Water-Pollutant Discharge-Fee System in China

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Abstract

The market-based pollutant discharge fee has long been argued to be more cost-effective than command-and-control policies. China adopted an environmental policy instrument for dealing with its water pollution in the early 1980s. However, the serious environmental deterioration that unfolded in the following decades cast doubts on the system's effectiveness. This article evaluates the water-pollutant discharge-fee system in China from the perspective of its design, top-down implementation, effectiveness, and external and internal driving forces. It discusses its role in China's overall water-pollution control and extends the analysis to provide constructive insights into a recent major reform that converted the fees into environmental taxes.

Keywords: water-pollutant discharge fee, market-based environmental policy instrument, China

Sistema de tarifa de descarga de contaminantes del agua en China

Resumen

Durante mucho tiempo se ha argumentado que la tarifa de descarga de contaminantes basada en el mercado es más rentable que las políticas de comando y control. China adoptó un instrumento de política ambiental para hacer frente a su contaminación del agua a principios de los años ochenta. Sin embargo, el grave deterioro ambiental que se desarrolló en las décadas siguientes arrojó dudas sobre la efectividad del sistema. Este artículo evalúa el sistema de

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tarifas de descarga de contaminantes del agua en China desde la perspectiva de su diseño, implementación de arriba hacia abajo, efectividad y fuerzas impulsoras externas e internas. Discute su papel en el control general de la contaminación del agua en China y extiende el análisis para proporcionar una visión constructiva de una reforma importante reciente que convirtió los aranceles en impuestos ambientales.

Palabras clave: tarifa de descarga de contaminantes del agua, instrumento de política ambiental basado en el mercado, China

中国污水排放收费制度

摘要

长期以来，人们一直认为基于市场的污染物排放收费标准比命令管控政策规定的标准效益更高。中国在20世纪80年代初采用了一项处理水污染的环境政策工具。然而，在随后的几十年中出现的严重环境恶化使人们对该系统的有效性产生怀疑。本文从设计、自上而下的实施、效益、内外动力等方面对我国污水排放收费制度进行了评价。本文还讨论了该制度在中国全面水污染管控方面的作用，并就近期一项将收费转化为环境税的重大改革给予了建设性意见。

关键词：水污染物排放费，基于市场的环境政策工具，中国

Introduction

A water-pollutant discharge-fee system is defined as a basic environmental management policy and economic instrument to control water pollution and environment deterioration. As a comprehensive and independent system, it originated from industrially developed countries and is considered as a national measure of charging organizations or individuals who discharge pollutants into water bodies (Bai and Qu 2009). The water-pollutant discharge-fee system could stimulate and facilitate pollution control, and the polluters are obliged to take social responsibility for contaminating water bodies and environment.

The contamination fee is charged based on two major principles: one is based on environment quality, which entails that discharging pollutants into water bodies would be charged for a pollution discharge fee; the other is based on an environmental standard, which entails that water pollutants exceeding the national standard would be charged by the quantity and concentration of contaminants (Lv 2009).

Water-pollutant discharge-fee system was introduced in the 1980s in China, by which the government and administrative departments charged for external environmental loss by translating the loss into internal costs for the pollutant discharger (Xu and Ni 2004). The development of water-pollutant discharge-fee system is a landmark in environmental law systems and has become one of the most significant elements contributing to environmental protection in China. The system developed during the vast expansion of environmental protection on institutions, laws, and policies in the first decade after implementing the policy in the 1980s (Xiang and Wang 2003), at which time the dramatic degradation of environmental quality aroused governmental and public concerns. Thus, China turned to economic incentives to address the environmental problems and achieve equity, fairness, and efficiency. Technically, China developed a series of management systems to deal with environmental pollution, among which the discharge-fee system was the earliest and most important one. The water-pollutant discharge-fee system was set up within the discharge-fee system, thereby aiming to regulate pollution behavior and the relationship between polluters and other social parties, stimulate enterprises and polluters to take their responsibilities, reduce and control the amount of total waste, quantify the environmental cost, and maximize social welfare (Zhang 2008).

