



A case study of urban environment—economic management in Xiamen, China

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Efficient urban environmental management methods are of importance, even essential to urban sustainable development. Economic methods have increasingly had advantages over other methods of environmental management during the course of the economic system's transition in China. Therefore, the establishment of an effective urban environment-economic management system is necessary and valuable. This paper primarily studies urban environment-economic management and establishes a framework for an urban environment-economic management system. As an example, we created the environment-economic management system of Xiamen, giving priority to economic methods combined with other management methods. We also investigated some problems probably arising in the application of this management system. Finally, a preliminary benefit analysis of the environment-economic management system of Xiamen was conducted. This new comprehensive framework for an environment-economic management system may be used in other cities in China and other developing countries around the world.

Keywords: sustainable development

Introduction

Different stages of urban development may produce different environmental problems, so environmental management methods should differ accordingly at each stage (Chen et al., 2004). Theory and practice have revealed that it is reasonable to choose economic methods at the present stage and in the future (Ma, 1999). Therefore, more and more attention has been paid to these methods. Many experts and scholars have researched its definition (Zhang and Li, 1996), classification (Shen and He, 2001), applicable conditions (Hua et al., 2002) and estimate standard (Zhang and Li, 1996). Even now, research has focused on each single method's usage, without exploring the combination of economic methods with other methods. To strengthen urban environmental management and realize urban sustainable development, it is essential and significant to implement an urban environment-economic

management system that gives priority to economic methods and can be combined with other methods (i.e., legal, administrative, technical, educational means). Using Xiamen as an example, we propose an environment-economic management system and investigate some of the problems that may occur during the implementation of this system.

Concept of urban environment-economic management

The use of urban environment-economic management is not common at present. Similar concepts can be found in the literature, but it is not specifically defined (Xu, 2001; Jiang, 2003). So far, the concept of economic methods in environmental management is used relatively frequently, and is classified and defined according to environmental management means, such as legal, administrative, economic, technical, and

educational means. In fact, to obtain a better management effect, various kinds of methods should be combined.

Dense population and centralized social and economic activities result in increasingly complicated and serious urban environmental problems. It is essential to apply effective and integrated urban environmental management. Moreover, a developed urban economy and prosperous culture provide favorable conditions for implementing economic methods. Based on the above-mentioned necessity and possibility, we think that an urban environment-economic management system should be developed. This system combines economic methods with other methods in urban environmental management

A series of factors are needed to ensure the favorable practice of environment-economic methods, such as the perfect statute system, the right market economy system, the effective management system, and a favorable environmental consciousness (Hua et al., 2002). Consequently, it is necessary to combine economic means with others, such as legal, administrative, technical (including information technology), and educational means. In a word, urban environment-economic management is a set of system methods. It contains a

combination of economic, legal, administrative, technical, and educational means, and employs economic leverage to adjust urban social and economic activities. Environment-economic management is ensured and standardized by laws and administrative regulations, implemented by concrete economic methods, and promoted by technical and educational means.

Urban environment-economic management system

Generally, a city has relatively concentrated administrative sections and enterprises, better market economy conditions, and a good public environmental consciousness. As a result, we can use economic and other methods in urban environmental management, and establish an urban environment-economic management system in which the government, enterprises, and public interact with one another (Figure 1).

Urban environment-economic management aims to construct a management network among the government, economic enterprises and the public, and to carry out the management by their cooperative efforts. The government makes the environment-economic policy and manages enterprises and individuals. Enterprises

