resources and development projects through special inspections. This has helped achieve a thorough understanding of the development and utilization of province’s mineral resources, providing the basis for promulgating “Views on How to Further Strengthen Environmental Protection in Development and Utilization of Mineral Resources.” The fourth issue is adopting policies and measures aimed at slowing down pollution from electrical and electronic products. In 2010, the authorities issued “Views on How to Achieve the Healthy Development of Recycling Industries,” which proposed establishing a province-wide network for urban and rural specialized recycling of appliances. At present there are three bodies in the Guangdong provincial government that share the responsibilities for managing electronic waste, providing a certain degree of control over the problem. Those bodies are the Guangdong Provincial Economic and Information Technology Commission Energy-Savings and Recycling Board, and the Atmospheric Environment and Waste Management Division, and Solid Waste Management Center of Department of Environmental Protection of Guangdong Province.

C. Province-wide Rural living Environmental Problems

At this point in time, rural living standards in Guangdong Province have been greatly improved by a relatively long period of administration and governance. Overall, however, in terms of the rural living environment, there remain substantial inadequacies, including relatively serious environmental pollution through widespread mishandling of human and livestock waste, the random discarding of household waste and sewage, vulnerabilities in drinking water security, inadequate control over biological disease vectors, and heavy metal contamination of the soil. Villagers’ satisfaction rate with their living environment continues to be low.

Table 1-1: Living Environment (Unit: %)

Area	Attitude	Acceptability Level			Level of Unacceptability
		Acceptability	Average	Total	
PRD		40	23	63	37
East		29	30	59	38
West		44	29	73	26
Mountainous		50	24	74	26

(Guangzhou Public Opinion Research Center—Rural Status: significant regional differences, led by PRD—Second of a series of opinion surveys of rural villagers in Guangdong Province, 15 September 2011)

1. Relatively Low Treatment Levels of Rural Household Waste

Poor treatment of household waste is one of the main reasons for the deterioration of rural water, air and soil. According to the investigation by relevant departments of Guangdong Provincial Government, Guangdong Province produces about 36,000 tons of household waste per day—the majority of which is not properly treated. At the same time, there are still a certain proportion of simple landfill facilities in Guangdong, causing serious pollution to the surrounding air, water, and soil. According to the Guangdong Provincial Department of Health’s “Investigatory Report into the Monitoring of Rural Sanitation”, 56.16% of household waste in rural Guangdong is disposed of in designated areas (pooled areas), while 37.74% is thrown away in designated areas in the vicinity of the house, and 6.1% simply thrown away. Waste collectors collect 55.26% of household waste from designated disposal areas, while 32.37% was unified collection, and 12.37% was collected randomly. In rural villages that have designated areas for the collection of household waste, the incidence of randomly tossed garbage was far lower than in villages that did not have designated collection areas. As to the land type within 30 meter radius to designated dumpsites, 53.81% were in open areas, 51.90% were beside roads, 14.29% were in farmland, 10.95% were beside rivers, and 8.10% were in residential areas. Some 68.42% of waste dumps gave off an obvious odor, while 76.05% had flies.

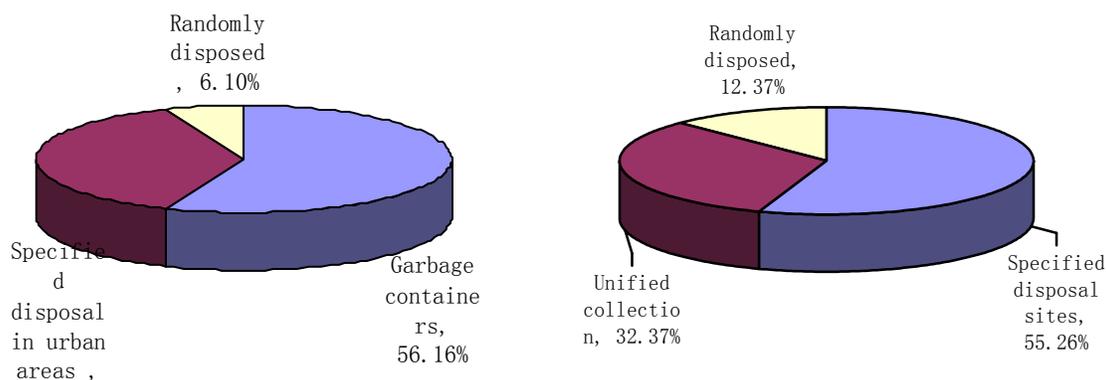
Table 1-2: Sources of Rural Waste in Guangdong Province

Area	Total waste, tons/month	Production waste, tons/month	Household waste, tons/month	Personal waste kg/month/person
PRD	4326.75	1921.74	2405.01	130.8a
Dongguan	2090.70	922.56	1168.14	38.46abc
Guangzhou	1059.00	344.10	714.90	46.30abc
Zhaoqing	3019.35	1025.88	1993.47	57.79ab
Foshan	900.60	403.35	497.25	23.92c
Huizhou	742.20	244.56	497.64	28.83c
Jiangmen	2312.10	784.50	1527.60	70.09ab
Zhongshan				

East Guangdong	Shantou	3130.50	720.30	210.20	34.43bc
	Jieyang	1116.00	691.35	424.65	7.615c
	Shanwei	1484.40	672.60	811.80	35.19bc
West Guangdong	Zhanjiang	519.00	204.90	314.10	10.69c
	Maoming	168.45	114.45	54.00	35.40bc
	Yangjiang	452.78	279.56	173.22	20.80c
North Guangdong	Shaoguan	373.51	153.01	220.50	21.66c
	Qingyuan	417.00	125.10	291.90	20.47c
	Heyuan	123.00	35.13	87.87	12.89c
	Meizhou	851.07	462.82	388.25	6.450c
	Yunfu	349.65	237.00	112.65	38.62abc
Total		23436.05	9342.90	14093.15	29.23

Note: The lowercase letters in the far right column represent per-capita garbage production in various regions (Using the Duncan multiple comparison analysis, $P < 0.05$)

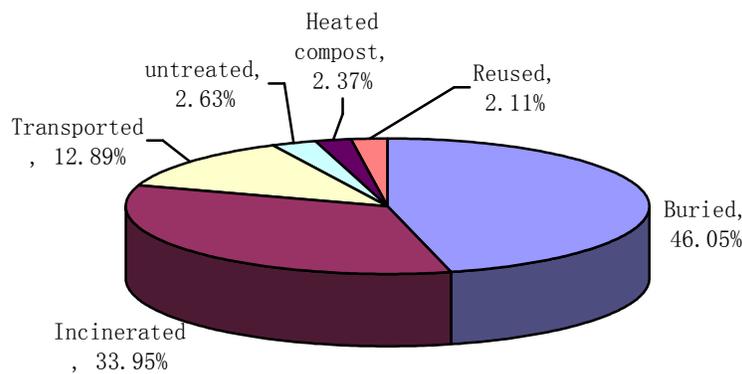
Graph 1-2: The collection and disposal of household waste in rural Guangdong Province (survey data)



Overall, the treatment of household waste in the RASC in Guangdong is relatively low, and by 2011, only 20 counties (cities) have resolved problems associated with the treatment of household waste, while 47 continue to use relatively unsophisticated treatment methods. On a village and township level, the facilities for the treatment and

disposal of household waste are correspondingly lagging and majority of the rural household wastes have not been properly treated yet². According to the Guangdong Provincial Department of Health’s “Investigatory Report into the Monitoring of Rural Sanitation,” as of August 2011, 19 counties that were surveyed had a total of 116 waste treatment plants (areas), processing 10,200 tons of waste daily, covering 6.5 million people, or 40.7% of the population in those counties. In terms of treatment, 46.05% was landfill, 33.95% was burnt, 12.89% was transported away, 2.63% was untreated, 2.37% was composted and 2.11% was reused. But, however the waste was treated, the vast majority of it failed to meet acceptable treatment standards.

Graph 1-3: Guangdong Rural Household Waste Treatment (Survey Data)

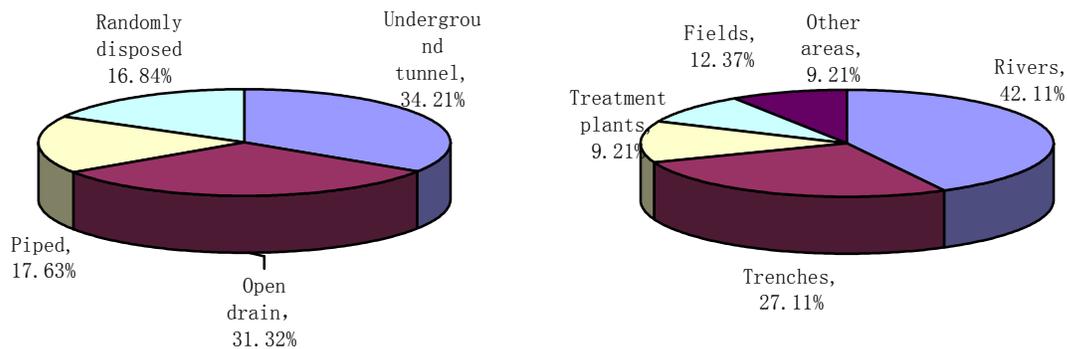


2. Sewage Treatment is Insufficient

In recent years, as urbanization in Guangdong has accelerated, sewage effluent in RASC has increased accordingly. According to statistics, in 2006 urban sewage reached 4.2 billion tons, or 64.1% of the province’s total wastewater discharge. In most small and medium-sized cities and towns, untreated sewage is discharged directly, resulting in serious pollution of agricultural environments. Meanwhile, rural sewage treatment rates are relatively low, and sewage treatment facilities are lagging. According to a Guangdong Provincial Department of Health report, “Investigatory Report into the Monitoring of Rural Sanitation,” the villages surveyed produced a daily average of 381.78 tons of sewage, with 90.79% being naturally dispelled via culverts (34.21%), ditches (31.32%), pipes (17.63%), or randomly (16.84%), rivers (42.11%), ponds (27.11%), fields (12.37%), processing plants (9.21%), and other (9.21%). As of August 2011, in the 19 counties surveyed, there were a total of 77 sewage treatment plants, treating a daily average of 1.8 million tons of sewage, covering 6.3 million people, or an average of 39.15%. Such facilities are concentrated in small townships, and overall the rural sewage treatment rate remains low.

Graph 1-4 Methods and Location of Rural Sewage Discharge in Guangdong

² Implementation Guidance on Further improving treatment of Household Waste. 2012, Guangdong provincial government.



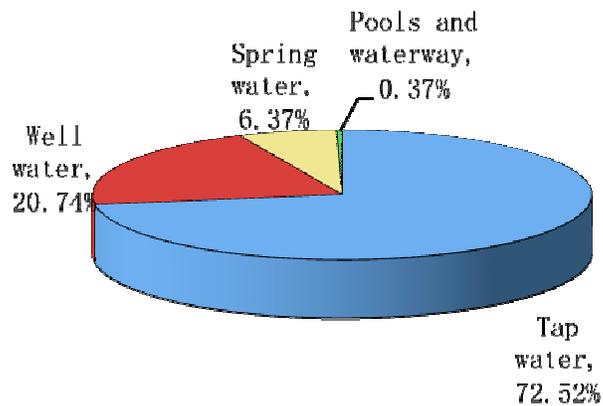
3. The System for Ensuring the Rural Drinking Water Security Requires Improvement

In terms of drinking water safety, many years of efforts in Guangdong have significantly improved the safety of drinking water in RASC, but the province still has a rural population of around 6 million for whom the safety of the drinking water remains an unresolved issue, with a section of economically underdeveloped areas supplied with water that does not meet standards. By the end of 2010, according to a prefectural-level survey of 15 cities, 23,000 construction projects that supplied water to rural areas had been undertaken, and of those 644 supplied more than 1,000 cubic meters of water daily, while 1,290 facilities had a scope of 200–1000 cubic meters, 3,363 supplied 20–200 cubic meters. In addition, some 17,000 village water tanks provided water supplies of 20 cubic meters or less³.

At present, the majority of Guangdong’s drinking water comes from the tap, accounting for 72.53% of all water supplied. Well water accounts for 20.74%, spring water 6.37%, while ditches, canals and river water accounts for 0.37%. In terms of the distributed water supply for Guangdong’s population, most of the well water is contaminated, while the water supply from springs and collected rainwater tends to be relatively good. Most spring water and collected rainwater has excessive bacterial content, but this is a problem that can be solved by boiling and other measures. However, there is no guarantee that supplies of such water are sufficient.

Graph 1-6 Sources of Rural Drinking Water in Guangdong Province (survey data)

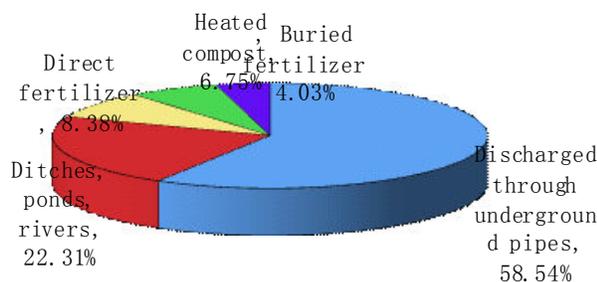
³ Source: Guangdong Provincial Department of Water Resources, “Guangdong Province Rural Water Supply Situation and Suggestions”



4. Mixing Human Waste and Livestock Manure Remains a Rural Problem

After years of development, rural residents of Guangdong Province have made great progress in handling human waste and livestock manure. But, overall, however, improper handling of the two is still polluting rural living environments. With around 1 million people in Guangdong still unable to afford sanitary latrines, development in the region remains very uneven. Although a certain number of sanitary latrines have been built in rural Guangdong, rates of treatment and utilization as biogas remains low. According to the Guangdong Provincial Department of Health’s “Investigatory Report into the Monitoring of Rural Sanitation,” in rural Guangdong, 58.54%—the majority—of human and animal waste is disposed of via sewers, 22.31% via ditches, ponds, and rivers, 8.38% as fertilizer, 6.75% is composted, and 4.03% is buried in the soil as fertilizer. The lack of facilities for treating human and animal waste makes it impossible to avoid pollution; it simply gets shifted and concentrated in certain areas. According to statistics, around 80% of infectious diseases—more than 30 different kinds, including dysentery, cholera, hepatitis and ascariasis—in rural Guangdong are due to unsanitary toilets and drinking water pollution caused by human and animal waste.

