Water Pollution Control in China: Review of laws, regulations and policies and their implementation

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for

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Abstract

The Economic Research Institute for ASEAN and East Asia (ERIA) was established in June 2008, aiming to pursue three pillars of research issues, “Deepening integration”, “Narrowing Development Gaps”, and “Sustainable Development”. Under the pillar of “Sustainable Development”, a project on mainstreaming sustainable development policies in East Asia (ERIA-SD project) was initiated for the period 2008-2010 and IGES is responsible for its coordination. The purpose of this project is to promote sustainable development concerns into policy making process in this region, in particular developing countries. Under the ERIA-SD project, IGES conducted a study on the enforcement of water pollution control in China, for which we prepared this policy review.

The purpose of this report is to review China’s environmental laws, regulations and policies with special focus on water pollution prevention and control. In this report, we analyse the evolution process of environmental laws and regulations in China with special emphasis on water pollution control. The environmental legal system and environmental management organizations are illustrated. We also introduced major implementation measures for the enforcement of environmental laws and regulations and provided two case studies to indicate the current situation and future trend of China’s water pollution control.
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1. Introduction

The Economic Research Institute for ASEAN and East Asia (ERIA) was established in June 2008, based on the official endorsement at the third East Asia Summit by sixteen member countries. ERIA Research Project aims to pursue three pillars of research issues, “Deepening integration”, “Narrowing Development Gaps”, and “Sustainable Development”. Under the pillar of “Sustainable Development”, a project on mainstreaming sustainable development policies in East Asia (ERIA-SD project) was initiated for the period from FY2008-2010 and IGES is responsible for its coordination. The purpose of this project is to promote sustainable development concerns into policy making process in this region, especially developing countries. Under the ERIA-SD project, a study on the enforcement of water pollution control in China is identified as one of its thematic studies.

The purpose of this report is to provide a preliminary review on China’s environmental laws, regulations and policies with special focus on water pollution prevention and control. Based on this policy review, we will assess major factors influencing the effectiveness of China’s enforcement of water pollution control and further analyze the contribution of environmental investment and technology to environmental enforcement in China.

China’s environmental statistical data, legal document and relevant internet information are used as main data resources for this report.

Rest of this report is organized as follows: Part 2 introduces the evolution process of environmental laws and regulations in China with special emphasis on water pollution control. Part 3 illustrates environmental legal system and environmental management organizations. Part 4 explains major implementation measures for the enforcement of environmental laws and regulations. Part 5 provides two case studies to indicate the current situation and future trend of China’s water pollution control. Part 6 concludes this report.
2. Evolution of environmental laws and regulations in China with special emphasis on the protection of water environment

With intensive growth of heavy industries, water pollution accidents happened, which alongside with the Stockholm Conference on Human and Environment (1972) aroused the attention of Chinese government in the early 1970s. This stimulated the establishment of Leading Group on Environmental Protection of the State Council (LGEP), China’s initial environmental administrative organization. By the end of 1980s, a comprehensive environmental management system had been set up consisting national, local and sectoral governmental environmental organizations. However, the level of environmental degradation due to rapid economic growth surpassed the progress made in environmental protection and environmental quality has been deteriorating. Many environmental accidents and ecological disasters happened in 1990s, such as arseniasis pollution in drinking water, acid rain, sandstorms and floods. After the Rio Earth Summit on Environment and Development in 1992, China introduced the concept of sustainable development into its environmental law-making and policy-making and has gradually developed its own theory based on the Scientific Outlook on Development.

Similar to other countries, the evolution of China’s environmental management system also experienced from point source pollution control to non-point source pollution control; from individual source pollution control to comprehensive river basin management; from singular mandatory administrative measure to policy mix of multiple tools and means; from end-of-pipe abatement and cleaning-up to pollution prevention; and from emphasizing the quantity of economic growth to the quality of growth based on sustainable development.

2.1 Three evolution stages of China’s environmental protection

The evolution of environmental protection in China can be divided into three stages according to the changes of guiding ideologies as well as developing level of legislation and institution system. The features of each stage are shown in Table 1.
|---------------------|---------------------|------------------------|
| **Legislation** | ♦ Constitution (1982)  
♦ Environmental Protection Law (Trial Version) (1979)  
Total¹: 2 laws | ♦ Environmental Protection Law (1989)  
♦ Water Pollution Prevention and Control Law (1984)  
♦ Air Pollution Prevention and Control Law (1987)  
♦ Cleaner Production Law (2002)  
Total¹: 27 laws and 25 regulations |
| **Institution Development** | ♦ Leading Group on Environmental Protection, State Council (1972)  
♦ Ministry of Environmental Protection (2008) |
| **Major Implementation Measures** | ♦ Three Simultaneity System  
♦ Pollution levy system  
♦ Environmental impact assessment system | ♦ Target-responsibility system for environmental protection  
♦ Quantitative examination of integrated environmental management  
♦ Emission permit system  
♦ System of centralized control  
♦ Enforcement of pollution abatement to noncompliance by designated date | ♦ Total emission control  
♦ Cross-century green projects  
♦ Levy on centralized waste water treatment in urban area |
| **Major Events** | ♦ The First CNCEP² (1972), the starting point of environmental protection work in China | ♦ The second CNCEP² (1983), setting environmental protection as a fundamental national policy | ♦ “Zero point” action (1997, 1998)  
♦ Environmental enforcement campaign (2003~present)  
♦ The Third Session of the Sixteenth CPPCC³ National Committee (2003), Scientific Outlook on Development |
| **International** | ♦ Stockholm Conference on Human and Environment (1972), arousing environmental awareness worldwide | | ♦ Rio Earth Summit (1992), promoting sustainable development  
♦ Kyoto Protocol, solving global warming problem |
| **Major Pollution Accidents** | ♦ Water Pollution in Dalian Bay (1972, big loss in aquaculture)  
♦ Water Pollution in Guanting Reservoir (1972, caused sickness of local residents) | | ♦ Flooding of Yangtze River in 1998 (economic loss: 255 billion RMB; 1320 death)  
♦ Songhua river water pollution accident (economic loss: 69 million RMB; 8 death) |

Notes: 1. present total number including revised versions; 2. CNCEP=China National Conference on Environmental Protection; 3. CPPCC=Chinese People's Political Consultative Conference; 4. "three simultaneity"= pollution abatement facilities must be designed, constructed and operated the same time with the main project.
(1) Stage 1: 1972~1983

Invoked by several environmental pollution accidents happened in 1972⁵), this stage is a foundation of China’s environmental protection work. There are several milestones for the starting of organization construction, legislation and management framework. The Stockholm Conference marked the beginning of environmental awareness of Chinese central government; the first China National Conference on Environmental Protection(CNCEP) marked the beginning of environmental awareness of governments of all levels; the foundation of LGEP marked the beginning of construction of environmental administrative organizations; the Environmental Protection Law (Trial Version) marked the beginning of environmental legal system; the guiding principles specified by 32 Chinese characters, i.e. overall planning, rational layout, comprehensive utilization, recycling, public participation, taking initiative action, environmental protection and benefiting the whole society, which marked the beginning of environmental policy making.

In this stage, China’s economy highly relied on heavy industries, such as iron and steel industry, chemical industry and machinery manufacturing industry. All of these heavy industries produced great amount of pollutants, especially “three wastes”, i.e. waste water, waste gas and solid waste⁶). As a result, most of management measures of this stage were imperative administrative orders aimed to enforce end-of-pipe abatement. Three major implementation measures in this stage (so called “old three measures”) were: Three Simultaneity System, environmental impact assessment system and pollution levy system. The first two focused on the pollution prevention and the last one added in economic stimulation. These three measures were well executed at that time and still play an important role at present.

(2) Stage 2: 1983~1991

China’s environmental protection achieved significant development in this stage. Environmental protection was confirmed as a fundamental national policy during the second CNCEP, and strengthening environmental management was confirmed as a policy priority for environmental protection. Therefore, the amended Environmental Protection Law (1989) and six environmental individual laws were enacted successively. NEPA was found in 1988, and local Environmental Protection Bureaus (EPBs) were also set up nationwide. By then, basic framework of legal system and environmental institutions has been set up³). Environmental protection was added into national developing plan since the Seventh Five-Year Plan, which embodied the concept of coordination between environmental protection and economic growth.