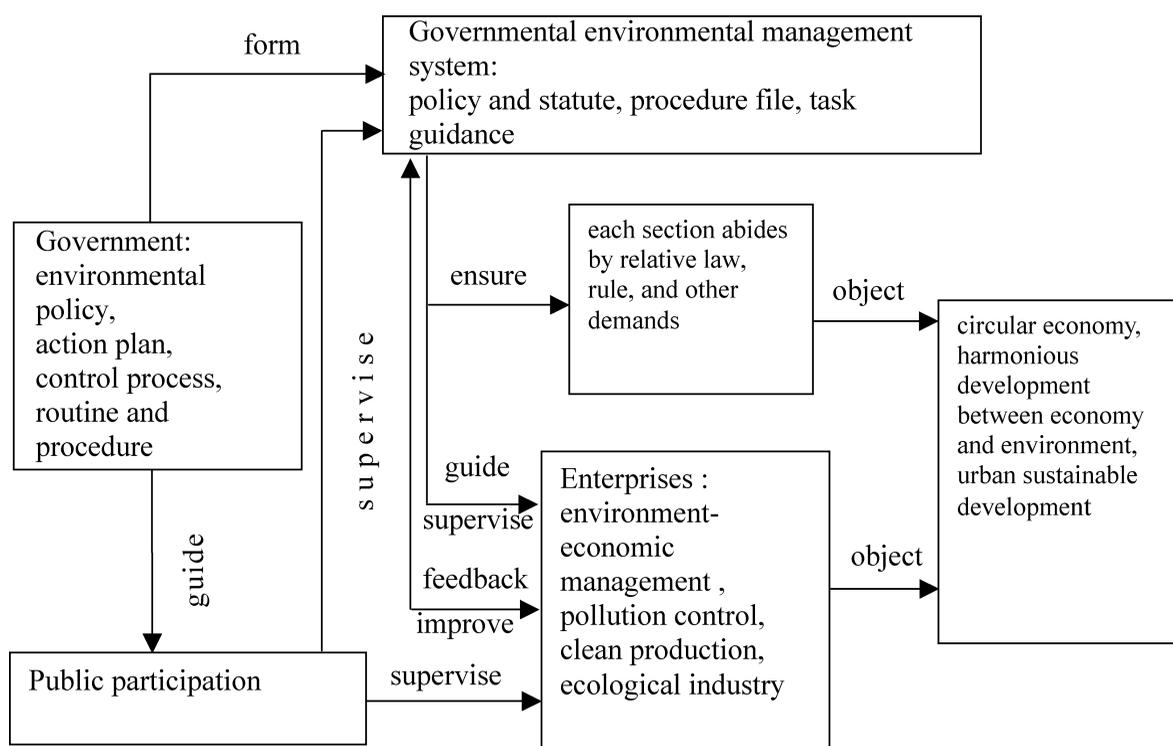


Figure 1. The environmental management system consisting of government, enterprises and public.

implement the environment-economic management and give feedback of the management effect to the government, so that the government can accordingly ameliorate the detailed rules in the future. The public participates in and supervises the implementation of the environment-economic management. By each participator's interaction, the system can ensure immediate and improved information communication.

A case study: urban environment-economic management of Xiamen in China

With the construction of a special economic zone over last 20 years, the social economy and environmental protection work in Xiamen have been developing harmoniously and quickly. This supplies a suitable social, economic, and environmental base for implementing environment-economic management.

Urban environment-economic management system in Xiamen

In recent years, Xiamen mainly used traditional order-control environmental management methods, combined with some economic methods, such as pollution charge and eco-compensation charge. According to the demand of the economic system's transition, Xiamen should enhance the economic methods' usage. As well, based on its current favorable social, economic and environmental condition, Xiamen can establish an urban environment-economic management system. With the analysis of current management methods, environmental resources condition, environmental protection objects and other factors, we developed an environment-economic management system for Xiamen. This includes pollution charge, emission trading, eco-compensation, resource charge, and inspiring mechanism, combined with other means, such as legal, administrative, technical, and educational means (Table 1).

Pollution charge has been used for pollution control in nearly all environmental studies. Complying with related laws and statutes, Xiamen should adjust the standard of pollution charge and gradually improve its efficiency as the level of the economy develops in different phases.

Emission trading can be used in the prevention and remediation of air pollution, especially sulfur dioxide. Xiamen is not a big pollution source to the atmosphere, but external sources have a strong influence on it (Xi-

amen Environmental Protection Bureau, 2001). The government of Xiamen could try to regard the whole city as a pollution source and trade it with other cities producing sulfur dioxide. The trade may be restricted by local governmental limited programmes and other factors; hence, negotiation among local governments and the national environmental protection bureau's coordination is required.

To effectively prevent the destruction of the ecological environment by economic activities, and to accelerate the ecological environment's recovery, it is necessary to use eco-compensation in Xiamen. During the beginning period, attention can be focused on one or two industries, and then can be enlarged to incorporate others. These industries can include the exploitation and utilization of water, land, forest and fishery resources.

Different compensation methods can be used for different objects. For the destruction of the ecological environment, practicality compensation is feasible (e.g., destroyer of mangrove is asked to grow a piece of this plant in other suitable areas) on top of an eco-compensation charge. On the other hand, the people who protect the ecological environment can get economic subsidies or job priority. The detailed compensation method and quantity should be decided by many experts qualified in various fields.

For the common method of eco-compensation charge, every borough's environmental protection substation should collect charges uniformly in accordance with stated principles and standards, or the resource management sections could be commissioned to collect when necessary.