Research on the water-pollutant discharge-fee system in China has been pursued only sporadically. Because the system is defined within the broader discharge-fee system, most studies focus on analyzing the whole system and the emission trade, rather than the water-pollutant discharge-fee system specifically. The legal framework of water-pollution control is designed based on a watershed-control zone and pollution-control unit to promote firms' pollution reduction (Ma, Wang, and Wang 2013; Wu, Xu, and Ma 2015). But the system's implementation in China's provinces is disconnected due to hydrological conditions and regional administrative regulations. The political mechanism determines the central government's implementation of the system to the county level. Although the environmental reform intensity varies across space and time, the decentralized environmental targets are poor to fulfill due to economic growth is overriding (Ge and Wang 2001; Zhou and Chen 2008). In addition, simple emission-reduction targets with career-promotion opportunities for local governors has appeared too aggressive to examine detailed problems during the fee system's enforcement (Genia and William

2012). Thus, the gap in the top–bottom enforcement approach and the mechanism's disconnection provide more space and flexibility for local officials to geographically transfer pollution (Kahn, Li, and Zhao 2015). The existing empirical evidences focus primarily on the correlation between economic growth and industrial pollution (Gao, Su, and Yang 2014; Li 2015; Wang, Wu, and Yan 2008), and on finding a technical solution for the water-pollutant discharge (Hammer 1996), so that the discussion of the water-pollution discharge-fee system has limited to pollutants theoretical analysis (Liu 2009). In-depth systematic and comprehensive studies combining the characteristics of water-resource utility are insufficient and unable to provide strong support for decision making.

1. Design of the Water-Pollutant Discharge-Fee System

During China's transformation to a market-oriented economic structure, the country's environmental deterioration cast a shadow on its unprecedented economic growth. The environmental externality was paid by the environment and the public that was exposed to the pollution, rather than by polluters. Water pollution issues became highly sensitive for the conventional water-utilization mode in the early developing stage. Increasing contaminated water and the conflict between water supply and demand stimulated the government towards water-resource sustainability.

1.1. Development of the Water-Pollutant Discharge-Fee System

The water-pollutant discharge-fee system in China was designed as an indispensable component of the broader discharge-fee system and enforced in 1982. It was approved as an independent section in the *Temporary Regulation of Pollutant Discharge Fee*, which aimed to balance the water-resource shortage and the environmental costs by using price lever. The issue of water-resource protection and sewage discharge was first officially mentioned in the *Environment Protection Report* of 1978. In accordance with the polluter pays principle (PPP), the report stressed that polluters should pay for pollutants in the wastewater they discharged. In 1979, water-pollutant discharge fee was written in the Environmental Protection Conditional Law, which stated that pollutants exceeding the national standard should be charged. The water-pollutant discharge-fee collection was systematically redefined in the *Temporary Regulation of Pollutant Discharge Fee* of 1982, including revisions of its purpose, objects, charging standard, and management method, based on two years of pilot implementation and contamination facts. It was applied through the top–bottom political mechanism at the central, provincial, prefectural, and county levels. The approval of the temporary regulation provided legal support for the fee collection of water-pollutant discharge.

Then the approval of the water pollution prevention law in 1984 was an

important step. It was the first independent law defining water pollution from different perspectives and strengthening its strategic meaning and impact. Subsequently, the rules for water-fee collection were adjusted in the environment protection law in 1989 from simply charging for the total amount to a standard-exceeding charge based on pollutant quantity and concentration. Moreover, the standard was broadened by expanding the pollutant types. During the 1992 nationwide shift in economic structure, an increasing amount of enterprises contributed substantially not only to gross domestic product (GDP) growth, but also to environmental pollution. In 1993, the *Inform of Fee Collection on Wastewater Discharge* was adopted and the work on water-pollution reduction was strengthened under the pressure of water-quality deterioration. In 1996, the *Integrated Water Pollutant Discharge Standard* was approved to enhance and normalize the fee-collection work.