Graph 1-7: Manure Treatment Methods in Rural Guangdong



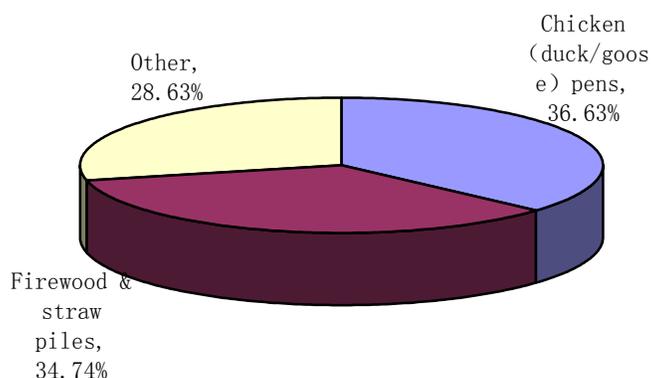
5. Disease Vector Control Work Still Required

Currently, there are three modes of control of disease vectors in rural Guangdong Province: the first is in the economically developed PRD region, where village- and township-level governments provide partial funds and also exact fees on residents for

services provided by PCOs; the second mode occurs in areas where there is less economic development (an example is Zhaoqing City, Guangning County), but where the local government pays close attention to rural health by carrying out comprehensive management of environmental health, and constantly improving primary health facilities, exterminating the so-called “four pests” (rats, flies, mosquitoes, and cockroaches) and undertaking measures to control their breeding grounds and their density; the third mode, which is used in quite a few areas, combines the annual Patriotic Sanitation Month and other seasonal events—largely in spring or autumn—to carry out one or two large annual activities in which pests are killed and eliminated.

However, overall, disease vector control is a weak link in rural health work. In rural areas of Guangdong, provincial-level authorities lack special funds for dealing with disease vectors, at the municipal level there is basically nothing. According to the Guangdong Provincial Department of Health’s “Investigatory Report into the Monitoring of Rural Sanitation” of 380 villages, 65.53% had carried out work to eliminate rats, 54.74% flies, 56.05% mosquitoes, and 51.32% cockroaches. Disease vector breeding sites in the vicinity of rural homes were largely pens for chickens, and ducks/geese, accounting for 36.63%, followed by stacks of firewood and straws 34.74%. Some 50.37% of homes’ kitchens had cockroaches and their larvae, 38.05% of homes had rats, 65.11% flies, and 53.47% of homes had water containers within 30 meters, of which 22.47% were mosquito breeding grounds. In other words, rural control of disease vectors in Guangdong still has a long way to go.

Graph 1-9 Statistics on Rural Guangdong’s Main Breeding Grounds for Disease Vectors (survey data)



D. Rural Production Environment Has Continuing Problems Province-wide

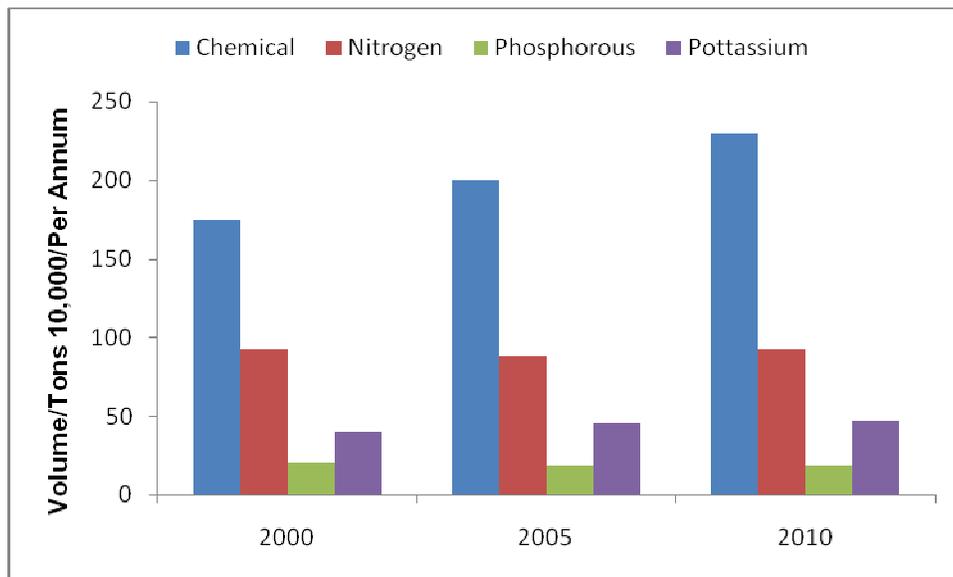
1. Chemical Fertilizer and Pesticide Pollution Difficult to Control

a. Excessive Use of Chemical Fertilizers Causes Water Pollution

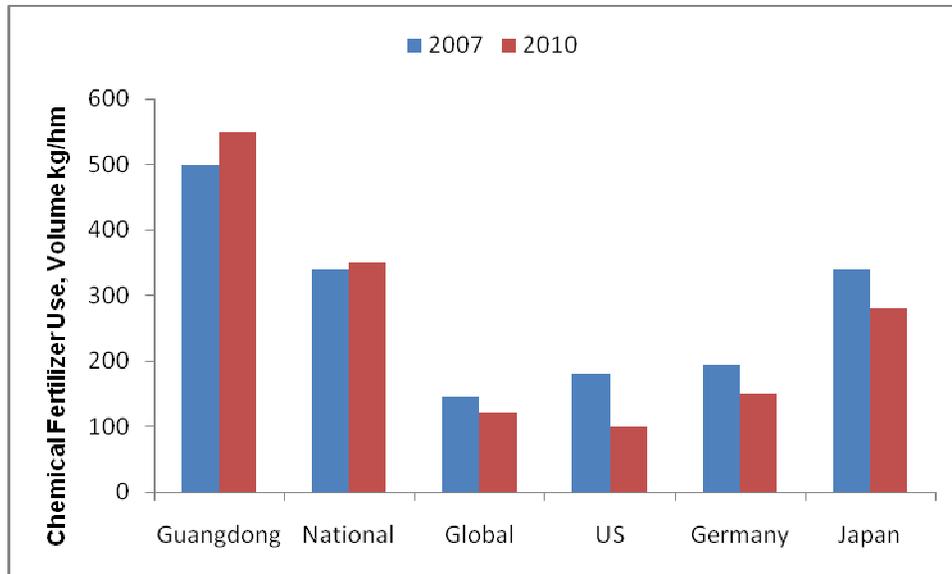
Excessive use of chemical fertilizers is widespread in rural areas in Guangdong. The results of the first national pollution survey show that annual demand for the major pollutants in Guangdong was total nitrogen (165,400 tons), and total phosphorus (23,700 tons), with chemical oxygen demand (COD) reaching 1 million tons, accounting for 39.95%, 57.98%, and 40% of total emissions respectively, with ton-usage of chemical fertilizer per hectare at 245.95 tons in 1995, 227.79 tons in 2000, 283.29 tons in 2005, 347.27 tons in 2009, and 349.64 tons in 2010 respectively, showing an upward trend.

When it comes to the use of chemical fertilizers, among the chief problems are, firstly, a lack of knowledge about chemical fertilizers, which leads to low take-up rates—for example, the utilization rate of nitrogen fertilizer is only 30%, which is around 20% lower than in developed countries. Another problem is outdated technologies and methods in the application of chemical fertilizers, causing loss and waste—the province’s average fertilizer application intensity is 544.31 kg per hectare; much higher than in developed countries, where on average usage is limited to 225 kg per hectare. When high levels of nutrients are released into the environment, it causes serious water pollution, and the results of this can be seen in Guangdong coastal waters in recent years, with increasingly frequent red tides, which are closely related to the heavy use of chemical fertilizers in agriculture.

Graph 1-10: Chemical Fertilizer Use in Guangdong in Recent Years



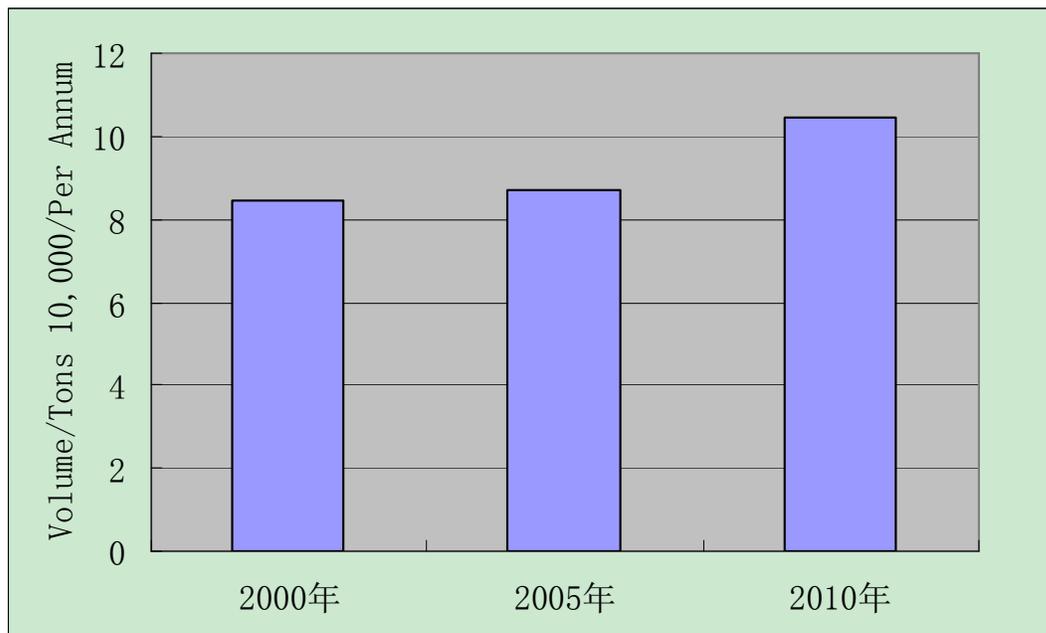
Graph 1-11: Intensity of Chemical Fertilizer Usage in Guangdong Compared to the rest of the PRC, the World, and Developed Countries



b. Improper Use of Pesticides Affects Agricultural Product Safety

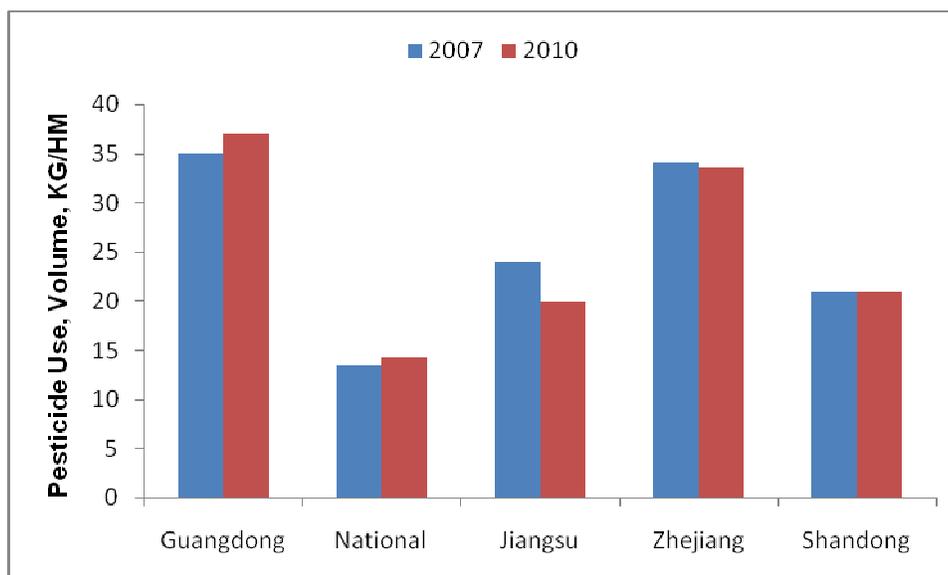
Use of pesticides has increased annually in recent years in Guangdong—80,400 tons in 1995, 84,700 tons in 2000, 87,000 tons in 2005, 103,700 tons in 2009, and 104,400 tons in 2010. In 2010, around 10 kg of pesticides were used per hectare in Guangdong. In addition to 30%–40% of the pesticide being absorbed by crops, the majority is absorbed into the atmosphere and deposited as precipitation into bodies of water, the soil and agricultural products, resulting in pesticide-residue contamination of the human food chain, endangering human health.

Graph 1-12: Pesticide Use in Guangdong in Recent Years



Graph 1-13: Volume of Pesticide Usage in Guangdong Compared to the rest of the

PRC, the World, and Developed Countries



2. Large Areas Contaminated by Livestock and Poultry Waste

The rapid development of the livestock industry in Guangdong in recent years has resulted in environmental pollution caused by livestock and poultry waste becoming increasingly prominent. The first national pollution survey results showed that in 2007, livestock and poultry produced 8.5 million tons of waste in Guangdong, mainly in six cities with well-developed livestock and poultry industries, including Yunfu and Jiangmen. These six cities alone accounted for 56% of Guangdong's total generation of livestock and poultry waste. According to "Investigatory Report into the Monitoring of Rural Sanitation," 25.53% of the monitored livestock and poultry effluent points suffered from polluted water, while in terms of daily production, of 45,145 tons, 64% of the water was directly discharged as untreated sewage. To this day in Guangdong, the treatment of waste is crude, and the lack of effective treatment of sewage and waste from the livestock and poultry industries causes pollution that has affected the entire province, making the issue an important factor in the quality of the environment.

Table 1-3: 2010 The Scale of Guangdong's Porcine Industry

Items	Plots	Heads
Annual No 1-49	1,122,787	6,951,387
Annual No 50-99	54,420	3,670,554
Annual No 100-499	35,766	7,164,740
Annual No 500-999	8,800	5,824,891
Annual No 1,000-2,999	3,817	5,963,116
Annual No 3,000-4,999	1,001	3,739,508
Annual No 5,000-9,999	581	3,830,914
Annual No 10,000-49,999	361	5,928,675
Annual No Above 50,000	24	1,830,044
Total	1,227,557	44,903,829

(Source: Guangdong Province Annual Rural Statistics, 2011, 11, 09)

3. Heavy Metal Pollution Still an Outstanding Issue

In 2010, the Department of Environmental Protection of Guangdong Province, overseen by the Ministry of Environmental Protection's "Notice on Implementation of an Investigation into National Soil Pollution" (2006, No 116), carried out a survey of soil pollution. The survey revealed that heavy metal pollution is a serious problem in Guangdong. At present, the soil in rural parts of Guangdong contains heavy metals that exceed limits, contaminating rice, vegetables, and other agricultural products, directly endangering the health of rural residents—in particular the health of children—and also badly affecting the health of urban residents.