In this stage, China’s economy increased rapidly by an average annual growth rate of 10%. However, high energy consumption and high material consumption result in high emissions. During this period, the implementation rate of the “old three measures” increased year by year. For example, the implementation rate¹ of EIA for large and medium sized projects was almost 100% while the implementation rate² of “Three Simultaneity System” was about 96%⁴). Based on the new features of economic-social development of that time, “new five measures” were proposed,

¹ Ratio of projects that executed EIA among all projects that should execute EIA.
² Ratio of project that executed “Three Simultaneity” among all construction projects.
viz. target-responsibility system for environmental protection, quantitative examination of integrated environmental management, emission permit system, system of centralized control, and enforcement of pollution abatement for noncompliance by designated date. By then, the management structure consisting of eight major implementation and enforcement measures was established. Target-responsibility system is set between central and local government. Quantitative examination of integrated environmental management is of planning level. System of centralized control is of tactical level. And the other three measures are of specific level. Different from stage one, various economic instruments were introduced into the management system besides imperative administrative orders, such as subsidy on pollution abatement, tax preferential policies on comprehensive utilization of wastes, resource tax and compensation fee. These measures stimulated the enthusiasm of enterprises on environmental protection.

(3) Stage 3: 1992–present

The Rio Earth Summit (1992) was a milestone for the beginning of considering sustainable development in policy making of China’s environmental protection. In this stage, both legislation and institution construction were improved to a new level. By now, 26 environmental individual laws and more than 50 environmental protection administrative regulations in total were enacted. After upgraded to SEPA (1998), China’s environmental administrative authority was upgraded again to MOEP in 2008.

In this stage, China’s economy has grown rapidly under the socialist market-based economic system. However, industrial sectors contributed not only to economic development but also to pollution, which results in serious air and water pollution especially in urban areas. Environmental pollution accidents and ecological disasters greatly stimulated China’s environmental protection.

For instance, water pollution accidents of Taihu Lake (1990, 1995, 1998, 2007) and Huai River (1989, 1994, 2004) caused water shortage to nearby factories and drinking water crisis to millions of people, with direct economic loss over 100 million RMB. Those accidents stimulated the establishment of regulations for water pollution prevention of major river basins and the regulations for protecting safe drinking water. The revised Water Pollution Prevention and Control Law enacted in 2008 also added related content for protection of drinking water source. The “Zero point” action was implemented to strengthen environmental enforcement in both 1997 and 1998. In these enforcement campaigns, pollutants from enterprises of Taihu or Huai river basin must attained national emission standard by 0:00am on December 31st in that year. From 2003, SEPA and EPBs conducted environmental enforcement campaign annually by intensive inspections to polluting enterprises. Those activities achieved immediate but temporary outcome by shutting down tens of thousands serious pollution township and village enterprises (TVEs).

The flooding of Yangtze River in 1998 was a serious catastrophe in China’s modern history, which caused 1320 death and direct economic loss at 225 billion RMB. This accident attracted great attention by Chinese top leaders on the situation of severe environmental and ecological deterioration situation. And it also stimulated the enactment of forest law and meteorology law and other resource conservation laws.
The Songhua River pollution accident in 2005 caused 6 deaths, 69 million RMB of direct economic loss and serious pollution of drinking water source. After this accident, environmental supervision all over China was particularly strengthened through establishing Provincial Environmental Supervision Bureaus and increasing investment on equipments. Meanwhile, this accident stimulated the establishment of contingency plan for environmental emergencies and it was also a main reason to put drinking water safety in priority in the eleventh Five-Year Plan\textsuperscript{8}).

In this stage, four major implementation measures were proposed: total emission control, cross-century green projects, levy on centralized waste water treatment in urban area, and emission reduction. Especially, the transformation from concentration control to total emission control greatly enhanced the treatment rate\textsuperscript{1} of pollution sources. Meanwhile, many economic and integrated instruments were used. For example, CO\textsubscript{2} emission trading helps to distribute resource rationally. Green GDP accounting, environmental labeling, and ISO14000 EMS work as incentive to enterprises environmental pretention. Disclosure of environmental information complements the limited capacity of administrative supervision.

2.2 Water resource management

Compare to air pollution and solid wastes, water pollution has more direct impact on human health, since the symptom may appear immediately. Because human beings need to drink water every day, the insufficiency of safe drinking water can even cause social unrest. For the above reasons, water protection has always been a priority in the development of environmental management system in China.

In 1972, water pollution in Dalian Bay (city) caused more than tens of thousands of loss of marine output every year; another water pollution of Guanting reservoir caused fish pollution; and the water pollution accident in Songhua River caused Minamata disease of local people who ate fishes from polluted river. It was these water pollution accidents that arouse the environmental awareness of Chinese leaders and started environmental protection in China\textsuperscript{5}). Then, in stage 3, once again, those water pollution accidents acted as activators of environmental protection. For example, water pollution accidents in Huai River and Tai Lake in 1990s made the Chinese government shift its emphasis to drinking water safety and river basin management; while flood in 1998 stimulated the ecological protection.

In the process of legislation development, it is noticed that laws and regulations concerning water environment management are usually developed earlier than those of air pollution control or solid waste management. For example, the Water Pollution Prevention and Control Law enacted in 1984 was three years earlier than the Air Pollution Prevention and Control Law and eleven years earlier than the Solid Waste Pollution Prevention and Control Law. And it was even earlier than the Environmental Protection Law which was officially enacted in 1989\textsuperscript{1,2}).

New guidelines and new implementation measures are also implemented first in water laws and

\textsuperscript{1} The part of treated pollutants out of all emission.
regulations. For instance, pollution levy system, environmental impact assessment reporting system, spot inspection system, system of pollution discharge reporting and enforcement of pollution abatement for noncompliance by designed date system were all first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1984. And the emission permit system was first confirmed as legal provision in the implementation details of water pollution prevention and control law in 19893).

Meanwhile, in the “implementing Scientific Outlook on Development documents”, water pollution control was point out as the most important work for Chinese government in the near future9). In summary, water pollution accidents impel the development of environmental protection work while water environment is the experimental field for new management measures.

2.3 Summary

In summary, politics, economy, technology, international cooperation and public awareness are major factors that stimulate the development of China’s environmental management policy. Firstly, ecological civilization and material civilization are the two preconditions for political civilization of a society, since serious environmental pollution accidents may cause social unrest. On the other hand, politicians’ attention on environment directly affects the quality of environmental protection. And China’s environmental protection strongly affected by political will of top leaders. Secondly, it is believed that environment has strong correlation with economic development. Economic development need resource and damage environment most of the time, but economic development can also provide money for pollution abatement. Economic loss of environmental accidents stimulated the development of environmental policy making in China, and rapid economic growth also provided billions of investment on environmental projects. Thirdly, technology development may contribute to energy saving, lower cost of pollution abatement and accuracy of environmental monitoring. Fourthly, environmental issues are global, so international cooperation is needed to solve environmental problems. China’s environmental protection was first inspired by the Stockholm Conference, and then other international conferences such as Rio Summit also have great influence on guideline of environmental protection in China. As a developing country, China can learn from past experience of developed countries, but at the same time, China also faces heavy international pressure on its environmental issues. Finally, public awareness on environment is the most important factor for the success of environmental protection in China. The implementation of all policies needs support from public and the public can also influences decision making of governments in certain ways. In China, public participation rate in environment is still weak, so how to promote public participation may probably become the future trend in China’s environmental policy.
3. System of environmental laws and regulations and their implementation in China

This part will introduce environmental legislation system, legislation body, environmental management organizations, and their development.