In 2003, the pollutant discharge-fee system was systematically revised and the *Pollutant Discharge Fee Collection and Management Regulation* was promulgated together with the pollutant discharge-fee-standard calculation method as supporting documents. It was regarded as a comprehensive reform, clearly stating that the water-pollutant fee should be calculated and charged based on the equivalent of pollutant concentration and quantity in relation to the national pollutant standard. Furthermore, the areas covered by the system's policy were enlarged from inland water bodies to sea and ocean areas through the approval of the *Ocean Environment Protection Law* in the same year. This revision and extension were marked as a breakthrough in the pollutant discharge-fee system.

For the further promotion of structural change on economic development, the National Development and Reform Commission (NDRC), the Ministry of Finance, and the Ministry of Environmental Protection (MEP) jointly promulgated the *Adjustment of Pollutant Discharge Fee Collection with Related Issues* and the *Pollutant Discharge Fee Usage Management Approach* in 2014. The water-pollutant discharge-fee standard was declared more stringent than ever on national level. These laws and regulations formed the legal framework for the water-pollutant discharge-fee system in China. With the deepening reform of the market-oriented economy, changes appeared within the system to meet the actual needs. The system's evolution, as presented in Table 1, developed in accordance with social and industrial progress, which can be demonstrated by the change of the fee amount, as discussed in Section 3.

1.2. Framework of Water-Pollutant Discharge System

1.2.1. The Fee Standard

The fee-collection standard was enforced in 1982, by which a water-pollutant discharge-fee was collected based on enterprises' standard-exceeding concentration of pollutants. The orig-

Table 1. Development of the Water-Pollutant Discharge-Fee System in China

Year	Laws and Regulations	Features
1978	Environment Protection Report	The practice of Polluters Pays Principals in China
1979	Environmental Protection Conditional Law	Standard exceeding charge based on concentration & quantity
1982	Temporary Regulation of Pollutant Discharge Fee	Provide legal support for fee collection of water pollutant discharge
1984	Water Pollution Prevention Law	First independent law in terms of water pollution control
1989	Environment Protection Law (adjusted)	Pollution charge method revise and pollutant spices enlarged
1993	The Inform of Fee Collection on Wastewater Discharge	Water-pollution reduction work was strengthened
1996	Integrated Water Pollutant Discharge Standard	Enhance and normalize the wastewater fee collection work
2003	Pollutant Discharge Fee Collection and Management Regulation	System reform
2003	Ocean Environment Protection Law	System coverage area was enlarged from inland water to sea water
2014	The Adjustment of Pollutant Discharge Fee Collection with Related Issues & Pollutant Discharge Fee Usage Management Approach	System adjustment according to actual need

inal water-pollutant discharge-fee system did not reflect the principle that a homogenous amount of contaminants was charged equally: it only charged for the highest contaminant amount, which failed to meet the standard when the firm discharged more than one kind of pollutants in its wastewater. The fee per ton was formulated differently for each pollutant. The pollution-fee charge was defined only in the standard-exceeding amount, which in essence entailed that any pollutant discharge lying within the range of the national standard had been

legally permitted. And, the penalty fare was doubled for behaviors that went beyond the temporary regulation.

The water-pollutant discharge-fee system practiced a serious attempt to address pollution problems through an empirical application suiting the boost of firms, thus the fee standard was revised in 2003. This reform was a rational innovation. The fee-collection principle was changed from one based on excessive charge to one based on the discharged equivalent of water-pollutant. Once a pollutant was discharged into a water body, a pollution fee was charged, instead of restricting the discharge to a standard. The fee standard was set at 0.7 RMB per pollutant equivalent and the penalty fare was doubled for pollutants that failed to meet the standard. Moreover, enterprises that suffered economic loss could apply for half to full pollution-fee exemption.