4. Pollution from Aquaculture Cannot Be Ignored

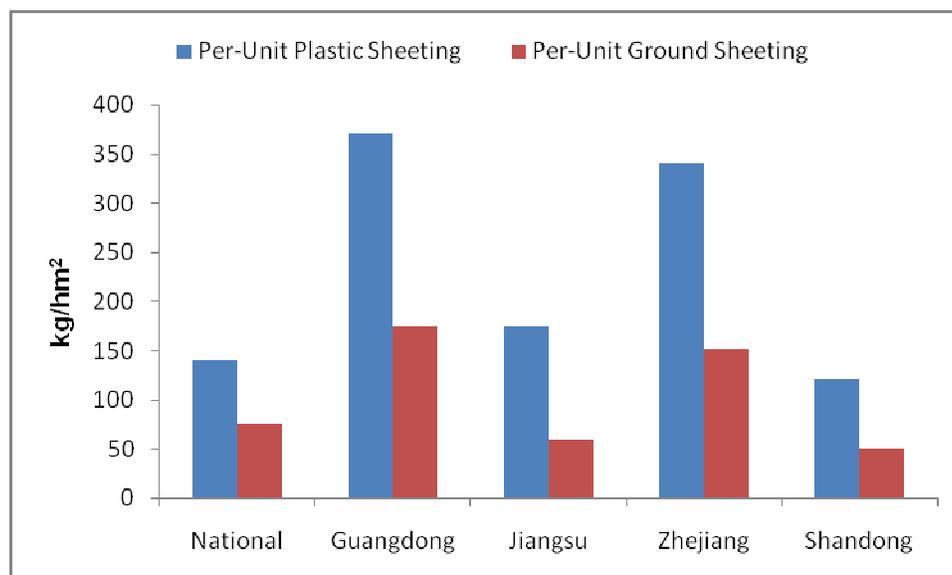
The situation in Guangdong in terms of aquaculture pollution is largely as follows: Firstly, there is too much feed, creating a polluted water environment. Environmental pollution as a result of aquaculture is largely a process of surplus feed, which is excreted back into the water, causing eutrophication—too many nutrients—which is a form of pollution that goes back into rivers and bodies of water when the aquaculture water is changed. The second issue is the misuse of veterinary drugs and additives that affect the quality of aquatic products. In an investigation carried out by the Guangdong Department of Health in 2010, 3,769 samples of Guangdong's shrimp, fish, and other aquatic culture products were tested for malachite green, chloramphenicol and methyl-testosterone and found a failure rate of 4.1%, showing that there is still a problem with excessive drug residues. The third issue is worsening environmental pollution at aquatic farms. Excessive industrial waste and pesticides have been discharged into rivers, lakes, the sea, and the atmosphere, resulting in polluted aquaculture production and poor environmental quality. In 2010, the pollution indices of the sea in coastal waters off Guangdong were mild (4.5%), medium (3.1%), serious (8.5%), with an area of seawater covering 22,042 sq km not meeting clean water standards due to an excess of 38.5% sewage emissions into the ocean.⁴

5. The Disposal of Agricultural Plastic Sheeting Cannot Be Overlooked

According to the "PRC Rural Statistics Yearbook," in 2010, Guangdong Province consumed 42,116 tons of agricultural plastic sheeting, 20,579 tons of mulches, 364.58 kg/ha of agricultural plastic sheeting per unit area, and 178.15 kg/ha of mulches. Guangdong per unit area usage of mulches and agricultural plastic sheeting were 2.35 and 2.62 times higher than the national average respectively. Its usage was higher than relatively developed provinces such as Jiangsu, Zhejiang and Shandong, becoming the PRC's biggest consumer per unit area of both mulches and agricultural plastic sheeting. In recent years, disk seeders are increasingly disposed of on Guangdong farms, and other plastic litter can be found in some regions. Leftover mulches not only affect agricultural production, but plasticizers and other plastic contaminants are also polluting the farmland environment, presenting a threat to sustainable development of agriculture that cannot be ignored.

⁴ Deng Yanjun, Tian Xingguo, Jiang Yanping, et al. "Guangdong Aquatic Product Quality and Safety Factors and Scientific and Technological Needs," *Guangdong Agricultural Sciences*, 2011, (23): 158-160.

Graph 1-14: Per-Unit Plastic Sheeting and Ground Sheeting, National and Provincial Comparison



6. Pollution from Burning Straw Remains Difficult to Control

For their energy needs, rural residents of Guangdong have gradually shifted to coal, liquefied gas, or electricity, and other energy sources, with the result that they regard straw as waste, leading to a serious problem of burning and negligent disposal. The problem is most serious in the areas of Maoming, Zhanjiang, Meizhou, Qingyuan, which together account for 42.73% of all the province's straw. Discarding straw is not only a waste of resources, but also has adverse effects on the village environment, air, and water, and can easily lead to the breeding of mosquitoes and flies, affecting rural health.

E. Rural Pollution Problems Caused by Industrialization and Urbanization

1. The Overall Effects of Industrialization and Urbanization on the Rural Environment

a. The Effects of Industrial Pollution on the Rural Environment

The impact of industrial pollution on the rural environment encompasses three main issues. The first is rural industrial solid-waste pollution. In 2010, Guangdong produced 12.8 million tons of township industrial solid waste, a 51.99% increase compared to 2006. According to a survey, 17.89% of Guangdong's villages suffered from industrial waste, 22.06% from chemical waste, and 17.65% from leather waste. The second issue is rural industrial wastewater pollution. It is estimated that rural Guangdong is currently producing around 3 million tons of industrial wastewater, and 727,300 tons—or 24.6%—of that is directly discharged into the environment with no treatment. The third issue is rural industrial air pollution. According to industrial output intensity discharge coefficient estimates, in 2010, Guangdong's rural industrial emissions reached 565.68 billion standard cubic meters, an increase of 51.06% since 2006.

b. The Effects of Urban Waste on Rural Areas

The first impact is taking up land. As estimated, 10,000 ton of waste needs to use land space of 1 mu, which means that annually nearly 1,000 mu of land in Guangdong Province are taken up by urban waste, seriously affecting sustainable development in rural areas. The second is exacerbating air pollution. The incineration of waste can generate hazardous pollutants, including sulfur dioxide, suspended particles, dust and others. The third is polluting water resources. Majority of landfill sites have not yet achieved waste treatment standards and lack proper facilities to treat leachate. As a result, leachate generated from buried waste cannot be effectively collected and treated, leading to underground water contamination.

c. An Overall Assessment of Rural Industrial Pollution and Urban Waste Management

Turning first to rural industrial pollution, according to the Guangdong Provincial Department of Health’s “Investigatory Report into the Monitoring of Rural Sanitation,” in rural Guangdong 54.41% of industrial waste is treated by landfill, 17.65% by incineration, 13.24% is recycled, and 14.71% is treated by other means. Meanwhile, when it comes to industrial wastewater, the treatment rate in rural Guangdong is 75.4%, but 24.6% of industrial wastewater is still untreated and directly discharged into the environment. Turning secondly to urban waste management, when compared to the treatment of industrial waste, the situation is negative, and rural residents are increasingly showing a spirit of resistance to the transfer for urban waste to the countryside, or for developing new waste disposal sites there for urban waste. The third issue is polling civic opinion. According to surveys, the “satisfied” and “dissatisfied” levels of rural residents to “controls of industrial, business, and other pollution” is basically flat at around 29%, meaning that more work on pollution controls needs to be undertaken.

Table 1-4: Assessment of Management of Industrial, Business, and Other Pollution
Work Unit: %

Attitude	Satisfied	Average	Dissatisfied
Indicator			
Management of Industrial, Business, etc, Pollution	29	29	29

Source: Guangdong Province Villagers’ Assessment of Environmental Pollution⁵

In terms of regional distribution, the PRD has the worst levels of pollution relatively speaking, and most rural residents were “dissatisfied” with the management of industrial, business, and other pollution.

Table 1-5: The Assessment of Various Kinds of Pollution by Rural Residents of Different Regions

Work Units: %

Attitude	Level of satisfaction	Level of dissatisfaction	Dissatisfaction minus satisfaction
Indicator and area	n	n	
PRD	21	37	16

⁵ Guangzhou Public Opinion Research Center, 2011

Guangdong east	32	27	-5
Guangdong west	30	25	-5
Guangdong northern mountainous regions	33	23	-10

Source: Public Opinion Research 26, Provincial Rural Eco-Environmental Research Reports

2. Industrial Relocations Lead to a Certain Degree of Pollution Transfers

As the PRD's traditional industries continue to transfer to underdeveloped regions—taking industrial production with them—problems associated with environmental pollution have become an issue. The first issue is an obvious need for water environment protection. The mountainous regions, and the east and west of Guangdong are the sources of the province's drinking water, but a considerable number of industrial relocation parks have located upstream from protected areas that are water sources, or adjacent to areas that supply grades I and II water, sometimes even locating within water-source protection areas, greatly increasing the pressure in terms of carrying out environmental protection work for water. The second issue is the threat to the safety of the rural environment. As industries transfer, rural industrial waste, sewage, air pollution, industrial parks occupying rural land, and other problems have become increasingly serious, affecting the production and lives of farmers. In the city of Zhaoqing, for example, according to departmental research data, more than 60% of transferred industry comprises ceramics, cement, paper, die-casting, aluminum, glass, electroplating, dyeing, leather, and other highly polluting industries, posing threats to rural environmental safety.

3. Despite Repeated Bans, Pollution from Small Traditional Industries in the Vicinity of Villages Cannot Be Stopped

Traditional small enterprises in the Guangdong countryside generally start from a relatively low base point—little capital, low levels of technology, and they not in harmony with the local environment. Untreated discharge of industrial wastewater has resulted in pollution in rural towns and villages, and is also contaminating the water used for agriculture. Meanwhile, industrial emissions have not only polluted the air in rural areas, but have also increased the incidence of acid rain, eroding buildings, and affecting agricultural production. The discharge of industrial waste also takes up a lot of arable land and consumes agricultural resources. According to statistics, wastewater COD emissions and solid waste from rural township enterprises account for over 50% of total emissions. Taking Nanhai District of Foshan City—one of the “National Top 10 Counties and Cities”—as an example, years of extensive growth model has made rural environmental pollution an accumulative problem. An example is the jade processing industry, which has become a major point source of noise and water pollution.⁶

4. Unregulated Exploitation of Minerals Has Seriously Harmed the Rural Environment

Regarding rural environmental problems associated with unregulated exploitation of mineral resources, the most severely affected areas are mainly located in the east, west and north of Guangdong Province, and are scattered over a total area of about 1,813.31 sq km. One issue in this kind of mining is that it has fragmented the landscape. Open-pit

⁶ Tan Wenxiong, A Study of Guangdong's Mine Ecological Environment and Ecological Restoration, 2008

mining, the felling of trees, stripping topsoil, digging up the land, waste rock dumps, and ash and slag from smelting have destructively affected local topographies and land resources. Meanwhile, underground mining has resulted in surface subsidence, and triggered changes in geomorphology and the environmental landscape. The second issue is that this kind of mining causes water pollution and destruction. Groundwater is transformed into mine water, leading to water contamination; gangue (waste rock) causes groundwater contamination; and mining causes the flow of rivers to change—in serious cases causing them to dry up. Rainwater on open dumps results in mineral leaching, contaminating surface water, rivers and streams. The third issue associated with mining of this kind is air pollution and its spread. The mineral products and waste exposed in the open air is prone to oxidation, weathering and spontaneous combustion, producing large amounts of harmful gases (such as CO₂, NO₂, and SO₂), while mineral dust is also harmful to human health. The fourth issue is the destruction of animal habitats, and undermining of biodiversity. Mining activities have destroyed some native ecosystems, including large areas of vegetation that has not regrown in a healthy state, while mines also act as barriers to the migration of species.

5. Pollution Resulting from the Burying and Incinerating Municipal Waste in the Countryside

As cities have grown in scale, their waste has inevitably encroached on the countryside. In the case of new waste treatment plants in particular, most are built far from urban centers and built-up areas, with some located in rural hinterlands. At present, the average radius of built-up areas of the key cities of Guangdong Province is 6.66 km, and the average distance from the city center for new or proposed incineration plants is 22.28 km, indicating that urban waste pollution is encroaching on rural areas.

Table 1-7: Average Distance of Waste Incinerators from City Centers

City	Metropolitan Area km ²	City Radius (km)	Average Distance from City (km)
Guangzhou	952	17.41	29.5
Shenzhen	830	16.26	27.3
Zhuhai	124	6.28	14
Foshan	152	6.96	22.1
Dongguan	92	5.41	7.8
Huizhou	215	8.27	42
Zhongshan	41	3.61	19.4
Shantou	182	7.61	13
Jieyang	58	4.30	24
Maoming	70	4.72	8.3

Source: Collected data and Google Maps

6. Shockingly Unregulated Dismantling and Recycling of Electrical and Electronic Products

Since the reform and opening up period, located in the coastal PRC, Guangdong has become a center for large-scale imports of e-waste from Europe, the US and other parts of the world. Gradually, this has formed an industrial e-waste recycling chain, especially in eastern parts of the province, such as Guiyu Township in Shantou, which is now known as a “leading e-waste town.” The environmental pollution caused by the simple dismantling of e-waste is shocking.⁷ The first issue is that it leads to dangerously contaminated areas with high levels of heavy metals and dioxin-like compounds. The heavy metals, and lead, chromium, copper, and tin contaminants associated with dismantling e-waste can be several hundred times—even thousands of times—higher than hazardous pollution standards, while polybrominated diphenyl ethers (PBDEs) levels can be more than 30 times higher than in other areas, and dioxin levels 37–133 times higher.⁸ The second issue is the serious threat to the health of residents. According to research carried out by Shantou University Medical College,⁹ workers in the e-waste industry in the Guiyu area suffer from headaches, dizziness, itching, rashes, nausea, insomnia, memory loss, and also had significantly higher incidence rates of conjunctival hyperemia. Blood tests on children revealed high levels of heavy metals, and tests in 2004, 2006, and 2008, showed lead levels exceeding safety standards by 81.8%, 70.8%, and 69.9% respectively.

F. Regional Variations of Characteristics and Trends in Guangdong’s RASC Environment

1. Environmental Differences Between RASC

Due to uneven development and differences in measures undertaken to protect the environment, there are significant variations in terms of the environmental situation between the PRD, and eastern, western, and northern parts of the province.

a. Air Pollution—Northern Guangdong Fair, PRD Worst, Equal in East and West

According to a study that carried out four surveys of 50 villages in different parts of Guangdong, air quality in RASC varies quite dramatically in different parts of the province, with northern Guangdong the best, the PRD the worst, and eastern and western parts of the province at about the same level. In urban areas and townships in northern Guangdong, the daily averages for pollution indicators are in line with the II-class standards of the national “Ambient Air Quality Standard” (GB3095-1996) and Guangdong’s reference values. The PRD’s urban and rural areas had the worst air quality, and some of the daily averages for pollution indicators did not meet either the above national standards or provincial reference values. The eastern and western areas of the province were relatively equal and of good air quality—in line with the national standards and provincial reference values.