3.1 Hierarchy of environmental laws and regulations

China’s environmental legal system is shown in Fig.1. At present, there are one environmental protection law; 26 environmental individual laws, including 15 nature resource laws; more than 50 environmental protection administrative regulations; and over 1600 local environmental decrees and rules.\(^1\)

In China’s legal system, the Constitution, the criminal law and the civil law are fundamental national laws which have the highest status over all laws and perform as basic guidelines for other laws. Contents on environmental protection were first introduced into the Constitution in 1982. It was explicitly stipulated in article 9, 10, 22 and 26 that “The country protects proper use of natural resources, precious animals and plants. The country protects living environment and ecology, prevent and control environmental pollutions”. Over the past thirty years, the Constitution has been revised four times, however, environmental protection remains as an essential part. The Criminal Law Code was first enacted in 1979 and revised in 1997. It is explicitly stipulated in Chapter 6 that “Damaging environment is a specific crime and have to commit criminal responsibility”. The General Principles of Civil Law was enacted in 1986 and it is explicitly stipulated in Chapter 6 that “Anyone who damages the environment should commit civil responsibility”.\(^2\)

Environmental Protection Law (trial version) was enacted in 1979. After ten years’ supplement and amendment, this law was officially issued in 1989. The main content of Environmental Protection Law consists of objectives, scope, guideline, basic principles, policies, key measures, management systems, organizing structures and legal responsibilities, etc. This law is a comprehensive substantive law which is adapt to the complexity of the environmental issues. This law also enjoys very high status in the whole legal system, preceded only by the Constitution and other foundational national laws. Therefore, this law acts as the basis for environmental protection work and legislation.\(^2\)
Fundamental National Law

Basic Environmental Laws

Individual Environmental Laws

Pollution Prevention and Control Laws

Resource Conservation and Utilization Laws

Environmental management Laws

Administrative Regulations

Administrative Rules

Local Decrees and Rules

Such as “implementation details of water pollution prevention and control law”, “provisional regulation on water pollution prevention and control of Huai river”, “contingency plan for environmental emergencies”, etc.

Such as “preliminary hearing management method of construction land using”, “management measures of marine natural reserve area”, “pollution prevention measures for hazard chemical waste”, etc.

Such as “pollution prevention methods for Wangyao water reservoir of Yanan city”, “water pollution prevention and control ordinance of Wuxi city”, “water pollution control measures of Yangzi river in Jiangsu province”, etc.

Fig. 1 Environmental legal system in China
Individual environmental laws are made according to the guidelines in the Constitution and Environmental Protection Law, which aim to protect certain kind of environmental element or restrict certain kind of activity. Different from the Constitution and Environmental Protection Law, individual laws make concrete and meticulous regulations on management. Based on different functions, the individual laws can be divided into three groups. The first group is pollution prevention and control laws. At present, there are five such laws, Water Pollution Prevention and Control Law, Air Pollution Prevention and Control Law, Solid Waste Pollution Prevention, Noise Pollution Prevention and Control Law and Radioactivity Pollution Prevention and Control Law. These laws focus on the pollution control of a certain kind of pollution source, but there are also contents related to resource protection and management. The second group is resource conservation and utilization laws. At present, there are sixteen such laws, Grassland Law, Forestry Law, Water Law, etc. These laws focus on natural resource reservation and management. The third group is environmental management laws. At present, there are five such laws, Environmental Impact Assessment Law, Circular Economy Promotion Law, etc. These laws are made to support environmental management and to promote sustainable development.

In the view of legislative body, the Constitution is constituted by the National People's Congress (NPC); the Environmental Protection Law is constituted by the Standing Committee of NPC; and the individual laws are constituted by the Environment and Resource Committee of NPC. The NPC is the only institution that can constitute laws.

In order to ensure the implementation and clarify the operation process of special environmental protection laws, as well as compensate for the inadequacy of present laws, the State Council, MOEP and other relevant national administrative authorities establish various regulations and rules, which include measures for the implementation of each environmental pollution prevention and control law; technical specifications of pollutant disposal; emission standard of major pollutants in various industries; management ordinance of certain pollutant or certain area; operation plan of new systems; solutions of certain problems; list of dangerous pollutants; important decisions towards certain major event, etc. Although the State Council and administrative authorities can not make laws, they have the right to submit proposals to the NPC when necessary.

Since the level of economic development and technology level is different among regions, and so is the natural resource allocation, it is necessary to establish local environmental protection laws, regulations and rules. They also embody the important spirit of “adaptation to local conditions”. Basically, Local People’s Congresses (LPC) are responsible for making local laws, while local governments and administrative authorities are responsible for making local regulations and rules. Those laws, regulations and rules mainly consist of special laws for certain pollutant, emission standards and other decrees. Sometimes, several governments may cooperate to make regional regulations across provinces. However, local laws, regulations and rules should not conflict with those of national level.

For major river basins, the State Council, MOEP, Ministry of Water Resource (MWR), other administrative authorities under the State Council, local governments, related local administrative
institutions, and management committee of river basin all participate to make regulations and rules. For a certain river basin, the Constitution, the Environmental Protection Law, the Water Pollution Prevention and Control Law, the Water Resource Law and Water and Land Resource Preservation Law are all effective. Besides those basic laws, the State Council can establish regulations towards certain river basin, such as the Provisional Regulations on Water Pollution Prevention and Control of Huai River Basin. However, more common pattern is that the river basin management committee first submits a draft and then all the related governments make their agreement and sign on the documents, such as the Provisional Regulation on Water Pollution Prevention and Control in Song and Liao River Basin. Also, local government can make its own regulations and rules of pollution control towards the certain part of river basin within its administration jurisdictions, such as Tai Lake Water Pollution Prevention and Control Ordinance of Jiangsu Province.

3.2 Hierarchy of environmental management organizations at various levels and their major responsibilities

The environmental management system is shown in Fig.2. The State Council of the People’s Republic of China, namely the Central People's Government, is the highest executive organ of State power, as well as the highest organ of State administration, which acts as the highest authority for environmental management. In detail, the State Council exercises its power to make guiding principles and policies, carry out administrative legislation, submit proposals to NPC, and coordinate confliction among various departments.

MOEP is the department in charge of environmental protection administration under the State Council, or administrative body of the State Council. It is written in the Environmental Protection Law that MOEP should implement management and inspiration on environmental protection work nationwide. Therefore, the responsibilities of MOEP are as follows: making national environmental guiding principles and policies; coordination, supervision and management over major environmental issues; implementing national objective of emission reduction and take proper responsibilities; instructing national environmental investment and fund allocation, promoting circular economy; controlling environmental pollution and promoting source prevention; formulating and implementing regulations on prevention and control of various pollution; instructing, coordinating and supervising ecological protection; taking responsibility for nuclear safety and radiation safety; taking responsibility for environmental monitoring and information disclosure; carrying out environmental technology work; promoting international cooperation; and organizing public education on environment.

Local governments of each level participate in environmental protection by making local environmental regulations, rules and standards as well as enforcing their implementation. They are responsible for making integrative developing plans considering environmental benefits, issuing emergency orders in facing large environmental disasters, solving cross-region environmental pollution problems and taking responsibility for environmental quality within its administrative regions.
The State Council

NDRC, MOF, MWR, MOC, MOA, SOA, MF, etc.

National level

Provincial level

Prefectural level

County level

Township level

coordination

National River Basin Management Committee

Management Committee of each Major River Basin

coordination

coordination

coordination

coordination

Administrative authorities

Cooperating departments

Fig. 2 Environmental administration system in China

Notes: NDRC=National Development and Reform Commission; MOF=Ministry of Finance; MWR=Ministry of Water Resource; MOC=Ministry of Construction; MOA=Ministry of Agriculture; SOA=State Oceanic Administration; MF=Ministry of Forestry.
Local environmental protection bureaus are the departments in charge of environmental protection administration of each government level. They are responsible for decision-making, macro-guidance, coordination among sectors and supervision over lower levels. Especially, environmental protection bureaus of provincial level are mainly in charge of making macro guidelines, policies, and regulations’ draft; environmental protection bureaus of county level and township level are mainly in charge of micro supervision, such as implementation of state policies, laws and regulations, monitoring pollution sources, supervision on report and registration on pollution discharge and issuing pollution discharge permits. Municipal environmental protection bureaus not only have macro functions but also have micro functions. They can make environmental policies and rules but they also have to work with direct objects to enforce implementation of various laws and regulations\(^3\).