Current water-pollutant-fee standard is defined according to the 2014 *Adjustment of Pollutant Discharge Fee Collection and Related Issue*. It declared an increase in the water-pollutant discharge-fee standard from 0.7 RMB to 1.4 RMB per equivalent. Within each discharging point, toxic pollutants and heavy metals should be added to the calculation. Other pollutants need to be sorted according to their concentration from the highest to the lowest, whereby the total fee charge should include no more than three types of pollutants. In addition, local governments are allowed to adjust the fee standard according to regional conditions. For pollution-control areas, heavily polluted areas, and economically powerful areas, standards are allowed to be set higher than the national level. The fee level dropped from 1982 to 2003 and doubled in 2014. As the half-full pollution-fee exemption is banned in the adjustment of 2014, the water-pollutant discharge fee notably increased and sped up the external environmental cost, as well as the cost within the fee system. The obstinate concept of "if you pay more you can discharge more" should be precluded. The 11th five-year plan set the target at "reducing 10% of the total pollutants," thus making it necessary to monitor enterprises to limit the total pollutant discharge amount. A critical penalty on standard-exceeding discharge would assure the system's operation and water-resource sustainability, theoretically limiting wastewater discharge to the largest extent.

1.2.2. The Fee Structure

The evolution of the water-pollutant discharge-fee system is also reflected in the fee structure. In 1974, wastewater was defined partially by an industrial waste-discharge standard. In 1982, the temporary regulation claimed that those discharging more than two pollutant types in wastewater should be charged by the highest one. The single-factor charge principle based on a standard-exceeding amount determined the water-pollution discharge fee. Enterprises from different areas adopted the same wastewater-discharge standard, though certain factors such as difference in economic development level, pollution transfer (even within same river-basin area), and water-

resource capacity and function were taken into account but would lead to different results. Any production plant's marginal cost of pollution control monotonically decreased the function of the pollution-emission quantity, so that the larger the pollution emission, the lower the marginal cost (Hou 2008).

According to the 2003 regulation, different levels of the water-pollutant discharge fee were defined as pollutant discharge fee plus pollutant standard-exceeding charge. The pollutant discharge fee was reformed to cover both the standard-meeting and standard-exceeding parts. The latter was doubled for excessive pollutant concentration. Until 2014, the block-rate pollutant structural change was designed for different situations (Xu 2014). The revision of the fee structure was partially tested in certain provinces and cities. The block-rate pollutant charge was first conducted in Tianjin. The pollutant fee increased to 7.5 RMB on COD and 9.5 RMB on ammonium and nitrogen: a tenfold increase compared to the previous standard. Which indicated that the smaller the amount of wastewater, the lower the fee. A differential charge standard was set in Tianjin in the *Inform of Block-Rate Based Pollutant Discharge Fee Standard Adjustment*, which regulated that pollutant discharge concentrations of 90%–100% should be charged according to a general standard, wastewater concentrations of 80%–90% should be charged by multiplying the discharge amount by 90%, concentrations of 70%–80% should multiply the fee by 80%, concentrations of 60%–70% should multiply the fee by 70%, and concentrations of 50%–60% should multiply the fee by 60%, while concentrations under 50% should be charged less than 50%. The different stages fit for different wastewater-discharging scales on firms' production abilities, which was quickly imitated and spread to other industrially developed provinces.

The other fee-structure improvement was conducted in ShanXi province, where the wastewater discharge fee increased to 1.4 RMB per pollutant equivalent. In addition, pollution concentration exceeded the national and provincial limits, or amounts exceeding the aggregate value would be double charged. If both of the conditions had been met, the fee would be tripled. Furthermore, the water-pollutant discharge-fee structure was set up based on different industries. Fees for the petrochemical, packaging, and printing industries were increased to 1.8 RMB per pollutant equivalent. The water-pollutant fee was graded by charging for every 10% for concentration percentages from 50% to 100%, while still halved for water-pollutant concentrations below 50%. Provinces with similar economic structures implemented this type of block-charge policy with adjustments concerning their regional natural resource capacity and developing mode.