Table 1-8: Quality of Air in Different Regions

Air	Sulfur-Dioxide Average	Nitrogen-Dioxide Average	Breathable Particulate	Air Pollution Index
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⁷ *Daily Economic News*, Guangdong Guiyu E-waste Industrial Upgrades Tumble, ” 2012

⁸ Fu Jiamo, “Study into Improving Health Risks in Areas Polluted by Electronic Waste,” 2009

⁹ Huo Xia, “Impacts on Human Health of Unregulated E-Waste Dismantling,” 2009

			Matter Average	Good	Fair	Bad
East	0.012 mm/m3	0.021 mm/m3	0.059 mm/m3	85%	9%	6%
North	0.009 mm/m3	0.014 mm/m3	0.034 mm/m3	90%	9%	1%
West	0.01 mm/m3	0.019 mm/m3	0.043 mm/m3	89%	8%	3%
PRD	0.014 mm/m3	0.029 mm/m3	0.065 mm/m3	65%	15%	20%

Source: Tang Lixia and Zuo Ting, "China Rural Pollution Investigation and Analysis: Data Collected from 141 Villages."

b. Water environment—Clear Differences between PRD, and Eastern, Western, and Northern Guangdong

The first issue is that water quality in the Pearl River, the Han River, and rivers in western Guangdong, is relatively good, while the water quality in rivers in eastern Guangdong is poor. The Guangdong Environmental Quality Report 2011 concurred, reporting that of the four major river systems in Guangdong, the Pearl and Han rivers, and western rivers, water quality is relatively good, while the eastern rivers' water quality is poor. In the east of the province 30% of rivers had pollution levels that exceeded Grade V. This is particularly true of the Shenzhen River and the Lian River, both of which continue to be severely polluted, exceeding Grade V. The main pollutants are ammonia nitrogen, COD, total phosphorus and dissolved oxygen. The rivers have lost even their basic capacity for self-purification, and are no longer suitable for fish. Out of the 17 major rivers in Guangdong that flow into the sea, 4 rivers have had different degrees of contamination. The Longgang River, Pingshan River, Foshan Waterway, Shiqiao Waterway, Shenzhen River, Meixi River and Lianjiang River are all heavily polluted. The most severely polluted sections of the rivers are those that flow through the densely urban sections of the PRD and some of the tributaries with small discharge in those areas. The main pollutants are fecal coliform, ammonia nitrogen, total phosphorus and some oxygen organics. Guangdong has 117 provincial control sections, and water in 70.9% of those sections is classed I–III, or "fair"; 13.7% are Grade IV, or "lightly polluted"; 6.0% are Grade V, or "moderately polluted"; and 9.4% exceed Grade V, or "heavily polluted."

The second issue is smaller bodies of water (gullies, creeks, streams, ponds). In mountainous areas and northern parts of the province, pollution is lighter, whereas in coastal regions and the plains water contamination is relatively heavy. The quality of water in small bodies of water in the west of the province (data below) does not inspire optimism, while in the PRD the situation is very bad, with excessive levels—of varying degrees—of 21 pollutants, including dissolved oxygen, permanganate index, COD, biological oxygen demand (BOD5), ammonia nitrogen (NH3-N), phosphorus, copper, zinc. In short, PRD river water quality is poor with 40% of the rivers exceeding Grade V, or heavily polluted. In terms of coastal waters, the Pearl River Estuary continues to be heavily polluted in contrast to the lesser degree of water pollution in northern Guangdong.

Table 1-8: Pollution in Small Bodies of Water in Different Regions

"Surface water quality" (GB3838-2002)	Grade I (%)	Grade II (%)	Grade III (%)	Grade IV (%)	Grade V (%)
North	10	12	42	26	10
West	3	22	35	25	15
PRD	0	4	22	54	20

Source: "China Rural Pollution Investigation and Analysis: Data collected from 141 Villages", according to consolidate relevant data obtained.

c. Noise Pollution—East and West Guangdong Fair, PRD Worst

In terms of the layout of the traffic system, population density, as well as industrial development, and other factors, the east, west and north of Guangdong Province has relatively less noise pollution, while the PRD's noise pollution is relatively heavy. In eastern, western, and northern parts of Guangdong functional area, daytime noise pollution of all kinds was higher than the national, and the PRD, compliance rates.

Table 1-9: Noise Pollution in Different Areas

Sound (GB3096-2002)	0 Grade	1 Grade	2 Grade	3Grade (%)	4 Grade (%)
All Guangdong	58. 3	80. 9	85. 6	98. 8	84. 6
Eastern Guangdong	73. 2	82. 4	87. 5	98. 4	85. 2
North Guangdong	83. 2	87. 4	89. 4	97. 4	81. 2
West Guangdong	79. 2	79. 4	85. 4	98. 4	89. 2
PRD	42. 2	77. 4	79. 4	99. 4	77. 2

Source: "China Rural Pollution Investigation and Analysis: Data collected from 141 Villages", according to consolidate relevant data obtained.

d. Soil Environment—PRD Pollution Worst, North Relatively Light

Soil pollution in Guangdong is common, but there remain big discrepancies in the type and extent of the pollution, with the PRD the most polluted, and northern Guangdong comparatively light but with still high levels of pollution, and with widespread soil contamination in eastern and western regions of the province. Measured by soil

standards (GB15618-1995), in terms of a compliance rate between grades I to III, northern Guangdong is the best, and higher than the provincial average, followed by eastern, and western Guangdong, while the PRD is the worst, and lower than the provincial average.

Table 1-10: The Extent to Which Different Areas Reach Soil Standards

(GB15618-1995) Soil Standard	Grade I (%)	Grade 2 (%)	Grade 3 (%)
All Guangdong	58. 3	70. 9	75. 6
East Guangdong	57. 2	62. 3	57. 5
North Guangdong	83. 2	87. 1	89. 4
West Guangdong	79. 2	79. 4	75. 4
PRD	47. 2	57. 4	69. 4

Source: “China Rural Pollution Investigation and Analysis: Data Collected from 141 Villages”, “The Guangdong Provincial Environmental Bulletin” (2008-2010), according to consolidated relevant data obtained.

e. Waste Volume—PRD Worst, East and West Equal, North Lightest

There are big regional differences in the average volumes of waste, industrial and household waste generation throughout RASC in Guangdong. The province’s average waste per-rural-village per month is 91.55 tons, while the household volume per month is 0.1364 tons. Waste per capita averages 29.2 kg per month. The PRD has the highest per-capita output, the east and west are both at around the same level, and northern Guangdong has the lowest. In a county-level survey on per-capita waste production, Dongguan (130.804 kg) topped the list, followed by Zhongshan (70.093 kg), and the lowest were Jieyang (7.615 kg) and Meizhou (6.450 kg). Dongguan also headed the list for rural household waste per capita per day (0.82 kg), followed by Guangzhou (0.75 kg), with the lowest daily household waste outputs in Maoming and Qingyuan, (0.31 kg).

Meanwhile, because the industrial base and production methods differ from area to area, the nature of the waste that is produced is also different. In the rural farming areas of Yunfu, Zhaoqing, and Yangjiang more than 70% of the waste is agricultural, at 74.30%, 71.67% and 71.52% respectively. In Maoming, Huizhou, and Meizhou, agricultural waste accounted for more than 50%, at 67.89%, 58.98% and 54.88% respectively, while in Dongguan, Foshan, and Zhongshan, most waste is industrial, accounting for 61.69%, 47.86%, and 42.14%. In Shanwei, Qingyuan, and Jiangmen, the majority of the waste was aquaculture waste at 44.86%, 44.63%, and 42.82%. However, overall, in Guangdong Province, waste is mainly either agricultural or industrial, at 32.87% and 29.73% respectively, followed by aquaculture, construction waste, and—the smallest contributing factor—medical waste.¹⁰

2. Development Trends

From the above analysis, it is not difficult to see that, at present, Guangdong’s rural environmental protection and construction are at a tipping point. If immediate action and

¹⁰ Gao Haishuo, Chen Guikui et al “Investigation and Analysis of Waste Generation and Handling in Guangdong Province,” *Agro-Environment Science* 2012, 31 (7) 1445-1452)

effective measures are undertaken to increase rural ecological environment protection and management, it will be possible to reverse the continuing deterioration of the environment. But, if action and decisive measures are not taken, and the situation is left unchecked, environmental problems will proliferate and spread, leading to runaway environmental pollution. Once the environmental balance point is tilted, it will begin to seriously threaten people's health.

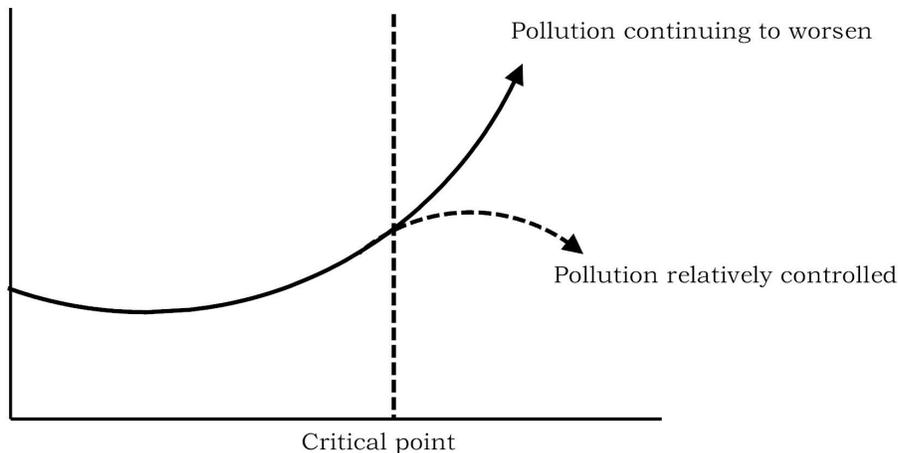
a. If Effective Measures Are Not Adopted, Pollution Will Continue to Worsen in Guangdong

The current trend of spreading and accelerating rural pollution in Guangdong has to be effectively curbed before the environment reaches a tipping point that is difficult to reverse. Firstly, looking at the problem from the geographical point of view, originally rural pollution was only a problem in the industrialized and urbanized PRD, and other industrialized and urbanized regions, but now rural pollution accidents are spreading into less developed parts of Guangdong, including the north, the east and the west. Secondly, there has been a diversification of the types and sources of pollution, leading to an overall deteriorating trend of pollution. This trend of diversification includes residue from the inappropriate use of pesticides and chemical fertilizers, and increasing levels of heavy metals, both of which are worsening. Meanwhile, the lack of centralized treatment for rural household waste and wastewater is leading to deterioration of the rural environment. The situation with rural household drinking water is grim also, among other problems. Lastly, because environmental work is currently still in the phase of passively responding to pollution, the result is bad environments that lack governance, and areas with good environments deteriorating, dragging down the overall effectiveness of Guangdong rural environmental governance.

b. With Effective Governance, It Is Possible to Restore and Optimize Rural Environments

Looking at the experience of the US, Japan, and other developed countries, if the government is able to implement effective measures, it can prevent environmental pollution and ecological destruction that arises from urbanization and industrialization. However, there is a point at which damage to the eco-environment is irreversible, and if that point is reached it becomes very expensive and very difficult to repair. For this reason, while it is important to strengthen the penalties and control of environmental pollution cases, it is even more important that preventive protection measures are undertaken in rural areas against environmental pollution. In other words, governance and control of rural environmental pollution is being taken very seriously by the provincial government, specifically formulating the "Guangdong Province Rural Environmental Protection 12th Five-Year Plan," and the "Guangdong Province Rural Environmental Action Plan (2011–2013)," requiring government and its departments at all levels to take effective measures to strengthen rural environmental protection. From this point of view, as long as the provincial government and all its departments act in this way, taking effective measures to implement effective governance, the rural ecological environment is increasingly likely to improve, gradually repairing ecological damage that has been caused by pollution.

Graph 1-15: Rural Environmental Protection and Ecological Construction Trends in Guangdong



II. Constraints to Improving Rural Environmental and Ecological Protection

A. Objective Constraints in Stages of Economic and Social Development

1. Rural Environmental Construction Has Failed to Keep Pace with Urbanization

In terms of its current stage of economic development, Guangdong's total GDP is large, and the province is maintaining high-speed growth. But growth is lagging in the province's sprawling RASC, and there is a huge urban-rural gap. According to Kuznets curve, economic development and environmental conditions have an inverted U-curve relationship. In Guangdong's RASC at this stage, the overall economy is still at the development stage, so environmental protection remains relatively weak. Lack of urbanization in RASC disperses populations, making it difficult to achieve economies of scale for the treatment of solid waste and wastewater. If it is desirable to achieve the same levels of treatment that cities have, it requires much greater investments of funds and equipment—far beyond the scope of toleration in RASC today.

2. Putting Economic Interests before Environmental Protection Still Exists in Less Developed Areas

For performance and economic considerations, there needs to be strict screening in the process of industrial relocation to avoid the recommendation of enterprises that are highly polluting and high-energy-consuming. In underdeveloped regions, in the heady rush of constructing industrial parks, putting economic benefits ahead of environmental protection remains relatively common, and some parks even go so far as to open high-polluting chemical and electroplating enterprises.¹¹ Regional governments that take this route are walking the PRD's path of "pollution first, clean up later" formula, in simple pursuit of GDP growth, lowering protection requirements sacrificing the local environment to draw in investment. As shown in Table 2-1, which compares the output values of polluting industries between the years 2000 and 2010, it is obvious that polluting industries in the PRD showed an overall decreasing trend, while, on the contrary, in eastern, western and northern Guangdong the proportion of polluting industries showed a rising trend. It is worth noting that the most significant decline in the PRD region was the extractive and non-metallic mineral products industries, along with other heavy polluting industries. Most of that industry moved to northern Guangdong.