Other administrative sectors such as water resource department, construction department and agriculture department are responsible for environmental protection within their function range. For instance, transportation department should take responsibility for pollution control of land and water roadways according to environmental protection law, water pollution control law, etc. Water resource department should take responsibility for the reservation of water and land resource according to related laws and regulations. Table 2 shows an example of responsibilities allocation among different departments in water pollution control.

**Table 2 Responsibilities allocation among departments in water pollution control\(^1\)**

<table>
<thead>
<tr>
<th>Ministry</th>
<th>Major Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Protection</td>
<td>Make water pollution control policies, rules and standards; water quality monitoring; examine EIA reports of hydraulic projects; participate in making water resource policies</td>
</tr>
<tr>
<td>Water Resource</td>
<td>Water resource management; make plans for water resource reservation; manage hydraulic projects; make water resource charging policies; water allocation; inspect water quality and quantity of surface water</td>
</tr>
<tr>
<td>Construction</td>
<td>Supervise planning and building of sewage treatment plans; manage drinking water in cities; manage water supply and usage in cities</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Control agricultural non-point source pollution, protect agricultural irrigation water</td>
</tr>
<tr>
<td>Land Resource</td>
<td>Protect ocean water, manage and protect ground water</td>
</tr>
<tr>
<td>Transportation</td>
<td>Pollution control in water carriage</td>
</tr>
<tr>
<td>Forestry</td>
<td>Forestry water conservation</td>
</tr>
<tr>
<td>Economy and Trading</td>
<td>Make clean producing policies and make industrial policies for water pollution control. Decide water usage allocation</td>
</tr>
<tr>
<td>Finance</td>
<td>Participate in the management of sewage fees, and make levy standards</td>
</tr>
<tr>
<td>Pricing</td>
<td>Decide sewage treatment charging fees and water resource price</td>
</tr>
</tbody>
</table>

In order to coordinate the holistic benefit of river basins, Chinese government established river basin management organizations. Nowadays, there are two kinds of these organizations which are affiliated to the state council. The first one is water basin administrative institution, which
represent MWR and it is in charge of the comprehensive management and development of river basin and the control major hydraulic projects; the second one is under joint management of MOEP and MWR, which is mainly in charge of water pollution prevention and control. Officially, the second one is regarded as a section of the first one. For each major river basin, there is a river basin management bureau, which is in charge of water resource preservation and water pollution control of certain river basin and the bureaus are directed by the two central organizations affiliated to state council.\(^{14}\)

In the vertical direction, MOEP supervises local EPBs and local EPBs can supervise EPBs of lower level governments. Meanwhile, local EPBs have the right to give advice on decision-making to their upper level institutions. In the horizontal direction, other Ministries of the State Council are parallel to MOEP, but their job contents are different. MOEP is in charge of nationwide environmental and ecology protection, or in other words, unified management; other authorities are in charge of environmental protection within their sectors, or in other words, separate management, and they should cooperate with MOEP on major environmental issues. The relationship between environmental protection bureaus and other sectors of local level is the same with that of central government.

With time being, the position of national environmental protection agency has grown from Leading Group on Environmental Protection of the State Council in 1972 to MOEP in 2008. Fig.3 shows the developing process over the passed 30 years.

Also, the number of national and local environmental protection organizations and their staff has been growing continuously over the passed 30 years. Fig.4 shows the changes in number of environmental protection organizations at national and provincial level, these organizations include environmental protection bureaus, supervision bureaus, monitoring stations, research institutes, education centers and information centers. By the end of 2006, there are 11321 environmental protection institutions around China with 393 of national and provincial level. Total number of staff is 170290 with 8772 of senior title.\(^{15}\)
Fig. 3 Development of central environmental protection institution in China\textsuperscript{16)
3.3 Summary

Currently, China has established a relatively complete environmental legal system, including Environmental Protection Law, individual pollution prevention and control laws, recourse conservation and utilization laws, environmental management laws, regulations, rules and local decrees. However, the complexity and rapidly growing number of laws and regulations have made it difficult for the public to learn instantaneously, and some laws are still lack of detailed regulation for implementation. Compare to legislation, poor implementation of those laws and regulations is a more serious problem. Over the past thirty years, environmental administrative organizations have enjoyed sound development. Central environmental administration was upgraded to MOEP under the State Council recently and total number of staffs in MOEP and EPBs has reached 60,000. However, enforcement capacity is still insufficient to manage present situation. And dual administrative system of EPBs draws back their effectiveness on local pollution control.
4. Enforcement of environmental laws and regulations in China with special focus on the protection of water environment

This part will introduce major legal/administrative measures for the implementation of environmental laws/regulations in China. Through comparison of these measures, we could find major merits or difficulties of each measures and analysis future trend.

4.1 Major legal and administrative measures for implementation

There are eight major legal/administrative measures for the implementation of environmental laws/regulations in China. They are environmental impact assessment system (EIA), “Three Simultaneity System”, pollution levy system, emission permit system, enforcement of pollution abatement for noncompliance by designated date, system of pollution discharge reporting, total emission control system, and enforcement of shutting down, merging and transferring. The first three were established in the 1970s, with the main purpose of controlling the “three wastes\(^1\)”. The three in the middle were established in the 1980s, with the main purpose of strengthening point source pollution control. The last two were established in the 1990s, with the main purpose of comprehensive river basin management.

(1) Environmental impact assessment system

EIA system is stipulated as “it is necessary to forecast and evaluate the negative affect towards environment and give out prevention measures before starting a construction project”. The target of EIA is newly-built construction projects and purposes are preventing environmental pollution, controlling pollution source, encouraging public participation, ensuring proper development and promoting sustainability\(^7\). For the procedure, local government or enterprises which are in charge of new construction project should submit EIA report and environmental administration authority should exam those EIA reports and make final decisions. EIA system was first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1984, and then the Environmental Protection Law and other pollution prevention laws also added the content of EIA\(^3\). Finally, in 2003, the Environmental Impact Assessment Law was enacted. EIA is the first administrative measure which has become individual law. Since the establishment of this law, more than thirty construction projects with total investment up to 2000 billion RMB have been rejected due to their high environmental risks\(^{16}\). Also, the implementation rate\(^2\) has reached a new height since the establishment of the law, as shown in Fig.5. However, local governments may interfere in EIA process due to short-term economic benefits and there are also corruptions in environmental administrative authority.

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\(^1\) Waste water, waste gas and solid waste.
\(^2\) Ratio of projects that executed EIA among all projects that should execute EIA.
The “Three Simultaneity System” is stipulated as “for all the construction projects which have potential environmental hazard, the facilities for pollution control must be designed, constructed and used at the same time with the main part”\(^3\). Obviously, the target of “Three Simultaneity System” is construction projects with potential environmental risks. This system together with EIA system carries out the concept of “prevention should be the first priority”. EIA system focus on making pollution prevention plans, the “Three Simultaneity System” focus on the implementation of those plans\(^18\). For the procedure, the organizations in charge of the projects should implement the construction of pollution control facilities and environmental administrative authority should participate in the designing and acceptance check. The “Three Simultaneity System” was first confirmed as legal provision in the Environmental Protection Law enacted in 1989, afterwards, major pollution prevention and control laws also add the content of “three simultaneity”. Regulations such as “Ordinance on Administration for Environmental Protection of Construction Projects” is established to support the implementation of the system\(^18\). Over the past thirty years, the “Three Simultaneity System” has made great contribution to pollution control of newly built industrial point pollution source. Since the 1980s, large and medium size projects enjoy sound implementation rate\(^1\) (over 95%) of the “Three Simultaneity System”\(^15\). Nationwide implementation rate\(^1\) of the “Three Simultaneity System” is shown in Fig.6. However, some private enterprises, especially TVEs do not conduct EIA or “Three Simultaneity” due to low environmental awareness.