The pollutant standard-exceeding charge is calculated for the following situations: the pollutant category is restricted by national regulations and regional laws, the total amount of water pollutant exceeds the upper limits, and the production equipment or the prod-

ucts are listed in the 2011 *Industrial Structure Adjustment Guide*. If the pollutant's discharge behavior falls under one of these situations, the penalty fee is charged once; while if it falls under two situations, the penalty is doubled; or meets all situations, the penalty go up to thrice. Moreover, to strengthen water-pollution control, the penalty fare is defined in terms 73 and 74 of the water pollution prevention law (2008): the irregular use of wastewater-treatment facilities and the demolition and idling of pollutant-treatment equipment should be charged by the upper level of the executive authority with a penalty fare of one to three times the water-pollutant discharge fee, while the national or regional standard-exceeding discharge over the total quantity-control indicators are charged with a fare of two to five times the discharge fee.

The flexible fee structure not only affects the industrial structure, but also guides the spacial distribution of enterprises avoiding environmental sensitive areas and gives preference to water-resource abundant and low development-difficulty areas, which has further practical implications from the perspective of development and management.

1.2.3. Pollutant Factors

With industrial development, the water-pollutant discharge-fee system was broadened by expanding the range of pollutant factors. The *Temporary Regulation of Pollutant Discharge Fee* set the standard for wastewater, waste gasses and solids, among which 20 types of water pollutants are clearly defined. In 1991, the list was extended to 29 types due to an increase in known facts about pollution. With further promotion of the water-pollutant discharge-fee system till 1993, the water-pollution fee was deepened from the content and the range. In 2003, the pollutant types were redefined and extended to 65, covering most of the water contaminants, of which 36 types were newly added, including heavy metals, radioactive materials, biochemical pollutants, etc. The fee standard changed from being single-factor dominant to being multi-factor based.

1.2.4. The Fee Collection Range

Environmental deterioration had been exacerbated since the 10th five-year plan, for prioritized achieving economic growth. Increasing transferrable or illegal point-source and nonpoint-source pollution resulted in compromised sanitation condition. In 1982, the fee system was limited to private and collective firms and units. However, supply-driven and conventional exploitation stretched the gap between water demand and the supply. It deviated from the original objective to control all wastewater discharged into water bodies, to cover and regulate any newly added pollution source within the system. Thus, the pollution fee was redefined in the *Pollutant Discharge Fee Collection and Management Regulation* of 2003, which was extended to include to all polluters, including plants, units, individuals from the industrial field, and commercial householders.

1.2.5. Calculation Method

The calculation method was reformed from being based on pollution concentration and quantity to being pollution-equivalent based in a more systematic and rational way. In 1982, the water-pollutant discharge fee was calculated by the pollutant-exceeding quantity, which was specific coefficient times the highest exceeding tons. In 2003, the pollution fee was calculated by the pollutant equivalent instead of the pollutant quantity, equaling 0.7 RMB times the largest three pollutant equivalents (the pollutant equivalent is the water-pollutant amount divided by the specific pollutant's equivalent value) plus the doubled penalty fare. The 2014 adjustment increased the equation coefficient from 0.7 RMB to 1.4 RMB and then introduced the block-rate charge. The fee calculated from the equation would times the degree it belongs to. Though the reformed calculation method accounting for regional economic level, characteristics of local industrial pollution, even the environmental cost, it was still far from stimulating emission reduction. Then as balancing inflation, regional standards required to set the fee at 2.46 RMB per pollutant equivalent, based on the consumer price index (Wang et al. 2014).

2. Implementation and Related Issues

2.1. Process Underlying the Water-Pollutant Discharge-Fee System

Over three decades of implementation, the water-pollutant discharge fee was enlarged from being collected centrally to being collected at the county level. This was implemented through institutional routines and developed in accordance with different phenomena, such as the transition from a standard-fee charge to a multiple-factors combined charge and more stringent regional standards than the unified regulation. Every step of the policy improvement formed an attempt to motivate enterprises and polluters to reduce pollution. The fee-collection process conducted through an apply–verify mechanism: the water-pollutant discharge unit applies for the total amount of discharged wastewater first, and then the environmental protection agencies verifed the quantity, thereby considering the plant's actual production scale and basing their calculation on the material balance principle. Only if the water-pollutant discharge got permitted can polluters discharge the wastewater legally. After the contaminating behavior, polluters would be charged the water-pollutant discharge fee. The organizational process of apply–verify policy is comparatively complex and several problems and failures appeared during its limited implementation. Currently, the system has been incorporated into the pollutant emission-permit system.