¹¹ Li Dong, "Underdeveloped Areas of Guangdong Investment Problems and Countermeasures," 2009

Table 2-1: A Regional Comparison of Output Value of Polluting Industries

industry	PRD		East		West		North		
	2000	2010	2000	2010	2000	2010	2000	2010	
Heavily polluting industries	Extractive	71.7 4%	51.09 %	0.44%	0.13%	22.10 %	29.15 %	5.73%	19.63 %
	Paper and pulp products	89.0 5%	87.46 %	3.05%	6.44%	4.35%	2.59%	3.54%	3.52 %
	Chemical materials and products manufactu ring	83.9 6%	88.38 %	7.07%	3.51%	6.58%	4.02%	2.38%	4.09 %
	Ferrous metal smelting and rolling processing	65.6 6%	66.18 %	0.65%	8.53%	6.13%	5.59%	27.56 %	19.70 %
	Steam and thermal power	77.4 1%	75.58 %	6.68%	10.97 %	6.67%	4.49%	9.25%	8.96 %
	Nonmetal Mineral Products	80.0 4%	64.35 %	5.79%	9.76%	3.50%	2.82%	10.67 %	23.07 %
	Food, Tobacco and Beverages	78.6 2%	70.70 %	8.12%	7.09%	7.89%	11.71 %	5.36%	10.50 %
	Pharmace uticals	87.0 3%	81.32 %	4.68%	11.14 %	2.21%	2.89%	6.10%	4.67 %
	Chemical Fiber Manufactu rers	90.4 8%	89.40 %	5.49%	9.74%	2.32%	0.00%	1.71%	0.87 %
	Metal Product Manfactu rers	89.1 6%	83.91 %	3.44%	6.44%	3.99%	5.86%	3.42%	3.80 %
light polluting industries	Print & Media	83.9 2%	74.90 %	12.10 %	18.76 %	2.73%	2.27%	1.24%	4.06 %
	Plastic Products	88.3 5%	78.41 %	8.39%	15.36 %	1.72%	1.50%	1.54%	4.73 %
	Leatherwa re and products	89.9 3%	84.79 %	3.07%	2.82%	6.41%	2.91%	0.59%	9.48 %

Electrical	95.6	94.00	1.96%	1.95%	0.88%	1.33%	1.48%	2.72
Goods and Equipment	8%	%						%

Source: Guangdong Province Annual Statistics

Note: The values in the table = all regions and sectors of industrial output value / value of the province's industrial output

B. Environmental Protection Externalities Constrain Agencies back from Taking Initiative

The fact that investing in environmental protection and management has an externality of benefits makes it difficult. Firstly, exclusivity comes with a high price, and it is very difficult for agents that take actions on environmental protection to exclude others to benefit. Secondly, the social harm caused by the environmental damage by economic agents is difficult to control, making it impossible to effectively contain environmental damage. Thirdly, environmental protection lacks appropriate compensation, tempering enthusiasm for environmental protection.

At a regional level, this presents local governments with external factors when it comes to utilizing and protecting their local environments. For example, if Guangdong's northern mountains—an ecological barrier—were developed for industry, it would damage the environment, and have an environmental impact on the PRD region. On the other hand, if the northern mountains are going to continue to act as an ecological buffer, ecological compensation should be given. But the externality of this for developed areas means that they do not conduct ecological compensation. At the level of individual economic agents, external economic factors are only considered from an individual cost-benefit point of view, and gains from the pollution are far lower than public costs of containing it, exacerbating the social burden of environmental protection. For example, an individual villager who litters might feel it has negligible impact on the own environment, but the impact on other villagers, or on the environment of the entire village, goes far beyond any damage to the individual. Therefore, given the externalities of the natural ecological environment, eco-environmental protection and governance cannot simply rely on individual behavior; it requires collective institutional arrangements and effective protection mechanisms.

C. Serious Shortages of Funds for Rural Environmental Protection

In Guangdong's RASC today, there is a serious shortage of investment for eco-environmental improvement. Almost all funding for environmental protection is focused on the province's cities, and establishment of environmental protection in RASC receives far less overall investment, leading to poor infrastructure, and limited capacity to treat contaminants. Meanwhile, in terms of the use of what funds are available for environmental protection agencies in the areas of agriculture, water conservancy and other decentralized departments, efficient coordination is lacking. During the process of funds being allocated to specific uses, lack of strict supervision and management lead to the risk of misappropriation as the funds are disbursed to lower levels.

On the issue of funding, in 2012, research sampling was carried out at Yihe Village, in Dongyuan County, Heyuan, and at Jiangdong Village, in Chaoan County, Chaozhou. The survey results showed that more than 60% of the villagers surveyed considered that there are funding gaps for environmental protection. Most of the villagers said they were willing to pay a fee for rural environmental protection work (see Table 2-2). In the existing

environmental funding, a high proportion is funded by villagers themselves. However, due to the fact that rural populations, especially in the east, west and northern regions of the province, have relatively low salaries, their capacity for self funding is limited, requiring an overall increase in government funding, while actively exploring better ways to raise funds.

Table 2-2: Willingness to Contribute Funds for Environmental Protection (unit: %)

Evaluation	CNY5 or less/Month	CNY5—10/Month	CNY10-20 / Month	More than CNY20/Month
Yihe Village	20	20	40	20
Jiangdong Village	21.95	35.37	35.37	7.32
Villages	20.93	31.4	37.21	10.47

Table 2-3: (Village) Funding Sources for Environmental Protection and Eco-construction (Unit: %)

Evaluation	Support from Higher Level	Village-level Government Support	Civic Self-funded	Sewage Charges	Other
Yihe Village	33.33	33.33	16.67	8.33	8.33
Jiangdong Village	9.35	27.34	49.64	9.35	4.32
Villages	17.79	29.45	38.04	8.59	6.13

D. Rural Environmental Management and Mechanisms Still Not in Order

1. The Government Lacks Supervisory Power on the Rural Environment

Compared to metropolitan systems for supervision and management of environmental protection, in the countryside there is next to nothing. Institutionally, at the three levels of city, county, and township, the county and township levels of hygiene administration are already out of kilter, making it difficult to normalize the treatment of county and township waste. Apart from some parts of the PRD, the Environmental Protection Bureau at the county level has not yet established a special department to carry out rural environmental protection work, and the vast majority of the countryside and townships do not have environmental agencies. In terms of regulatory systems, existing city and county environmental protection agencies for carrying out monitoring and regulating suffer from serious deficiencies of capacity, lacking personnel, equipment, management, and funding. Technical skills are weak, and monitoring networks do not extend to cover the countryside and townships, making environmental monitoring and enforcement difficult in rural areas, where there are very real needs. This is particularly true of drinking water sources in rural areas, and rural industrial and mining enterprises, and other important areas that require monitoring and supervision.

2. Rural Environmental Management Lacks Mechanisms for Overall Planning and Coordination

The current situation in Guangdong's rural areas in terms of ecological and environmental protection is the issue of "overlapping management," in which all environmental work involving all levels of development and reform, environmental protection, agriculture, finance, water, sanitation, and housing construction, touches on and includes a number of departments. On the one hand, because the various departments have their own interests, objectives and environmental aspirations, lack of coordinating mechanisms make it difficult to achieve good governance and environmental protection. On the other hand, overlapping management effectively equals "no management," or a management vacuum, with unclear rights and responsibilities, no basis for effective management, and environmental management and protection in RASC difficult to coordinate and carry out.

3. Environmental Considerations Neglected in Rural Construction Planning

At present, Guangdong's RASC lack scientific, rational and forward-looking planning. The main reason for this is the lack of an overseeing agency led by a government department to coordinate institutional mechanisms for rural ecological and environmental protection. As things stand, every village and township has to "go it alone," and in the absence of unified planning, they do not put a great deal of emphasis on environmental thinking. For most of the part, there is very little differentiation between village and township enterprise areas and residential areas, with the spilling in to each other. As a result, sewage, drainage, waste collection, and other waste treatment infrastructure lacks scientific planning, and integrated construction, resulting in open sewers, and garbage everywhere. In some industrialized rural areas, due to poor planning and improper layout, industrial pollution problems are more serious. When it comes to on-the-spot input, 75% of villagers agreed that the villages they reside have construction planning, but only a little over 40% agreed that their villages have environmental construction plan.

4. Lack of Effective Mechanisms to Provide Environmental Compensation

Environmental compensation mechanisms are based on protecting the environment and promoting harmony between man and nature, integrating administrative and market-based instruments, and adjusting the interests between all parties connected to the environmental protection and development. The aim is to employ economic incentives and the "polluter pays" principle together so as to promote sustainable use of resources, accelerate the construction of an environmentally friendly society, and achieve harmonious development in different regions, and between different interest groups. At present, Guangdong's rural environmental compensation mechanisms are imperfect. One issue is that, in terms of water resources, upstream regions that are in need of protection need downstream regions to transfer funds. But due to the lack of scientific valuation of the upstream water resources, the value of ecosystem services, ecological protection costs, and the opportunity costs, downstream areas have not undertaken reasonable compensation. Meanwhile, since the emissions trading platform is evolving at relatively slow pace in Guangdong, and is still in the planning stage, this is blocking establishment of a rural environmental compensation system.

5. Lack of Environmental Supervisory and Assessment Mechanisms

Under the existing evaluation mechanisms, local government assessments are still

dominated by economic indicators, and environmental construction is not yet fully integrated into local government assessments. According to this arrangement local government remains “heavy” on the economy, “light” on the environment, and there is a fundamental lack of guarantees for environmental protection. The first issue is the establishment of the statistical indicators for the environment. At present, bureaus of statistics lack a statistical indicators system due to constraints in funding and monitoring skills on the basis of inspections and interviews in, for example, Guangzhou, Heyuan, and Chaozhou, among other cities and areas. This makes it difficult to fully reflect the environmental state of different regions. When the indicators provided by villages and townships are inadequate, this also contributes to a lack of scientific evaluation indicators and uniform appraisal standards. The second issue is integrating local government appraisal systems. Although various attempts have been made, in terms of implementation, a variety of problems remain, with relatively small responses to the index, or that the environmental assessment is only a reference index, and has not become a hard target.

In 2012, a study group conducted a sample survey of local-level government officials in Guangzhou, Chaozhou, and Heyuan. The survey found that, for village officials in Guangzhou and Heyuan, less than 30% of their performance evaluation indicators factored in environmental protection, and the majority of RASC have yet to incorporate environmental indicators into the evaluation systems of their officials at all. The good news was that more than 50% of villages and townships in Chaozhou City area factored in environmental indicators in the evaluation systems of their officials.

Table 2-4: The Presence of Environmental Indicators in Village and Township Officials’ Evaluations

	Yes	No	Unknown
Guangzhou City	18	36	45
Heyuan City	29	43	29
Chaozhou City	50	10	30
City	32	29	36

E. Imperfect Policy and Regulatory System Makes It Difficult to Achieve Goals

1. Existing Environmental Policies for Rural Areas Are Imperfect

Firstly, policies on rural environmental construction are insufficient. Guangdong’s rural environmental construction policy is relatively uniform in terms of form and content, and mainly confined to guiding policies on “ecological environmental construction planning,” “eco-function zone planning,” and other kinds of planning that only provide guidance.” There are relatively few mandatory policies, the policy system is imperfect, and protection is weak. Secondly, environmental compensation policies need to be improved. In recent years, environmental protection has been biased toward subsidies for industrial parks and industrial enterprises, with rural environmental construction—and especially basic rural environmental infrastructure construction—unimplemented and receiving insufficient attention. One of the problems is that some enterprises that apply for assistance from environmental protection funds do not use the funds exclusively for environmental construction, resulting in a waste of compensation funds. Another problem is that currently compensation for rural environmental protection in the area of

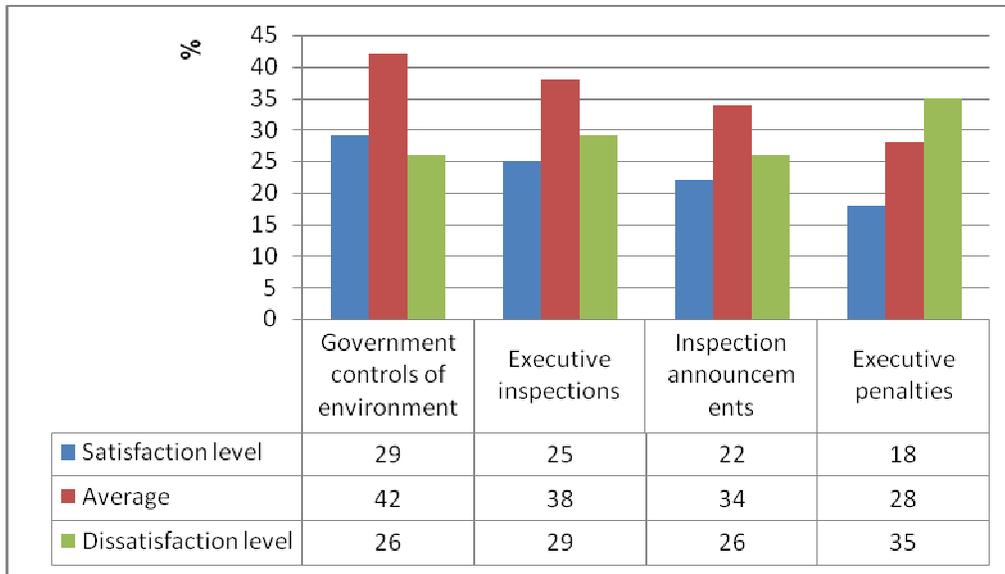
construction generally only offers compensation for infrastructure costs and not for operating expenses. For sewage treatment plants, for example, annual operating costs and transportation costs are the chief expenses, and are difficult for rural villages and townships to afford.

2. Existing Environmental Construction Policies and Regulations Cannot Be Executed

The aim of implementing rural environmental policy and enforcing administrative law is to optimize the management of the rural environment, which is an important means of improving the quality of the environment in rural areas. Environmental quality, pollution control, and the environmental rights of rural residents rely on environmental policy implementation and enforcement powers. But surveys reveal that the situation in terms of implementation of promulgated rural environmental construction policies and regulations, and the enforcement of laws at a grassroots level, lack grounds for optimism. Among the problems is, firstly, lax implementation of urban and rural planning. Contradictions between environmental construction and economic development, make the implementation of environmental policies by government departments at a grassroots level “ineffective,” and in some less-developed regions it has been the case that in order to pursue short-term interests, and unilateral economic development, departments continually adjust set plans, making it possible for industries that do not meet environmental protection requirements to take root locally. The second problem is that the enforcement of rural laws is ineffective. Basic environmental supervisory and management mechanisms are not perfect, with unclear division of responsibilities between the various regulatory agencies, poor coordination, lack of administrative enforcement personnel, and low standards of professionalism, law enforcement, and even local administrative intervention in rural environmental issues. This results in a situation in which, at a grassroots level, environmental laws are not followed, enforcement is lax, illegal acts are overlooked, and people or entities put themselves above the law, all of which makes environmental enforcement difficult, and the problem of weak enforcement becomes widespread.¹² According to poll data from the Guangdong Provincial Public Opinion Research Center, less than 30% of the public was “satisfied” with government enforcement of environmental standards, while most were “more than dissatisfied” in three areas of enforcement, revealing negative public assessment in which the satisfaction level for enforcement and punishment was as low as 18%.

aph 2-1: Assessment of Implementation of Environmental Regulations by Rural and Township Residents

¹²Peng Faqi, China's Rural Ecological Environment Protection Legal Issues, 2011



Source: Report on Province-wide Public Evaluations of the Environment¹³

F. Rural Understanding of Environmental Issues Hazy

“So-called environmental awareness refers to people’s awareness of the state of the environment and having a basic understanding of the rules of environmental protection, behaving in ways that are conducive to environmental protection according to their fundamental values.”¹⁴ At present, due to the low quality of the labor force, the shortcomings of rural environmental advocacy, and limited channels for learning about the environment, among other limitations, overall awareness of eco-environmental protection in rural Guangdong remains weak. In the Guiyu e-waste recycling industry, for example, under the weight of huge economic interests and the inertia of habitual behavior, there is a kind of wait-and-see attitude towards both pollution remediation, and industrial upgrading by those engaged in the local industry, local government, and even public opinion. In other words, eco-consciousness, and industrial transformation and upgrading have a long way to go.