\(^1\) Ratio of projects that implemented “Three Simultaneity” of all construction projects.
Pollution levy system

Pollution levy system is stipulated as “environmental administrative authorities can charge enterprises for the part of pollutant emission which exceed the emission standard and waste water which discharge into surface water system”. There are two kinds of levy systems. The first one is punishment on pollution emission which exceeds standards, such as levy on waste water, waste gas, solid waste, noise and radioactivity. The second one is resource occupation fee, such as waste water discharge fee. This system is the first economic measure for pollution control, with the purpose of stimulating enterprises to make proper environmental management within their own companies and getting stable financial source for point source pollution abatement. The target of this system is enterprises which discharge pollutant directly to environment. For the procedure, environmental administrative authority collects fees according to monitoring data. Pollution levy system was first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1984, and then the Environmental Protection Law and other pollution prevention laws also add the content of pollution levy. Regulations such as “Provisional Measures for Pollution Levy” and “Provisional Measures for Compensable Using of Special Fund of Pollution Source Treatment” are established to support the implementation of the system. In 2003 the Administrative Regulations on Pollution Discharge Levy was enacted by the State Council, which marked the consummation of this system. Since then, the pollution levy changes from over standard levy to total emission levy, and the price changes from low level to full cost charging. As it is shown in Fig.7, total pollution fees grow rapidly since 2003, and reach 14 billion RMB in 2006. Fig.8 shows the usage of pollution discharge fees, the biggest expenditure is pollution source control subsidy. However, low levy level can not compensate for environmental cost, and it has no incentive for enterprises to reduce their emission. In some places, pollution fees go into the account of local EPBs, which may cause the abuse of the money, and due to this reason, enterprises may not regard levy system with proper attitude.
Fig. 7 Total receipt of pollution discharge fee with time being (1993-2006)

Fig. 8 Usage of pollution discharge fee in 2002

(4) System of pollution discharge reporting

System of pollution discharge reporting is stipulated as “all enterprises that discharge pollutant directly or indirectly should report the type, quantity and concentration of pollutants to local environmental administrative authority and provide materials of pollution abatement”. The purpose of this system is to build a basic data base on environment pollution. With the information from this system, environmental administrative authority would be able to decide emphasis of work and make future plans on pollution control or accident prevention. What’s more, this system also acts as the precondition of emission permit system, total emission control system and pollution levy system. System of pollution discharge reporting was first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1984, and then the Environmental Protection Law and other pollution prevention laws also add the content of system of pollution
discharge reporting\(^3\). By 2006, the total number of enterprises that report on their pollution discharge has researched 523472. Fig. 9 shows the changes of total number of enterprises that report on their pollution discharge with time being.

![Fig.9 Total number of enterprises reporting pollution discharge (2001-2006)\(^{15}\)](image)

(5) Emission permit system

Emission permit system is stipulated as “all enterprises can discharge their pollutants to environment only when they have emission permit issued by environmental administrative authority”\(^3\). The process of issuing emission permit is: after enterprises reporting their pollutant discharge, environmental administrative organizations decide total emission quantity according to national guideline, divide emission allocation among enterprises and then issue emission permits\(^{22}\). The main purposes of this system are to protect major river basins and seriously polluted areas. This system, alongside with system of pollution discharge reporting, aims to perform total emission control. Emission permit system was first confirmed as major administrative measures in the Implementation Details of Water Pollution Prevention and Control Law in 1989, and then the Water Pollution Prevention and Control Law and the Air Pollution Prevention and Control also add in this system. The State Council also enact regulations such as “Management Measures for Water Pollutants Emission Permit” and “Management Measures for Water Pollutants Emission Permit in Huai and Taihu River Basins” to ensure the implementation of this system\(^3\). Fig.10 shows the issuing situation of emission permits with time being. It seems that the emission permit system enjoys sound development and the number of emission permits issued increasing year by year. However, according to “report about situation of the permit system of pollutant discharge operation in six provinces and cities” made by SEPA, in most areas, the effectiveness of emission permit system is limited partly due to low environmental awareness of enterprises\(^{23}\).
(6) Total emission control system

Total emission control refers to control total pollution emission within the scope of environmental carrying capacity base on environmental characteristics and self-purification capacity of certain area. Because long period of concentration control can not stop severe pollution situation, Chinese government started total emission control since 1996. Total emission control was proposed during the Fourth CNCEP and was first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1996, and then other pollution and prevention laws also add this content. Currently, COD, SO2, soot, industrial smoke, oil, cyanide, arsenic, mercury, lead, cadmium, hexabasic chromium, and industrial solid waste are on the list of total emission control.24)

Since the eleventh Five-Year Plan, Chinese Government put energy saving and emission reduction on important position and set emission reduction target of 10% on COD and SO2. In this campaign, total emission control and emission permit system are two important measures being used. In detail, central government assigned emission targets to each province, and then local governments divided amount of emission between industrial sectors by using emission permit system. According to statistic data, total emission of major pollutants began to decrease nationwide since 200725).

(7) Enforcement of pollution abatement for noncompliance by designated date

Enforcement of pollution abatement for noncompliance by designated date system refers to enterprises which pollute environment seriously or enterprises located in special natural protection area that excess emission standards must reduce their pollution level to a certain content decided before by designated date. Else, they would be fined or shut down. This system is originally created by Chinese government with the purpose to improve regional environment compulsorily. For the procedure, first EPBs submit list of enterprises to local governments, then local governments send out notification to those enterprises. After designated period, EPBs will check the result and submit list of enterprises that should be closed according to monitoring data to local government. It was first confirmed as legal provision in the Water Pollution Prevention and
Control Law in 1984, and then the Environmental Protection Law and other pollution and prevention laws also add this content\(^{26}\). Over the past thirty years, this system has contributed significantly on treatment of industrial pollution source. Fig.11 shows the completed investment in pollution abatement by designated date with time being. This system also acts as an effective measure for “Zero-point” actions in Huaihe River Basin and Taihu River Basin, in which pollution abatement must be implemented and attain certain level before 0:00am of the next year. Through those actions, industrial point source pollution was well controlled and water quality was improved immediately. However, the imperfections of this system have limited its effect greatly. For example, local governments that have determination exercising right often protect enterprises which pay more tax; and the period of the process is too long to protect the environment effectively. Sometimes, enterprises even use this system as a protection equipment for their illegal over-standard emission\(^{26,27}\).

![Fig.11 Completed investment in pollution abatement by designated date (1992-2006)\(^{15}\)](image)

(8) Enforcement of shutting down, merging and transferring

Enforcement of shutting down, merging and transferring system is stipulated as “enterprises that of low profit, high environmental pollution level and have high impact on the daily life of nearby residents must stop producing and improve their pollution control level; enterprises that of low resource utilization and high environmental pollution level, especially small sized, county level firms of papermaking, chemical industry, dyeing and printing, sulfur, etc. must be enforced to pollution abatement by designated date or enforced to shut down, merged or transferred; enterprises that harm drinking water source must be shut down”\(^{3}\). And enterprises that can not accomplish environmental abatement by designated date will also be shut down. Actually, this system is the most serious punitive measures for illegal pollution enterprises. The purpose of this system is to improve environmental quality in a short time and help to promote enterprises structure upgrade and improve resource allocation. For the procedure, after EPBs submitting proposals to local governments, local governments will make final decision and give command to
enterprises. Enforcement of shutting down, merging and transferring system was first clearly proposed in “Decision on Strengthen Environmental Protection Work of the State Council” in 1990\(^{28}\), and then various regulations and local rules were enacted to support the implementation of this system\(^{29}\). Although this system may have periodicity problem, it has been playing an important role in pollution control. Fig.12 shows number of enterprises which were shut down, merged or migrated with time being. However, if over used by local governments, this system may also cause social problems, such as the case of shutting down and transferring ceramic firms in Foshan city\(^{30}\).