Xiamen should implement eco-compensation in the Town of Lianhua in the Tong'an district. As a water source conservation area, Lianhua town has closed all stockbreeding and limited its tour development, and promised not to fund further industry enterprises. These restrictions in Lianhua play an important role in protecting the water source and bringing benefits to other districts. In order to realize social equity, the beneficiaries should compensate the residents in the water source conservation area for their sacrifice.

To make people aware of the value and scarcity of a resource, and in order to realize the resource's sustainable utilization, it is essential to collect a resource charge. This is especially important for the case of a shortage of water resources.

The charge standard is not invariable with social and economic development. Xiamen can adjust the charge standard by consulting existing standards in China and abroad (e.g., resource charge in Singapore (Huang,

Table 1. The urban environment-economic management system in Xiamen.

Economic methods	Combination with other methods	Relevant characteristics of Xiamen	Environmental object
Pollution Charge	legal means; administrative means; technical means (information system of collection and management)	has used pollution charge; pursue harmonious development between society and economy	water pollution; atmosphere pollution; noise pollution; solid waste discharge
Emission trading	legal means; administrative means; technical means (real-time inspection and management)	retain harmony between economic development and environmental capacity	air pollution in definite region
Eco-compensation	legal means; administrative means; technical means (expert support system), educational means	weak marine ecological environment; environmental protection plan for improving ecological environment	exploit energy and resources (e.g., river, lake and ocean) disafforestation and usage of grassland; landscape tour; develop areas construction
Resource Charge	legal means; administrative means; technical means (information system of collection and management)	lack water resource; lack land and mine; pursue resources' sustainable utilization	all kinds of environmental resources, especially for scarce resources
Inspiring mechanism	technical means (clean production and ecological industry); educational means; open information	push clean production; develop environmental protection industry	subtotal fields

2001)) and by considering the social and economic situation, the ability of enterprises and water consumers to pay, and the resource charge's collection status in different phases.

The economic methods aim to change human attitudes and activity into a mode more favorable for society, impel people to use resources reasonably, and protect the ecological environment. The transition can be accelerated by giving some prize or preferential policy to the groups and individuals who do well in related fields of environmental protection.

For enterprises that adopt clean production process and explore advanced techniques, the government can implement preferential revenue; for the ones that control pollution actively, the government can provide them with economic compensation; for the enterprises investing in environmental protection industries, the

government can afford financial support. For individuals, there is a significant amount of work to do, including encouraging them to reclaim and recycle resources through deposit-refundment, leading them to develop scientific studies, and finding funds for financing researchers to go abroad to study environmental technology.

Actualization of urban environment-economic management

By constructing an all-sided management network of government, enterprises and the public, it is hoped the urban environment-economic management system can realize efficient management. The administrative management sector functions as decision maker, formulates laws, statutes and standards, and performs

Table 2. The implementation of various forms of environment-economic management means.

	Government	Enterprises	Public
Pollution Charge	<ol style="list-style-type: none"> 1. constitute laws, statutes, standards and rules 2. audit and check discharge reporting 3. collect and manage pollution charge 4. research into information system 	<ol style="list-style-type: none"> 1. report pollution discharge 2. pay pollution charge 3. apply for special environmental protection fund 	participate and supervise
Emission Trading	<ol style="list-style-type: none"> 1. constitute laws and statutes 2. decide pollution source range 3. check and inspect 4. assign discharge right 5. buy or sell discharge right in feat time 	<ol style="list-style-type: none"> 1. report pollution discharge 2. trade discharge appropriately 	
Eco- compensation	<ol style="list-style-type: none"> 1. constitute laws, statutes and standards 2. assess project's environmental impact 3. collect and manage compensation charge 4. supervise and urge other compensation methods 	<ol style="list-style-type: none"> 1. report project's basic situation 2. pay for or accept eco-compensation 	pay for or accept eco-compensation
Resource charge	<ol style="list-style-type: none"> 1. constitute laws, statutes and standards 2. adjust charge standards 3. collect resource charge 	<ol style="list-style-type: none"> 1. pay resource charge 2. explore new resource—using techniques 	Pay resource charge
Inspiring mechanism	<ol style="list-style-type: none"> 1. constitute laws and statutes 2. give prize to prominent groups or individuals 	<ol style="list-style-type: none"> 1. dispose of pollution 2. push clean production 3. recycle resources 	devotion to environmental protection

uniform supervision and management. As managed objects, enterprises should comply with the government's regulations and actualize environment-economic management. Meanwhile, public participation and monitoring is critical for favorable practices (Table 2).