1. Unhealthy Rural Habits Are Hard to Completely Change in the Short Term

Rural residents that have long lived in scattered housing close to their own gardens and land, can use human and animal waste as organic fertilizer, casually dispose of their household waste, and directly discharge their wastewater. But with the advances of science and technology, modern consumer products have undergone tremendous changes, and as the amount of difficult-to-degrade household waste that is casually thrown away piles up it becomes increasingly difficult to handle. When large amounts of fertilizer and pesticide are used, the result is soil and water pollution with high treatment costs. In addition, urban areas have similar problems, as urbanization has brought many people together that previously lived in scattered housing, forcing them to change their ways of life. But it is difficult to change habits, and as a result amenities such as garbage cans, public toilets, and other sanitation facilities are not

¹³ 2011 Canton Public Opinion Research Center, 2011

¹⁴ 2004 Lu Zhongmei, Xu Xiang, editors, Collected Essays on Environmental Resources Law

effectively used, and environmental awareness is very weak.

2. The Overall Quality of the Rural Workforce is Low

In Guangdong the overall quality of the rural labor force is relatively low. According to data in the “Guangdong Statistical Yearbook 2011,” in 2010 educational levels of rural labor in the primary industry (agriculture), 6.0% were illiterate and semi-illiterate, 34.0% had primary education, 47.5% had attended junior high, 11.0% had high-school diplomas, 1.1% had vocational and technical education, while 0.4% had associate degrees and above. Some 80% of farmers engaged in the primary industry of agriculture had elementary and junior-high school educations, compared to about 12% that had graduate from high school and above. The low educational level of agricultural labor, and the lack of professional training, has led to the widespread misuse of fertilizers, and pesticides, according to the economic ability of farmers to buy it.

3. There is a Shortage of Publicity About Environmental Protection and Learning Channels are Limited

Firstly, the propagation of information about environmental protection in rural Guangdong is relatively weak. This is especially true of economically underdeveloped RASC, where there is a prevalence of functional departments that pay no attention to environmental construction work, and propaganda workers, finances, and material inputs are all limited. The result is that rural environmental protection work is ad hoc and last minute, making it difficult for the hearts of villagers to identify with environmentally friendly work and practice what is preached to them. Secondly, there are very limited channels for villagers to learn about the environment. The government has set up very few learning platforms for the convenience of learning. Insofar as there are libraries and other platforms for learning, they are more for the promotion of technical skills associated with agricultural production rather than environmental protection. Meanwhile, the majority of rural residents have very little interest in learning about environmental protection.

III. International Experience and Lessons on Environmental Improvement in RASC

A. South Korea: ‘The New Village Movement’ Significantly Improved the Economic and Environmental Outlook

In 1970, South Korea launched a nationwide “New Village Movement” to improve rural production and the living environment. The first thing that South Korea learned from this was that rural environmental protection is a key investment area, and it vigorously promoted the improvement of environmental infrastructure. From 1970 to 1980, the South Korean government invested accumulated 2.8 trillion won in the “New Village Movement,” accounting for about 50% of its total investment into the development of the living environment and environment infrastructure. In terms of improving the living conditions, most of the work involved improving housing, and the construction of public baths, and swimming pools. In terms of eco-environmental improvement, the work involved construction of agricultural roads, and bridges, establishing public compost fields, organization of fields for cultivation, governance of small rivers, and improving rural waste and sewage treatment. The second thing that South Korea learned was the importance of agricultural subsidy policies, and actively developing environmentally friendly organic agriculture. In the 1980s, South Korea regulated prices to support rural environmental protection, organized the land to facilitate scientific farming, and used direct subsidies to protect environmentally sensitive areas. Entering the 21st century, the South Korean government passed an agricultural bill that actively supported organic

agriculture, strengthening standardized management, and expanding the “subsidy” system, building out the agriculture base, improving the recycling and reuse of waste agricultural materials, improving the effective use of livestock manure, and promoting environmentally friendly agricultural development.

B. Japan: First Implement Rural Pollution Laws and Regulations

Japan’s laws and policies provide great support to rural environmental protection work: The first point is that Japan’s agricultural environmental protection is largely supported by national policy. Japan has, at various times, developed and implemented a variety of agricultural environmental protection policies and measures, and these have played an enormous role in guiding and promoting the sustainable development of agriculture. The second point is that legislative measures were employed to ensure the advancement of agricultural environmental policy. Centered on its Agricultural Basic Law, Japan has developed a series of agricultural environmental protection laws that have continuity and relevance, and where necessary it has made changes and additions to ensure the effective implementation of agro-environmental policy. The third issue is that in Japan the law is a yardstick for formulating responsive policies and measures. An example is the “Organic Agriculture Law,” which has since been used as the basis for successively promulgating the “Standards for Labeling of Organic Vegetables, and Fruits,” “Essential Points on Managing the Production of Organic Produce,” and “Organic Food Production Standards,” among other regulations. Promotion and implementation takes place at various levels of local government, ranging from municipal and prefectural to township. The fourth issue is that Japan’s policies are specific and targeted. The government implements many preferential policies for agriculture, such as providing interest-free loans from earmarked agricultural funds for farmers engaged in organic agricultural production, as well as subsidies and tax breaks for compost facilities and storage and transportation infrastructure for organic produce.

C. US: The Solid-Waste Management Experience of San Diego County

San Diego County, California, has placed great emphasis on the classification of solid waste, its collection and recycling, putting great efforts into solid-waste recycling programs, and achieving good results. It has achieved results by firstly promoting the waste-recycling program and encouraging active public participation. Since the early 1990s, San Diego County put great efforts into publicizing its solid-waste recycling programs to the public. The local government used public places such as supermarkets, schools, department stores, and shopping malls to publicize and identify recyclables, educating the public about environmental protection and recycling. Secondly, the program has been a success due to government funding for solid-waste transfer stations in remote areas. Due to lack of funds, establishing a collection and disposal system in some remote areas inhabited by Native American peoples was difficult, and solid waste frequently accumulated in these areas. Funding to solve this problem was specifically mobilized by the US Department of Agriculture, and were used to establish a solid-waste transfer station, with small trucks fanning out to smaller communities of Native Americans and collecting waste to transfer to the solid-waste transfer station (where preliminary recycling was also possible), before large trucks took the waste for disposal at landfills. Thirdly, the program has been a success because the government formed a broad coalition of community organizations, using various means to stop the illegal dumping of waste. Illegal dumping of waste in California’s Native American reservations was rampant, posing serious risks to the environment in those areas. To restrict the illegal dumping, the US Environmental Protection Agency and the Bureau of Indian Affairs formed the Torres-Martinez Solid-Waste Alliance, and by 2006 its members

included 24 federal, state, and local governments, and non-profit institutions. The alliance has actively brought together talent and resources from various agencies, provided support for public advocacy, while carrying out outreach, acting directly and firmly. In less than two years, the alliance cleaned up more than 20 illegal waste dumps, and effectively curbed illegal dumping in local Native American reservations.

D. Taiwan, China: Using Wetlands to Solve the Problem of Rural Sewage

Rural Taiwan, China has long used constructed wetlands—especially in areas where there is inadequate construction of concentrated sewage treatment facilities. The reason is that in RASC there are funding limitations and difficulties in installing centralized facilities, while the main pollutants in agricultural areas are household wastewater that does not require expensive and advanced technology to reach the minimum processing requirements. Compared to the technical complexity of sewage treatment plants, the only drawback in the use of constructed wetlands is the need for more land. In recent years, Taiwan, China has used three types of constructed wetlands: free-water surface systems, subsurface flow systems, and vertical flow systems. Free water surface systems are the most widely used, sometimes combined with subsurface flow systems to provide further treatment of sewage. Since the early 2000s onwards, Taiwan, China has launched a number of manmade wetland sewage treatment projects. In accordance with plans, some facilities have demonstrated their effective and efficient use of water. Typically, the construction costs for manmade wetland water treatment are around 20%–25% of the costs for conventional treatment, but two to three times more land is required. For example, Hualian, in eastern Taiwan, China, a county with a population of 350,000, and an area of 4,628 sq km, is one of Taiwan, China's leading agricultural counties and also has rich tourism resources. In 2007, Hualian constructed four manmade wetland wastewater treatment plants with different uses that further treated residential wastewater or polluted rivers, reducing the pollution of water bodies downstream. According to the Hualian County government, the four manually operated projects in the manmade wetlands needed to be carefully planned and implemented, on the basis of valuable experience garnered in the past about: (i) land acquisition; (ii) public approval; (iii) effective demonstration and promotion; (iv) pollution reduction; (v) risks arising from intrusive damage; (vi) compatibility with landscape; (vii) waste water collection and disposal; (viii) constructability.

E. Domestic and Foreign Experience of Rural Environmental Management

The above domestic and international experience of rural environmental management can provide the following lessons for Guangdong: 1. Implement integrated urban and rural development and environmental protection strategies. The urban-rural dichotomy restricts the development of rural PRC, and also affects rural environmental protection. South Korea's "New Village Movement" both strengthened rural infrastructure, while improving the rural environment. (2) Establish and improve rural environmental policies and regulations. Japan's environmental legal system, and supporting policies and measures are very comprehensive, providing a strong impetus to rural environmental protection work. 3. The government should increase investment in environmental protection in rural areas, through the establishment of diversified investment mechanisms. Rural environmental protection requires significant capital investment, with strong government support and a wide range of capital investment. South Korea's "New Village Movement," which combined government investment and rural methods for raising capital was a good solution to funding problems. 4 Give full play to social organizations in terms of rural environmental protection. In many developed countries and regions, environmental organizations are social forces that throw

themselves into the field of environmental protection in rural areas. 5. Mobilize farmers to carry out rural environmental protection through a sense of ownership. Mobilizing farmers' sense of ownership was a pioneering initiative by the South Korean government, which gave play to farmers' enthusiasm, initiative, creativity, and potentials, so that they felt part of rebuilding the countryside.

IV. Policy Recommendations for Environmental Improvement in Guangdong RASC

The guiding principle is to promote the improvement of environmental quality in rural areas, combining protection of the rural environment and promoting the sustainable development of agriculture, while persisting in being people-centric and making the people's livelihoods the priority, building an environmentally friendly way of life and rural production.

The main Objective is that, by 2015, the institutional mechanisms to gradually improve the environmental and living conditions of RASC will be increasingly optimized, and production methods will have improved, with effective prevention and treatment of industrial pollution. This will improve the rural environment and achieve sustainable rural economic and social development, leading to a continually improving overall situation.

—Gradually improve rural environmental protection mechanisms. The PRD will reach a 100% compliance rate in terms of standardized hardware in county-level environmental monitoring sites, while other regions will reach 80%; PRD standardized hardware in county-level environmental supervising agencies will reach 90%, and up to 60% in other regions.

—Increasingly optimize the rural living environment. PRD township sewage treatment rates will reach 65%, and up to 40% in other regions. By 2015, Guangdong's counties (cities) will each have built at least one more household waste landfill site or incineration plant, while township-level waste transfer stations and village-level collection points will be evenly distributed. By 2020, a system of guaranteed safe rural water supply will be available province-wide, achieving the administrative goal of 90% of villages using tap water and a 90% quality pass rate for provincial tap water. The aim is for 85% of toilets province-wide to be hygienic.

—Significantly improve rural production. The province's large-scale livestock farms (district) waste resource utilization should reach more than 90%, while crop and vegetable farming should reduce fertilizer use per unit area by 10%, with an 8%–10% emission reduction in the livestock and poultry breeding industry in 2010, and a 5% reduction in the amount of feed used per unit area in the aquaculture industry.

—Effectively prevent and control industrial pollution in rural areas. Sulfur dioxide, COD, nitrogen oxides, and ammonia nitrogen emissions need to reach national-level control targets province-wide. Industrial solid waste should achieve a comprehensive utilization rate of 85%, industrial wastewater discharge should reach a compliance rate of $\geq 90\%$, and water reuse of key industrial enterprises need to reach a rate of $\geq 65\%$. The province's outstanding mine environment remediation work needs to be basically completed in the so-called "three areas, two lines" areas (that is, within sight of important nature reserves, landscape areas, residential living areas, and major transportation routes, rivers and lakes). The e-waste and electronic-product recycling industry needs to achieve transformation and upgrading.

A. Establish rural ecological environment management systems and mechanisms

1. Improve the Management of Eco-Environmental Protection Organizations

Establish a system of joint meetings for environmental protection in RASC, and gradually integrate environmental protection functions. Coordination is required by the leading environmental protection departments—agriculture, housing construction, water, land, and other departments—so that they can each carry out their functions, using joint meetings for policy coordination, and communication, giving full play to rural environmental protection work. All levels need to follow the province's practice, and establish government leaders or leaders in charge at their level as the conveners of the rural environmental protection coordination mechanisms.

2. Establish and Improve Regulatory Oversight Mechanisms for Rural and Township Environments

Improve the oversight capacity of county environmental agencies, and gradually establish environmental agencies at the village and township levels for rural areas. Through the improvement of equipment, personnel training, and other measures, with monitoring capacity building as the focus, it is necessary to strengthen skills and improve county-level environmental monitoring and environmental monitoring stations' standardized construction hardware compliance rate. It is also necessary to gradually promote township-level environmental institution building on a provincial scale. Another essential is reinforcing and strengthening the rural village-level environmental inspectorate system. Based on regional economic conditions, full-time or part-time environmental staff should be hired, and encourage household participation and participation from rural residents entitled to basic living allowance, and other forms of personnel involvement, to build a relatively stable environmental cleanup team.

Gradually establish a province-wide rural environmental pollution monitoring system. Including pollution in soil, water, the air, and even other biospheres, and introduce early basis normative monitoring indicators and testing regulations. At important drinking water sources, carry out projects for early-warning forecasts and monitoring of increased heavy metals, and blue-green algae. Maintaining a focus on the safety of farmland and vegetables, divide work into long-term monitoring of heavy metals and environmental quality monitoring. During the period of the 12th Five-Year Plan, individual municipality in and above the prefecture level will build three to five monitoring stations for air control management.