![Fig.12 Number of enterprises which were shut down, merged or migrated (1992-2006)](image)

For the eight major measures introduced before, EIA system and “Three Simultaneity System” are for controlling of new pollution sources; pollution levy system, emission permit system, enforcement of pollution abatement for noncompliance by designated date, and enforcement of shutting down, merging and transferring are for controlling of old pollution sources, with reporting on pollution discharge being the precondition for others. Total emission control is a management guideline on pollution control while the others are specific measures.

However, there are some common problems in the implementation of these measures. Firstly, local governments often interfere in environmental pollution issues under the ideology of local protectionism. Secondly, some EPBs have corruption problems such as embezzling pollution discharge fee. Thirdly, many enterprises carry out pollution control passively partly because of low environmental awareness. Fourthly, enforcement of some measures may be lack of flexibility or long-term effectiveness. Finally, insufficiency of environmental supervision capacity limits the effectiveness of these measures.

### 4.2 Enforcement of pollution prevention and control laws and regulations

Environmental supervision, environmental inspection and environmental monitoring are three
major components in enforcement of environmental laws and regulations. Enforcement is precondition of all those measures introduced in the preceding part. Only with effective enforcement, can the implementation measures exert their full power.

(1) Environmental supervision and inspection

Environmental supervision and inspection are important to the effective enforcement of environmental laws and regulations. Environmental spot inspection is an important administrative system which means environmental administrative organizations and other organizations which have environmental supervision right have the power to inspect the implementation situation of environmental protection in the manufacture spots in their precincts. The purpose of this system is to enforce the implementation of environmental protection measures. Environmental inspection system was first confirmed as legal provision in the Water Pollution Prevention and Control Law in 1984, and then the Environmental Protection Law and other pollution prevention laws also add this content. Enterprises have the responsibility to provide information about operation situation of pollutant treatment plants, monitoring equipments and measures, implement situation of pollution abatement projects by designated date and so on. Recently, most EPBs of city and town level announced local decrees of routine inspection respectively.

In 1991, NEPA established “Provisional Measures for Environmental Supervision” which aimed to improve environmental law enforcement according to the spirit of “Strengthen Environmental Protection Work” of the State Council. Afterwards, regulations on system, procedure, code of conduct and penalties of supervision were enacted in succession. Recently, especially after Songhua jiang water pollution accident (2005), Chinese government greatly increase capital input on environmental supervision. In the eleventh Five-Year Plan, Chinese government invests 2 billion RMB in major pollutant reduction, among which a considerable part will be used in local environmental supervision capacity building. Also, environmental supervision organizations enjoyed rapid development during these years, as shown in Fig.13. National Environmental Supervision Bureau is founded in 2003 and provincial environmental supervision bureaus are founded mainly after Songhua jiang water pollution accident. By the end of 2006, there are 33 national and provincial level environmental supervision centers, 404 of prefecture and city level and 2366 of town level. In order to reinforce local environmental supervision, six supervision centers affiliated to MOEP are built in major regions, northeast China, east China, south China, north China, southeast China, and southwest China. Currently, there are discussions about necessity of building independent vertical environmental supervision system. From 2003, SEPA along with national supervision bureaus and other six authorities carry out “environmental enforcement campaign” every year. In 2006, a total of 1.7 million person times were sent out to inspect 720 thousand enterprises and 28 thousand enterprises were put on record while more than 3000 enterprises were shut down. These events have two-side effects, although they received immediate results in controlling pollution source and improving environment quality, they are also questioned to be lack of long-effectiveness. However, omission and corruption of enforcement officers limit the effectiveness of supervision.
Environmental monitoring includes environmental quality monitoring, pollutant discharge monitoring and emergency monitoring\(^ {34} \). An accurate and timely environmental monitoring system can improve environmental management capacity significantly. And environmental monitoring is also the precondition for total emission control, emission permit system, pollution levy system, enforcement of pollution abatement for noncompliance by designated date, etc. In 1983, Environmental Protection Bureau established “Management Measures for National Environmental Monitoring”, which was the first detailed administrative regulation on environmental monitoring. Then, the Environmental Protection Law and other individual laws for pollution prevention and control also add this content\(^ {1} \). In order to strengthen environmental monitoring to adapt new development of China, SEPA established “Management Measures for Environmental Monitoring” in 2007\(^ {35} \). Environmental monitoring centers are in charge of environmental monitoring work, and they belong to relevant environmental administrative authority. The development of monitoring centers is shown in Fig. 14. Currently, there are about 40 national and provincial level environmental monitoring centers, 400 of prefecture and city level and 2000 of town level.

During the past thirty years, environmental monitoring technologies have developed from artificial monitoring to automatic online monitoring. Since the ninth Five-year Plan, waste water discharge automatic online monitoring technology started to spread nationwide in industrial enterprises, which improve the efficiency greatly\(^ {36} \). In 2008, MOEP established two regulations on management of online monitoring\(^ {1} \). According to the “Three Measures” on emission reduction, all of national major pollution sources must complete installation and testing of online monitoring equipments by the end of 2008\(^ {1} \). This action will greatly improve industrial source pollution monitoring capacity and make pivotal contribution on compassing emission reduction goal. However, high cost and low level of technical staffs are the two major resistances to the popularization of online monitoring\(^ {36} \).
Since 2001, China has entered environmental pollution accident-prone period. Especially the Songhua jiang water pollution accident in 2005 revealed the vulnerable situation on China’s emergency monitoring system. After the accident, national and provincial contingency plan for environmental emergencies were established respectively. Recently, the number of research papers on emergency monitoring increases significantly, and research fields include basic theory on emergency accidents, monitoring technology, GIS information system and regulation system. However, research on legislation and management on emergency monitoring is still insufficient.

![Fig.14 Total number of environmental monitoring centers in China (1992-2006)](image)

### 4.3 Other policy measures

Public participation and information disclosure are important complementary to mandatory measures introduced in previous paragraph. They are paid much attention by central government in recent years, which reflects the trend of multiple measures in environmental management.

(1) Public participation

Public participation is of great importance in environmental protection. Firstly, it is a way to maintain residents’ own right by participating in supervision and decision making; secondly, public participation in environment may make up the insufficiency of supervision by government and may also improve the quality of environmental policy making, since government can take social cost into consideration; thirdly, public participation can improve the environmental awareness of the society, which may act as pressure for polluters. For the above reasons, this concept was first proposed in the Environmental Protection Law in 1989, then Water Pollution Prevention and Control Law (1996), Noise Pollution Prevention and Control Law(1996), and Environmental Impact Assessment Law(2003) also add in this content. For its implementation, MOEP enacted “ Provisional Measures of Public Participation in EIA” which detailed the procedure and measures. Chinese government greatly supports public participation in environment. At present, there are more than 2000 non-government environmental protection...
organizations in China which play an important role in environmental education and other environmental issues\(^{39}\).

The benthonic membrane project of Yuanmingyuan is a good example to show the progress of public participation in China. A professor in ecology noticed the news of this project accidentally in March 2005, then he informed major media to report his oppugns against the project, after seeing the news, more scholars participated in this debate against the administer of the park. However, this project did not submit EIA report, as a result, it was stopped by SEPA at the end of March. Then, SEPA held social hearings in April, in which 120 people and more than 50 media participated, and which was considered as the first hearing in environment. Afterwards, this project was consigned to research institutions for EIA. Finally, this project was restarted following new plan in August\(^{40}\). In this example, the sharp percipience of scholars, the support of common people and media, the positive response of government all shows the improvement of public participation.

However, the participation rate of public is still low in China. According to a survey in Guangdong and Guangxi province, more than 85% of local residents do not know any information about big projects which may have potential environmental hazard\(^{41}\). Reasons of this situation may be as follow: education level is low, environmental awareness is low, information disclosure system is not effective enough, and lack of channels.