Urban environment-economic management not only regards economic incentive as a principle motivation for change, but also emphasizes the collaboration of various other methods: (1) Selection of economic means. Each economic method has its own suitable fields as listed in Table 1. Moreover, there are some principles for selecting them. Taking pollution charge and emission trade as example, when finite fixed pollution sources can be monitored accurately, it is wise to choose pollution charge. While pollution sources' marginal reduction costs are different and there exists a gross limit, the emission trade is more reasonable (Zhang and Li, 1996). Moreover, the

management cost, economic benefit and environmental effect should be considered. (2) Combining economic means with other environmental management means. As a relatively new method, economic methods are closely related to other environmental management methods. It is necessary to combine them with others in order to achieve the smooth actualization of the economic methods. As described previously, the other methods include legal, administrative, technical, and educational means. For example, when economic means cannot be implemented with legal support, the educational means is an alternative. This combination is possible in Xiamen because of the existing favorable foundation and future program of information harbor, education city and technology city. (3) Combining environment-economic management means with other urban management means: Due to its complexity, urban environmental problems have to be solved

by a complicated system. Therefore, the environment-economic management method should be combined with other urban management methods. Concretely speaking, the combination includes three aspects: a) government combines economic methods with integrated control of urban environment, target responsibility system for environmental protection, opening administrative affairs, land's sustainable use, and the construction of environmental infrastructure; b) enterprises combine economic methods with asset's re-composing, technical reconstruction and adjustment of production structure; c) the public combines economic methods with changing consumption trends, participating in the construction of environmental infrastructure, and joining in the reform of marketing environmental services.

Benefit analysis of the environment-economic management system

By combining various methods effectively and by constructing an implementation system that includes government, enterprises and the public, the environment-economic management system is estimated to achieve a satisfactory performance and to bring about great profits.

We will give a simple benefit analysis by comparing the eco-compensation in the Town of Lianhua with a traditional order-control instrument. To give the residents in the water source conservation area an eco-compensation charge and to help solve their problems (e.g., moving and obtaining employment), and strengthen environmental education, the eco-compensation will be actualized favorably.

Government

After implementing eco-compensation, the government will decrease their cost for treating sewage and will abstain from executing laws and statutes compulsively.

$$B_G = \sum_{i=0}^{19} \frac{C_{Ti} - C_{Ei}}{(1+r)^i} \quad (1)$$

where B_G —government's benefit, C_T —cost of traditional order-control instrument, C_E —management cost of eco-compensation, r —discount rate, i —time, the total time is assumed to be 20 years.

Table 3. Benefits of eco-compensation; Unit: 10^4 \$; B denotes benefit; G denotes government, R denotes residents; P denotes public.

Object	Benefit
B_G	2,187.5
B_R	126,647.5
B_P	484,250
Sum	613,085

Note: Data is mainly from the annual of Xiamen special economic zone in 2002.

Resident in the Town of Lianhua

By solving problems of moving and obtaining employment, the resident's income will increase.

$$B_R = \sum_{i=0}^{19} \frac{I_{Ei} - I_{Ti}}{(1+r)^i} \quad (2)$$

where B_R —resident's benefit, I_E —resident's income under eco-compensation, I_T —resident's income under traditional instrument.

Other benefits for the public

Due to the effective protection of the water source, the residents in the catchment area and other public areas can gain huge benefits in health, recreation, fisheries and wildlife legacy.

$$B_P = B_H + V_{BD} = B_H + V_R + V_F + V_W \quad (3)$$

where B_P —public benefit, B_H —reduced health loss because of water source conservation, V_{BD} —value of biological diversity, V_R —value of recreation, V_F —value of fishery, V_W —value of wildlife legacy.

The eco-compensation's benefit in the Town of Lianhua is estimated in Table 3. For other urban problems, we choose relevant economic methods, and combine them with other methods. Carrying out urban environment-economic management will produce tremendous social, economic and environmental benefits.

Conclusions

In allusion to serious urban environmental problems and urban characteristics, it is necessary and feasible to establish an urban environment-economic management system in which the government, enterprises and public are interactive.

Taking Xiamen as an example, we created an urban environment-economic management system. It includes pollution charge, emission trade, eco-compensation, resource charge, and inspiring mechanism, combined them with legal, administrative, technical, and educational instruments. Of course, there are some principles when selecting the suitable instruments and their combination. In the process of the implementation, government, enterprises and the public have their own definite responsibilities and work. By their cooperative efforts, urban environment-economic management will hopefully achieve huge benefits, improve urban environmental quality and realize urban sustainable development.

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