3. Establish and Improve Technological Support Mechanisms for RASC

The essence of rural environmental problems is a contradiction between economic development and environmental resources—the contradiction between humanity's infinite appetite and nature's finite supply. Technological innovation is the key to solving this problem.

It is necessary to use technological innovation to promote improvements to rural and township living environments. Universities, research institutions, businesses, and many other forces of agricultural nonpoint source pollution control technology need to join together to tackle soil and water pollution control technology, and carry out other rural environmental technology research. It is also necessary to make great efforts to improve the overall quality of rural environmental protection personnel.

Reconstruct and improve the agricultural sciences and technology service systems at a grassroots level. Governments at all levels should focus on agricultural sciences and

technology services at a grassroots level, and increase their investment in them. Promote institutional reform at grassroots level, integrating the functions of what were formerly science and technology, agriculture, aquaculture, and other departments. Explore the establishment of regional units as service centers to comprehensively promote agricultural skills, carrying out animal and plant testing and disease monitoring, and other work in the public interest. Accelerate the integration of farming needs and the results of scientific research to improve the practical application of the results of scientific research in rural areas.

B. Improve Rural Environmental Protection Policies and Regulations to Promote the Internalization of Environmental Costs

It is only through strengthening the enforcement of environmental protection laws in rural areas, promoting reform of the system of fines for pollution discharges, establishing and improving compensation mechanisms for RASC in a manner that fully reflects market supply and demand, resource scarcity and costs of environmental damage, and that it is possible to internalize environmental costs in terms of resources, and avoid society paying the costs for polluters' work.

1. Improve the System of Rural Environmental Protection Policies and Regulations

Amend and improve the "Guangdong Agricultural Environmental Protection Ordinance," and formulate laws and regulations on prevention and control of rural soil pollution, prevention and control of water source pollution, and other issues, promulgating them in the name of the provincial government strengthening rural environmental protection documentation, and integrating existing rural environmental protection policy and funding.

2. Strengthen the Enforcement of Rural Environmental Laws, Promote Reforms of Pollution Discharge Fines, Implement 'Polluter Pays'

Strengthen enforcement of rural environmental laws. Increase the cost of legal violations, and carry out thorough investigations into environmental violations according to the law. Improve the coordination mechanisms for regional watershed environmental enforcement, while strengthening departmental joint law enforcement and border enforcement linkages. Establish and improve the convergence of administrative law enforcement and the judicial system, set up pilot environmental courts, establish an environmental public-interest litigation system, and improve the mechanisms for providing environmental damage compensation. Establish a system in which legal representatives of enterprises issue public apologies for serious environmental violations.

Promote reforms of pollution charges. Gradually increase fines for emissions of major pollutants, and actively promote reforming the system of fines for discharges of ammonia nitrogen, nitrogen oxides, oil and gas, and other pollutants. Develop a simple, unified discharge coefficient and expand the levying of fines on the furniture manufacturing, packaging, printing, and other industries.

3. Establish and Improve Environmental Compensation Mechanisms for RASC

Ecological compensation mechanisms are an important part of environmental economic policy, with the aim of protecting the environment by adjusting the economic interests of stakeholders to realize environmental protection. This involves executing "Methods for Providing Ecological Compensation in Guangdong Province" to the letter, in adherence with the principles of "whoever protects, benefits," and "total output control, rewards and punishment," transferring appropriate compensation payments to key ecological function areas of the county (or city), enhancing the capacity to provide basic

public services. It is also necessary to constantly improve the ecological compensation calculation standards, exploring local conditions in terms of implementation of monetary compensation, social security, technology development, compensation in kind, and other forms of compensation. Explore the establishment of reasonable compensation mechanisms up and downstream, and gradually establish a multi-participatory compensation system in which government, society, enterprises, and other parties involved all play a role.

C. Strengthen the Rural Environmental Planning, Promote Comprehensive Improvement of the Rural Environment

1. Integrate Urban and Rural Planning, Speed up Village Planning

Accelerate the convergence and coordination of urban and rural planning. In the PRD and in other regions, with rich financial resources, achieve “unified urban and rural planning, unified management, and unified assessment” as the goal of environmental construction planning. In the north, east, and west regions of Guangdong, where there is a relative lack of local finance, there is also a need to increasingly and proportionally add investment in infrastructure in RASC.

Accelerate rural planning. Government at all levels should implement the requirements of the “Urban and Rural Planning Act,” and bring funds for management of urban and rural planning into their budgets. It is also necessary to continue to promote province-level pilot village planning work, gradually increasing the areas subject to village planning. According to Guangdong’s terrain in various regions, propose several planning templates or technical standards, effectively guiding the development of rural planning and construction so that it is gradually standardized. Implement the “10,000 villages, 100 towns” remedial building program, and strive to achieve the 10% target for annual remediation of villages.

2. Deepen the ‘Award Governance’ Policy, Promote Integrated Environmental Improvement and Establishment of Model Ecological Projects

Actively implement the “Award Governance” policy, and vigorously carry out the continuous remediation of the rural environment. Accelerate the remediation of villages in the vicinity of key watersheds, protected areas that are sources of drinking water, and major lakes and reservoirs. Efforts need to be made so that by 2015 the province has 50 or more newly reconstructed model villages, while also fundamentally solving the outstanding environmental issue of “problem villages.”

Actively promote the establishment of the ecological model and establish a movement to create livable villages and townships. Establish and improve the ecological model, and create a multi-level index system, developing appropriate assessment and incentives according to local conditions, promoting construction of the ecological demonstration work in situ. Actively promote livable cities and towns and livable villages, promotion of historic towns and villages, and the planning and construction of model villages, as well as construction work in historic villages.

D. Make Village Waste and Wastewater the Focus, Optimize the Village Living Environment

1. Increase the Treatment of Village Household Waste

Continue to promote and improve the “family gathering, village collection point, transit town, county processing” waste treatment model, while encouraging other safe and economical methods of treatment. Where there is a centralized waste treatment and disposal facility in the city (or county), for the surrounding towns and villages within a

transportation distance of 30 km, that facility should be the central household disposal site, with all waste transported to the site and disposed of there. Villages outside the scope of this area, or for which transportation is difficult, beyond range or present difficulties for transportation should collectively set up a sanitary treatment facility in a regional center. Villages that are temporarily unable to integrate with the urban waste disposal system can adapt to local conditions, making a reasonable choice of economical, suitable and safe disposal techniques and technologies.

Raise funds for waste treatment. Strive to have the treatment of waste and the operating costs for facilities included in local government budgets. Gradually explore the introduction of household waste disposal fees in cities and towns; in some rural areas charge public sanitation fees.

Gradually establish a rural sanitation cleaning system. Put together a relatively fixed sanitation cleaning team, strive to ensure that every village has at least one full-time or part-time cleaning staff that is equipped with the necessary tools and waste collection and transport vehicles.

Carry out an experimental pilot to promote rural waste sorting. Pesticides and other harmful/hazardous waste should be treated separately. Inorganic waste can be treated through sanitary landfill, while kitchen waste, agricultural waste, and other organic waste can be converted into household biogas through anaerobic fermentation.

2. Improve the Proper Treatment of Rural Wastewater

Accelerate the installation of township-level sewage treatment facilities. Focus on building sewage treatment facilities for townships in water source conservation areas and in the vicinity of key reservoirs that supply drinking water, especially in the villages and townships in the urban peripheries of PRD cities, which require centralized pollution control facilities and construction of supporting pipe networks. Townships in the north, east, and west regions of Guangdong can adopt a combination of decentralized and centralized sewage treatment facilities to encourage rain and sewage diversion. Towns and villages closer to the city need as far as possible to integrate their sewage treatment with the city sewage system. Those farther away from the city whose wastewater mainly comes from households need to use treatment techniques like constructed wetland treatment process. It is also necessary to improve the treatment of wastewater from family units that raise domestic animals, progressively realizing the separation of human and animals.

Using appropriate households, draw up a village sewage treatment technology roadmap. In villages where the layout is relatively dense, those that are better off, should use more advanced technologies such as activated sludge process, biofilm, constructed wetlands and other centralized systems. Towns and villages that are closer to municipal sewage-pipe networks, and which are in accordance with the requirements of the municipal pipe network can access centralized municipal sewage treatment.

Choose an appropriate sewage drainage system. For densely populated and economically developed areas, townships should adopt a combined sewage intercepting well system; where the population is relatively fragmented and less well off, villages can use a combined system.

3. Strive to Establish Rural Water-supply Projects

Continue to complete construction projects associated with safe rural drinking water. Upgrade already completed works, carry out strict project management, financial management and project acceptance, and actively ensure that all water users are included in the process, so as to ensure that by 2015 the entirety of the province's rural areas have access to safe drinking water.

Strive to promote the construction of tap-water projects for every rural village.

Guangzhou, Shenzhen, Zhuhai, Foshan, Dongguan, Zhongshan, and other developed areas in the PRD need to integrate within the scope of urban drinking-water supply coverage. Other areas need to implement the “Guangdong Rural Water Project Construction Program” on the basis of existing rural drinking water safety projects, expanding the network through reforms, interconnections, integration and other measures that comply with state standards for tap-water quality supplied to incorporated villages and conditionally unincorporated villages, basically covering the safety of the province-wide rural water supply system. Do away with the limitations imposed on the river system by administrative divisions, optimizing high-quality water sources as centers so as to achieve appropriate distribution. Take creative measures in terms of the operational management, while also focusing on follow-up measures to solve any management problems.

Strengthen the development of rural drinking water quality monitoring networks, realistically guarantee the safety of drinking water. Use professional bodies to further establish and improve the province's water quality monitoring network, put in place funding for monitoring and timely provision of rural water quality monitoring data. Delineate water-source protection zones, and gradually establish the zones as protection areas, with boundaries and warning signs to prevent mining, industry, fertilizers, pesticides and other causes of water pollution and destruction in the area.

4. Strengthen the Construction of Rural Public Toilet Facilities

Engage thoroughly with the patriotic public health campaign in rural areas, and improve basic rural sanitation infrastructure. The PRD region needs to strengthen the management of public and household toilets, as well as other sanitary latrines, and in particular it needs to avoid migrant worker settlements becoming a blind spot in latrine reforms. The mountainous regions of northern Guangdong, and the east and west of the province are seeing an accelerating pace of improvement in terms of rural lavatories, increasing the dissemination of hygienic toilets. Meanwhile, rural villages require guidance in choosing latrine construction modes that are appropriate to local conditions.

E. In the Poultry and Livestock Industries, Make Pollution Prevention and Control the Focus, Improve Agricultural Production Methods

1. Strengthen Pollution Prevention and Control in the Poultry and Livestock Industry

Put more work into minimizing sources of pollution in the livestock and poultry industries, and increase the scope of pollution prevention and control. According to the capacity of the local environment and total control requirements, optimize the layout of the development of livestock and poultry farming areas, and according to the law, demarcate areas where breeding is banned, restricted or suitable. Focus on the 300 large-scale pig farms listed in the “Guangdong Provincial Key Pig Farms” and the large-scale livestock and poultry farms required to meet the major pollutants reduction targets of the 12th Five-Year Plan, put great efforts to promote pollution prevention and control and reduction of major pollutants in large-scale livestock and poultry farming. It is also necessary to promote comprehensive utilization and governance of the entire poultry and livestock breeding process to guide the development model of the poultry and livestock industries in an ecological direction, ensuring that the task of reducing agricultural sources of pollution, such as COD and ammonia nitrogen emissions, is achieved.

It is recommended that policies and regulations be drawn up requiring that the safety of drugs for livestock and fish—as well as aquaculture feed additives—should first be scientifically proven. The random introduction of toxic chemicals into the food chain

needs to be prevented at source.

It is recommended that the Development and Reform Commission and other departments include environmental cost estimates at the feasibility study stage of industry, mining, and farming projects to better reflect profit margins when environmental work is carried out properly.

2. Prevent Agricultural Surface Pollution

Prevent and control surface pollution by chemical fertilizers, pesticides, and other pollutants, while continuing to promote testing of the soil for appropriate fertilizers. Actively promote specialization regarding crops and pests, promoting efficient, low toxicity varieties of pesticides, and advanced plant protection machinery. Demonstrably propagate pesticide-toxicity-reduction technologies, and set up a pesticide-toxicity-reduction demonstration area. Explore new methods of treating pesticide-packaging waste, and establish a complete pesticide-packaging waste recycling system. Promote the comprehensive utilization of organic fertilizers, microbial fertilizers, and compost to promote and propagate soil testing and fertilizer recommendations.

Prevent straw, agricultural plastic sheeting, and similar kinds of pollution. Actively promote technologies that return straw to the fields as compost, and strengthen environmental management of agricultural plastic sheeting, promoting the use of biodegradable plastic film, and improving agricultural plastic sheeting technologies.

Strive to develop branded and ecological agriculture. Encourage leading agricultural enterprises to develop branded agricultural products, fostering the safety backbone of agricultural products and foodstuffs. Also encourage the development of pollution-free agricultural products, green foodstuffs and organic agricultural products, and carry out standardization of agricultural products.

Reform policies for fertilizer subsidies, gradually reduce and abolish fertilizer subsidies, and establish incentives for environmental agriculture. Explore avenues of funding for fertilizer subsidies through raising prices for grains and cereals or through measuring the work involved in applying fertilizer to land. Gradually reduce and abolish subsidies for fertilizer production so that fertilizer prices reflect true costs. Also actively explore establishing a system of financial subsidies, tax incentives, and other compensatory incentives to reduce the production and application costs of organic fertilizers.

3. Promote Soil Pollution Prevention

Establish monitoring and risk assessment for basic farmland and important agricultural products bases—especially the “vegetable basket” bases. Develop trial models for restoring farming fields with contaminated soil. Gradually establish a hierarchical system of management for using soil, in agricultural production areas; classify, formulate and implement countermeasures for contaminated soil management.

F. In the Interests of Preventing Industry Pollution, Control the Effects of Industrialization and Urbanization on the Rural Environment

1. Strictly Control Environmental Pollution Arising from Industrial Relocations

Make scientific plans to develop rural industry. Accelerate standardized planning and designated locations for the electroplating, leather tanning, dyeing, paper, and other heavy polluting township and village enterprises. Separate industrial parks from rural residential areas by establishing buffer zones. Establish central treatment centers in industrial parks for industrial waste and sewage.

Require strict environmental approvals for construction projects in rural areas. In accordance with the main zoning and environmental zoning requirements, prohibit development and construction in rural areas that does not meet with the project area’s

defined functions. Call on all localities to cut pollution loads, freeing environmental capacity before approving any new construction projects.