(2) Information disclosure

Information disclosure consists of two main aspects: first, government could provide information about laws and regulations, construction projects, environmental quality, and other information such as model city for sustainability; second, enterprises could provide information about environmental management performance such as green GDP or CSR activities, pollution control system and green products certification. Therefore, information disclosure system has two major merits: first, it is the precondition of public participation, with enough information, residents can involve in environmental decision making, which will decrease mistakes of the government; second, public can supervise enterprises for their environmental protection work through information disclosure, which can become a kind of pressure on those enterprises\(^{42}\).

For these reasons, Chinese government has being endeavored to build information disclosure system over these years. For legislation, the Constitution and the Environmental Protection Law clearly stipulated that government should release environmental information to public. Then, from the beginning of the 21 century, the Water Resource Law, Solid Waste Pollution Prevention and Control Law and Clean Production Promotion Law also add the content of information disclosure. In order to ensure the implementation, SEPA established “Management Measures of Information Disclosure for Environmental Administrative Organizations” in 2003, “Announcement about Environmental Information Disclosure of Enterprises” in 2005, and finally “Environmental Information Disclosure Measures (trial version)” in 2007, which is the first comprehensive administrative regulation about environmental information disclosure\(^{42},43\).
At present, environmental information disclosure system in China includes national, provincial, and local environmental quality reports; major river basin environmental reports; weekly report of air pollution situation of major cities; environmental administrative information; environmental level evaluation of enterprises; information of serious pollution enterprises, etc\(^4\). However, compare to other developed countries, information disclosure system in China is still far from prefect. Especially, the timeliness, accuracy and completeness need to be improved in the near future\(^4\).

### 4.4 Summary

Implementation measures can be divided into five groups as shown in Table 3. Over the past thirty years, environmental implementation measures developed from single mandatory orders to integrated measures consist of command and control, economic incentives, information disclosure, public participation and voluntary approach. Recently, although mandatory orders are still in dominant position, environmental protection organizations start to pay more and more attention to economic incentives by raising the price level and strict regulation on the manipulation of the money. Meanwhile, information disclosure and public participation are also highly promoted by Chinese government through the establishment of EIA laws and other related regulations. However, they are still at the initial stage and still need to be strengthened in the future. Table 4 shows the evaluation and major problems of these measures.
<table>
<thead>
<tr>
<th>Classification of environmental implementation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Command and Control</strong></td>
</tr>
<tr>
<td><strong>Economic incentives</strong></td>
</tr>
<tr>
<td><strong>Information disclosure</strong></td>
</tr>
<tr>
<td><strong>Public participation</strong></td>
</tr>
<tr>
<td><strong>Voluntary approach</strong></td>
</tr>
</tbody>
</table>

Source: Summarized by the author.
According to the quantitative research on effects of existing measures of environmental management on pollutant discharge of enterprise conducted by Baitao LU in 1999, pollution levy, environmental subsidy, environmental supervision and administrative intervention all have obvious influence on COD emission, among which environmental subsidy has relevant higher influence than others. This result can be interpreted as enterprises are highly depending on national environmental subsidy for pollution abatement construction; pollution levy level is too low to have incentives; environmental supervision capacity is too weak; and passive actions under administrative orders to not have good results.)

Although Chinese government still need to strengthen environmental supervision and environmental monitoring, economic incentives, information disclosure, public participation and voluntary approach will become the new trend of environmental management measures. Meanwhile, the relation between the government and enterprises will change from conflict and distrust to cooperation and trust.
5. Case studies

5.1 Water pollution in Taihu River Basin

Taihu Lake is the third largest lakes in China which locates in the center of Yangtze delta. The catchment area of the lake is 36.9 thousand square kilometers and total length of watercourse is 120 thousand kilometers. Taihu River Basin is across three provinces and one provincial level municipality, Shanghai, Jiangsu, Zhejiang and Anhui, which are the most economically developed areas. In 2007, total population of Taihu River Basin was 49 million, total GDP was 2865 billion RMB, and personal GDP was 58 thousand RMB, which was two times more than national level45).

The most important feature of economic growth in Taihu River Basin is the rapid growth of TVEs. Most of TVEs are of chemical industry, paper-making industry, electroplating industry and other heavy pollution industries. In some places of Jiangsu province, average number of TVEs per village even exceeds 100. Low environmental awareness of enterprises, together with short-sight of local governments has caused present serious pollution situation in Taihu River Basin. According to a survey conducted by Taihu River Basin Management Bureau in 2004, over 30% industrial enterprises discharge pollutant illegally46). Conflict between economy and environment is very intense in this area.

From the 1980s, water pollution began to appear with the rapid economic development of Taihu area. Since then, the water quality of Taihu degenerate one level every ten years47),48). From 1990 to present, cyanobacteria erupt every year. And for the most serious eruption were in 1990, 1995, 1998 and 2007, it even caused severe drinking water supply crisis in Wuxi city, which was a great hazard to daily life and social stabilization.

In the end of April 2007, cyanobacteria erupted in Meiliang Bay of Taihu Lake. In early May, cyanobacteria further aggregated and the distribution range enlarged with the concentration of chlorophyll a over 100 micrograms per liter. On May 28th, the water quality in Gonghu water supply factory deteriorated suddenly, and emitted bad smell. On May 29th, water supply crisis began, and bottled water got out of service. Meanwhile, MWR and MOR initiated emergency plan. On June 6th, water supply finally recovered to normal state. The 2007 water supply crisis was an artificial environmental disaster caused by pollution.

According to environmental evaluation standard of surface water in China, in the year 2008, integrated water quality of Taihu Lake was below class V, with 7.4% of class IV, 27.2% of class V, and 65.4% below class V. Major pollutants include total nitrogen, total phosphorus, ammonia-nitrogen, COD and BOD545). From 1997, the concentration of COD remains stable at class III, and the concentration of ammonia-nitrogen increases slightly around class II. But the concentration of total nitrogen and total phosphorus keep increasing, and water quality of these two pollutants is below class V and class IV respectively. So, the biggest pollutant of Taihu lake is total nitrogen and the second one is total phosphorus. Fig.15 shows the concentration of total nitrogen with time being and Fig.16 shows the concentration of total phosphorus with time being. From the late
1990s, Chinese government strengthen the pollution control of industrial point sources, due to this reason, the ratio of industrial pollution declined while domestic sewage and agriculture nonpoint source become bigger contribution parts for water pollution problem in Taihu lake. Table 5 shows the category distribution of pollutants. Table 6 shows the geographical distribution of pollutants. Jiangsu province contributes most part of pollutants, partly because 52% of Taihu area belongs to Jiangsu province, which is the biggest part; and partly because Jiangsu province has great number of TVEs which discharge pollutants to Taihu Lake.

![Fig.15 Concentration of total nitrogen (1987-2008)](image1)

Note: Data from 1998 to 2004 is missing.

![Fig.16 Concentration of total phosphorus (1987-2008)](image2)

Note: Data from 1998 to 2004 is missing.
Table 5 Sectoral distribution of pollutants

<table>
<thead>
<tr>
<th></th>
<th>COD</th>
<th>NH₃-N</th>
<th>TN</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial point</td>
<td>31.13%</td>
<td>34.04%</td>
<td>29.31%</td>
<td>4.91%</td>
</tr>
<tr>
<td>Domestic sewage</td>
<td>23.71%</td>
<td>22.51%</td>
<td>19.35%</td>
<td>27.58%</td>
</tr>
<tr>
<td>Agriculture nonpoint source</td>
<td>45.16%</td>
<td>43.44%</td>
<td>51.34%</td>
<td>67.51%</td>
</tr>
</tbody>
</table>

Table 6 Geographical distribution of pollutants

<table>
<thead>
<tr>
<th></th>
<th>COD</th>
<th>NH₃-N</th>
<th>TN</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiangsu</td>
<td>68.91%</td>
<td>69.96%</td>
<td>69.33%</td>
<td>55.92%</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>29.53%</td>
<td>27.82%</td>
<td>28.76%</td>
<td>38.1%</td>
</tr>
<tr>
<td>Shanghai</td>
<td>1.56%</td>
<td>2.22%</td>
<td>1.91%</td>
<td>5.98%</td>
</tr>
</tbody>
</table>

In 1998, the State Council initiated “Zero-point action” to alleviate the pollution situation in Taihu lake\(^{48}\),\(^{50}\). Since then, Chinese government has invested millions of RMB to build sewage treatment plants, support ecological restoration projects, and control nonpoint source pollution\(^{48}\),\(^{51}\). However, except for partial improvement in some points, the integral situation keeps getting worse.