Strengthen environmental regulation of industrial enterprises in rural areas. Increase the supervision and management of industrial pollution and remediation efforts while gradually implementing monitoring for excessive sewage, and require enterprises that exceed pollution standards to take remedies within a specific timeframe.

Optimize the industrial structure in rural areas. Guide underdeveloped areas to strive to develop eco-industries and specialty industries, as well as ecological agriculture, eco-tourism and other specialist industries, encouraging the development of high-tech environmentally friendly projects, ensuring that industrial relocations and industrial upgrading of underdeveloped areas are simultaneously undertaken in the province.

2. Strengthen Environmental Monitoring of the Opening up of Mineral Resources

Strengthen mining and resource development. Put strict environmental controls on the development of mineral resources, making it strictly prohibited in protected areas that are drinking water sources, in strictly controlled eco-zones, and other important environmentally protected areas for planning and construction of mineral resource development projects. Strengthen supervision of the development of mineral resources, and environmental inspections within the timeframes of construction projects, and strengthen environmental emergency management. Take initial steps to establish a monitoring system at national, local and mining area geological levels, periodically conducting comprehensive investigations into provincial mining tailings. Adhere to the principles of “whoever develops, protects; whoever pollutes, pays,” implementing a mining financial deposit system for environmental remediation, and urging the implementation of environmental protection and mining rehabilitation measures aimed at those with mining rights.

Promote geological environment recovery works at mine sites. Build a number of outstandingly administered demonstration mines to encourage the construction of mining parks. According to the severity of the geological environment at mines, delineate key governance and general management areas, and carry out restoration. Improve surveys of the province’s geology, developing a “three areas, two lines” greening of the mines operation.

Guide and use market leverage to accelerate mine governance. In the less developed regions of northern Guangdong, put mining management in the overall regional development planning, improving the local economy’s over-reliance on mineral resources. By cultivating and standardizing the market for mining rights, optimize allocation and utilization of mineral resources. Encourage all kinds of social capital investment into mine treatment.

3. Prevent Damage to the Rural Environment from Burning Urban Landfill Waste

Adhere to making waste a resource so as to reduce total volume. Use the preponderance of labor resources and economic leverage to support policy, finances, and other areas, promoting the growth and development of renewable resources and recycling industry.

Promote waste treatment technological innovation. Expand the related fields of scientific research and technological innovation, promoting waste disposal, resource utilization technology applications and popularization. Actively introduce and learn from foreign advanced technology, equipment, and experience.

Sites for incineration facilities should be scientifically investigated, guaranteeing rural residents the rights to environmental justice and the right to know. Regarding urban

waste disposal programs, the informed consent system should be expanded to the village and township level, further improving the system of public participation, listening to and considering the opinions of the people to be affected, as well as damage compensation requests, so as to avoid public scrutiny that brings the government's credibility into question.

4. Implement Campaigns to Improve the Electrical and Electronic Products Recycling Industry

Strengthen control of waste electrical and electronic products at the source, strictly controlling of the flow of such waste. Make clear the principle of the producer's responsibility. Through green production and mandatory recycling, turn around the continuing surge of waste electrical and electronic products, as well as the confusion about who is responsible for. Carry out multi-sector collaboration and supervision, along with strict controls on e-waste imports and transport, ensuring an orderly flow of waste electrical goods and electronics.

Encourage the existing waste electrical and electronic products recycling industry to upgrade. Improve environmental access requirements. Through financial subsidies and other incentives, encourage the industry to carry out technological innovation, promoting industrial upgrading. The government should take initiative to invest in industry consolidation and address linkages for the public good and focus on resolving the outstanding problems of recycling electronic-waste incineration filters, extracting precious metals, and pollution from barbecuing circuit boards in recycling electronic-waste.

G. Improve Organizational Guarantees, Form a Positive Sense of Rural Environmental Protection

1. Strengthen Rural Environmental Protection Through Evaluation Mechanisms

Gradually shift from a performance evaluation system that places undue emphasis on economic development indicators, realizing the new system's goals of sustainable development. Gradually establish of "urban and rural overall planning," with long-term eco-responsibility assessment mechanisms. Bring rural environmental protection, especially at the protected sources of rural drinking water, within the scope of all levels of government accountability assessments. Also strive, within the period of the 12th Five-Year Plan, to promote a province-wide rural environment responsibility system for remediating the environment.

2. Integrate and Optimize Financial Funds, Continue to Increase the Input of Public Funds

Sufficiently integrate all available funds related to rural environmental protection, reducing construction duplication. Gradually increase provincial special funds for rural environmental protection and waste disposal, rural drinking-water safety, pollution prevention and control and other areas earmarked for special funds. Local governments at all levels should gradually increase their budgets to encompass matching funds for environmental protection in rural areas. Continue to implement and improve the "Governance Award," "Rewards for Repairs," systems, and other incentives, while exploring allocations of competitive funding.

3. Develop 'Green Financing,' Explore Establishing a System of Multi-inputs

Explore the establishment of a multi-input system, and strive to gradually form a system of "financial allocations—market funds—social subsidies—villager self-help," and other multi-channel funding avenues to provide a system of guarantees for the rural

environmental protection.

Use market-based instruments to develop “green financing.” First, encourage the development of green credits. Through window guidance and rediscounting, relending interest-rate concessions, tax incentives, and other policies attract bank capital to invest in environmental protection in rural areas. Secondly, explore rural environmental protection financial innovation. Environmental financial innovation in Guangdong’s rural areas is feasible, but presents some difficulties, so gradual and progressive exploration of options is encouraged: (i) explore the development of green trust funds. This is when a trustor with specific environmental resources entrusts them to a trustee that has environmental and ecological protection capabilities together with a common desire to maximize the investors’ funds or donations for management, with the resulting benefits returning to society and the public; (ii) explore the development of green insurance. That is to say, environmental pollution liability insurance, enterprises taking out environmental accident risk insurance with insurance companies, insurance for compensation of victims of pollution. Thirdly, compete for assistance from international financial institutions. Guangdong Province has a solid foundation of support from the World Bank, and ADB, and it should continue to strive to attract project assistance from these international financial institutions.

Strive for social subsidies, and encourage rural villagers in some areas to explore a system of self-financing. Guangdong has a relatively strong sense of social welfare, with hard-working, supportive community groups and businesses, donations and contribution from various sources. In rural areas where there has been rapid economic development and conditional payment for treatment of household waste and sewage, it is possible to explore the implementation of a system of charges, with specific, set fees.

4. Implement the National Action Plan for Rural Environmental Protections

Implement the villagers’ autonomous environmental movement to improve rural environmental awareness. Strengthen rural environmental propaganda work, and guide farmers to throw off bad habits, while promoting a scientific and civilized way of life. Give play to the important role of common people in protecting the rural environment. Get the younger generation involved, and strengthen environmental education in schools.

Place importance on the role of autonomous grassroots organizations. In accordance with the guiding principle of “Village matters are settled by the villagers, managed by the villagers, and supervised by the villagers,” give full play to village committee’s autonomy in its environmental functions. According to the village rules, encourage rural residents to participate in environmental protection work.

Strive to give play to environmental social organizations that play a role in strengthening regulation of rural environmental protection. In Guangdong Province, take the opportunity to encourage the development of social organizations, giving play to the pivotal nature of organizations such as the Guangdong Environmental Protection Foundation so as to foster environmental social organizations. Keep innovating for environmental charity fund raising mechanisms and charity organizations. Mobilize community volunteers in RASC to carry out environmental action. Give play to the news media and public opinion, guaranteeing the public’s right to know and right to oversee. Improve controls, exposure methods, and reporting mechanisms for all kinds of environmental violations. Slowly bring projects that affect the rural environment into the public hearing system. Major environmental pollution accidents must be promptly made public.

V. Suggestions and Recommendations for Projects Requiring ADB Support

The World Bank, ADB and other international financial institutions’ financial

assistance have a sound foundation in Guangdong Province. ADB and Guangdong, for example, have cooperated successfully in the field of environmental protection. This includes Guangdong's use of ADB loans to promote energy conservation (the Guangdong Energy Efficiency and Environment Improvement Investment Program that started in 2009), the PRC and ADB's first government-led loan financing to SMEs in the field of energy conservation. The project adopted multi-batch financing, in the form of lending from intermediate financial services institutions that has supported 19 sub-projects in three batches, supported by \$100 million in ADB loans. Another example is the implementation of the Guangdong Chaonan Water Resources Development and Protection Demonstration Project, with a total investment of \$206.4 million, supported by an ADB loan of \$100 million. The project includes construction of water conservation demonstration projects for rural areas, and integration of urban and rural water supply systems, striving to serve as a model for comprehensive environmental protection of water resources, and their development and utilization in Guangdong Province and even the country's relatively underdeveloped central and western regions, where there are obvious contradictions between the people and the land they live on. Guangdong is expected to have a huge demand in the future in terms of rural environmental investment, technologies and advanced experience. It can be predicted that ADB and Guangdong have extremely broad prospects in terms of cooperation in rural environmental protection, and it is recommended that ADB continue to provide technical assistance and project finance loans for the province. It is recommended that ADB provide technical assistance and loans for the following projects.

A. Guiyu Town Waste Electrical and Electronic Equipment Recycling Sector Management Project Proposal

1. Project Demonstration and Innovation

The development of the Guiyu Circular Economy Industrial Park (hereafter "the Industrial Park") in Shantou City, Guangdong Province will increase the levels of treatment, standard recycling and reuse, and improve the recycling and reuse system of waste electrical and electronic equipment (hereafter "e-waste"). The project aims to tackle environmental pollutions and strives to become a demonstration project in e-waste recycling, dismantling and reuse in China and also a model of integrated management of informal recycling and waste treatment sector and pollution control in developing countries.

2. Construction Contents and Objectives

The Guiyu Circular Economy Industrial Park in Chaoyang District, Shantou City is located in a region of Guiyu Town that consists of Huamei, Xianma, Liandi, Dongyang, Ximei and Nanan areas. The proposed Industrial Park development project outputs mainly include environmental infrastructure, e-waste recycling network, four large business areas, four large centers, transaction markets, information network and public facilities. The project will be implemented in three stages and aims to accommodate all the e-waste dismantling enterprises in Guiyu Town and standardize environmental management of enclosed zones. It also aims to rapidly reduce the level of annual new pollutions to zero and meanwhile effectively control existing pollutions.

3. The Scale of Investment

The total project investment is estimated at 1.9899 billion RMB equivalent, of which USD 200 million equivalent will be financed by a proposed ADB loan and the rest will be financed by counterpart in China.

The detailed cost estimate and financing plan is presented in the following table:

Guiyu Circular Economy Industrial Park Investing Plan

Proposed items	Components	Cost estimate (10,000 RMB)
Four large business areas	Dismantling Area Phase I	19,000
	Dismantling Area Phase II	25,000
	A precious metal recycling & processing plant, a smelter	49,000
	A plastics recycling & deep processing plant	19,500
	A hazardous waste transfer station	5,850
	A compressed waste transfer station	100
Four large centers	A R & D center and training building	1,720
	A comprehensive management building	2,000
	Logistics distribution center warehouses	1,540
	A freight terminal	1,200
	A logistics control & management center	1,680
Terminal transaction markets	Transaction markets	2,500
	Warehouses	1,500
Environmental infrastructure	An industrial wastewater treatment plant	4,000
	wastewater treatment, waste air treatment, noise control, urban greening, environmental monitoring, etc.	5,000
	A sewage treatment plant	37,200
	A landfill site	11,000
	Environmental pollution control	10,000
Information network	Development of local area network (LAN) and Internet websites	1,100

	Information bases	100
Total		198,990

4. Loan Repayment Arrangement and Counterpart Fund Financing Plan

In accordance with the principle of "who uses, who repays", clearly define the debt relationship through the various levels of financial guarantee for lending responsibilities. Counterpart funds for project-related is to be raised by the implementation agency.

B. Proposal of Heavy Metal Contaminated Farmland Soil Restoration Demonstration Project

1. Project Demonstration and Innovation

Regional farmland soil heavy metal contamination and quality and safety of agricultural product issues cannot be resolved by using a single engineering technical method. This project combines the existing method of heavy metal detection, develops adequate remediation technology suitable for local bio-geochemical characteristics, establishes soil heavy metal contamination restoration diagnostic technologies and standard system on the basis of field demonstration, provides technical support on solving large-scale regional soil heavy metal contamination in the province, so the quality and safety of agricultural product issues can be resolved totally. Technical roadmap is described as follows:

2. Construction Contents and Objectives

(1) Project Demonstration Base and Construction Contents. Selecting Guangdong Shantou Lianhuashan tungsten mine As & Cd compound contaminated rice field and Shaoguan Qujiang Cd-contaminated rice field to establish four core demonstration bases, setting up low, moderate and severe heavy metal contamination restoration technology demonstration test in each demonstration base. According to the biological factors, topography factors and other bio-geochemical indicators, determines the major limiting factors of restoring the regional farmland heavy metal contamination and vegetation. Focusing on screening technology of high-endurance, low absorption heavy metal agricultural crop varieties, soil iron sulfur cycle control technology and other key technologies in the technology roadmap, by optimizing, integrating and using these technologies and products in large scale application, to form systematic heavy metal compound contamination prevention technology system in the hot zone red soil system.

(2) Project Anticipated Objectives. Restoration Objectives: By 2018, demonstration area decreases its soil heavy metal contamination significantly and its soil heavy metal concentrations meets the Level III of "Soil Environmental Quality Standards" (GB15618-1995), heavy metals As and Cd contents in agricultural products exceeding the limits below 50 percent in the core demonstration area, average contents of Cd and As in the agricultural products lowered than 50%, regional soil heavy metal contamination restoration technology becoming mature, and establishing comprehensive soil heavy metal contamination monitoring and early-alert system. Demonstration Objectives: Four core demonstration areas established, core demonstration area reached 10,000 mu, core technology expansion and application area reached 100,000 mu, 5,000 person-trip of agricultural technicians trained in core demonstration areas, restoration diagnostic techniques and standard system for heavy metal contamination in farmland soil facilitated, providing demonstration effect to carry out a comprehensive soil

restoration work in the future. Ecological Objectives: Vegetation coverage of demonstration area is above 95%.

3. The Scale of Investment

Contaminated soil remediation project cost: 10,000 mu × 25,000 yuan/mu = 250 million yuan;

Clean irrigation water protection project cost: 40 million yuan;

Monitoring supervision costs: 20 million yuan;

Project completion acceptance costs: 10 million yuan;

Total: 320 million yuan (about US\$ 50 million).

4. Loan Repayment Arrangement and Counterpart Fund Financing Plan

In accordance with the principle of "who uses, who repays", clearly define the debt relationship through the various levels of financial guarantee for lending responsibilities. Counterpart funds for project-related is to be raised by the implementation agency.

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