After the 2007 water crisis in Taihu River Basin, Chinese government farther strengthen on the environmental improvement work of Taihu. In 2008, the State Council, NDRC, MOEP, MWR and local governments jointly established “comprehensive management plan for water environment in Taihu River Basin”. The range of this plan include 4 cities and 30 towns in Jiangsu province, 3 cities and 20 towns in Zhejiang province, and 3 towns in Shanghai. The plan can be divided into two parts: period one from 2007–2012, and period two from 2013–2020. The major spirit of this plan is total emission control: capacity control and object control. Total capacity emission control means allocating discharge amount base on the calculation of water environment capacity; while total object emission control means establishing emission object according to emission of base year and trying to achieve the goal. The result of capacity calculation is shown as Table 7.

Table 7 Calculation result of emission limitation (10³ ton/year)

<table>
<thead>
<tr>
<th></th>
<th>COD</th>
<th>NH₃-N</th>
<th>TN</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiangsu</td>
<td>345.7</td>
<td>26.4</td>
<td>40.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Zhejiang</td>
<td>170.8</td>
<td>10.8</td>
<td>16.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Shanghai</td>
<td>7.7</td>
<td>0.7</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>524.2</td>
<td>37.9</td>
<td>58.6</td>
<td>4.9</td>
</tr>
</tbody>
</table>

This plan emphasis on ten major aspects:

i. Drinking water safety: there are 89 projects for water source protection and improvement, emergency water source area construction, regional joint water supply, and advanced treatment of drinking water.

ii. Industrial structure adjustment: Jiangsu environmental protection bureau established “water
pollutant emission limitation for sewage treatment plants and major industrial enterprises in Taihu area”, which is the most strict emission standard of China. As a result, about one-third firms will be shut down, another one-third will change their production and the other one-third will improve their waste water treatment level. And according to industrial policy, the “small-five”, “small-fifteen”, and “new small-five” high pollution industries will be shut down.

iii. Industrial waste water treatment: there are 140 major projects in the near future. And for future trend, emission standard will continue to increase with time being.

iv. Domestic waste treatment: In order to meet emission standard of level one A of domestic waste water, 249 sewage treatment plants will be built and 188 be reconstructed. Besides, 4516 kilo meters’ waste water pipeline will be constructed. Finally, the treatment capacity will reach 100 million ton per day by the end of 2020.

v. Agricultural nonpoint source pollution control: Firstly, for planting, fertilizer reduction plan will be carried out, which will reduce the usage for average 30%. Besides, 4700 kilo meters’ ecological intercept channel will be built to reduce the emission of TN and TP; Secondly, for stock raising, anaerobic treatment of excrement and utilization of methane will be promoted; Thirdly, for fishing, fence aquaculture will be prohibit. Besides, 54950 waste water treatment or solid waste treatment plants will be built to reduce rural pollution to 80% by the end of 2020.

vi. Ecology renovation: projects for protection wetland, planting trees and silt removal will be carried out.

vii. Water environmental capacity improvement: about 5 billion tons of water in Yangtze river will be induced to Taihu lake every year. This project can help to promote water flow of Taihu lake, which will reduce the possibility of cyanobacteria eruption. And it is also effective for diluting the concentration of pollutants, which will increase the water capacity.


ix. Strengthen supervision system: focus on net work construction of supervision system and information disclosure of Taihu River Basin.

x. Increase research input: 14 major research projects are in the plan.

Total number of projects for the above ten major aspect is about 1238 and total investment will be 137 billion RMB, with the first three emphasis aspects of domestic waste treatment, water environmental capacity improvement and agricultural nonpoint source pollution control. Based on calculation, newly increased treatment capacity will meet the requirement for emission reduction and objects will be achieved.

In 2008, Jiangsu province established “Water Pollution Prevention and Control Ordinance of Taihu Lake in Jiangsu Province”, which is a comprehensive local law aims to stop the pollution situation in Taihu. Then the Leading Group of Water Pollution Control of Taihu Lake in Jiangsu Province was also founded. During 2008, Jiangsu government shut down 4300 high polluted small chemical industrial firms, one year ahead of schedule, built sewage treatment plants in all towns. By the end of 2008, urban sewage treatment rate has reached 84%. Jiangsu province set a good example for water pollution control in Taihu area. However, for the future 20 years, water pollution control in
major river basins will continue to be the important mission for China.

5.2 Energy saving and emission reduction

In order to apply the Scientific Outlook on Development, build a concordant society, improve people’s living standard and maintain long-term development of China, Chinese government proposed emission goal in the eleventh Five-Year Plan that: “by the end of 2010, energy dissipation for unit GDP should be reduced by 20% and emission of major pollutants (COD and SO₂) should be reduced by 10%”\(^{(53)}\).

In order to achieve this target, energy saving and emission reduction are put in extreme priority level by Chinese central government. The Leading Group on Energy Saving and Emission Reduction of the State Council was founded in June 2007, and Premier Wen serves as group leader. Afterwards, most provinces established similar leading groups in succession.


Major implementation measures include “Promoting water pollution control in major river basins”, “reducing pollution in major industries and accelerating industrial structure upgrading”, “establishing pricing policy, taxing policy, financial policy, trading policy, etc to build long-term mechanism for pollution reduction”, “Controlling new pollution source by strict EIA system and using regional restriction”, “Increasing capital input on the construction of three systems”, “Carrying out environmental enforcement campaigns to punish illegal pollution”, etc. Central government will invest 23.5 billion RMB on energy saving and emission reduction in the eleventh Five-Year period. In 2007, 482 waste water treatment plans were built with total treatment capacity of 13 million ton per day. In the meantime, 2018 heavy pollution papermaking firms and 500 chemical industry firms were shut down\(^{54}\).

Emission level of COD and SO₂ decreased by 3.14% and 4.66% in 2007 and the date changed to 4.42% and 5.95% in 2008. The dropping of both indicators is a big success for emission reduction, which may due to the success of industrial restructuring, pollution treatment projects, strict accountability system, effective levy system, etc\(^{55}\). However Chinese government still needs to make great effort to meet the challenges of the emission target in the eleventh Five-Year Plan.
6. Conclusions

Starting from early 1970s, China’s environmental management has developed from end-of-pipe abatement to pollution prevention, and from emphasizing economic performance to sustainable development. Serious pollution accidents, political will of top leaders and international cooperation are the major three driving forces for China’s environmental management. Because water has more direct relation with human health, water pollution and control has always been the priority of China’s environmental protection.

China’s environmental legal system consists of Environmental Protection Law, individual laws, regulations, rules and local decrees. NPC is responsible for making laws and administrative authorities such as the State Council is responsible for making regulations and rules. At present, environmental legal system is relatively complete, how to ensure the implementation becomes the key issue. In vertical direction, China’s environmental management system consists of four levels, MOEP, provincial EPBs, municipal EPBs and county EPBs. In the horizontal direction level, other authorities of the State Council cooperate with MOEP in environmental issues. Although they are playing an important role in environmental protection, dual leader system limits the effectiveness of local EPBs.

China’s environmental implementation measures have developed from single mandatory orders to integrated measures consist of command and control, economic incentives, information disclosure, public participation and voluntary approach. Although mandatory orders are still in dominant position, more attention has been paid to economic incentives and other measures. Public participation would become future trend of environmental management measures.

Recently, energy saving and emission reduction have become key issues of the Chinese government. In order to achieve the emission reduction target, Chinese government emphasizes on total emission control, emission permit system, industrial structure upgrading, and environmental performance assessment as major measures. In 2007 and 2008, emission of major pollutant continues to decrease, which may be considered as stage success of this campaign.
References:


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