2.2. Problems in System Implementation

2.2.1. Low Charging Standard and Weak Enforcement

Water-pollutant discharge-fee system has been adopted as an economic-incentive approach to controlling pol-

lution in a cost-effective way, there is widespread debate on whether the economic-incentive approach is more suitable than a command-and-control policy in developing countries (Barde 1994; Blackman and Harrington 2000; Panaiotov 1994; Motta, Huber, and Ruitenbeek 1999; Wolverton and West 2005). The advantages and disadvantages of such an approach have been analyzed in various situations. Bell and Russel (2002) indicate that developing countries do not possess the conditions for the implementation of market-based strategies. While constructive efforts are made to practice the fee system in China to control water pollution, even its stimulating effects are not that obvious and there exists deviation from the policy's main purpose. Especially, the fee design impedes enterprises from reducing emissions: theoretically, the optimal charge level should be set at the point at which the marginal control cost equals the average marginal loss. If the pollutant-fee standard is higher than enterprises' cost on pollutant reduction, the profit would drive enterprises to pursue technological innovation and device upgrades for emission reduction, or simply to choose to pay for pollutant emission rather than investing in pollution control, so that the incentives of the water-pollutant discharge-fee system would ultimately become ineffective. As difficult to define each pollutant's marginal loss, the average cost on pollutant control has been adopted under technical assistance from World Bank's research of The Design and Implementation of Pollution Discharge Fee in China in 1994, instead of calculating pollutants' marginal treatment fee. Consequently, the cost of illegal discharge is lower than that of abiding by the law, which leads to the strange phenomenon of active contaminating payment versus passive improvement measures on pollution reduction.

2.2.2. Low Efficiency

The process of collecting the pollutant discharge-fee met great resistance in its initial steps and significant percentages of enterprises eager to obtain higher profits consequently ignored environmental pollution, with some even refusing to pay the pollution fee, though investing in the visible short-term benefit program. Local environmental protection bureaus are understaffed, underequipped, and underpaid, thereby generating a poor system-implementation condition. The implementation of bank transfers appeared as a milestone in normalizing the pollution discharge-fee collection. As disputes between dischargers and executors mostly occur in the disconnection and noncompliance operation of the apply–verify procedure, false and concealed reports, lax law enforcement, and negotiated charges are common. Additionally, regulators set a single fee that was applied to all plants, with no regard for different levels of environmental tolerance or the demand of the regional-development function. In principle, the system not only lacks flexibility but also obstructs polluters' adoption of abatement technologies. Furthermore, technical support is rarely mentioned and grossly limited in the system's implementation. Disconnections within the water-pollutant discharge-fee system, including discharger registration,

establishment of a pollution information-management system, pollutant measurement, pollution-loads calculation, monitor-receiving water bodies, and so forth directly lower the regional environmental authorities' efficiency and weaken the system's influence and power.

2.2.3. Revenue Issue

The water-pollutant discharge-fee system generates revenue and should be earmarked for environmental expenditures rather than for departmental expenditures. The water-pollution discharge fee is collected by local environmental authorities. The 2003 pollution discharge-fee-management regulation stipulates that it is to be used as a specific environmental protection fund, covering the major pollution-source-control program, the regional pollution-prevention program, the new technology-application program, and other pollution-control programs. In theory, local environmental protection bureaus only act as fee-collection units, of which the management fee should not be included in the pollution-discharge fee, though departments' management funding is in fact heavily reliant on the pollution-discharge fee. The connection between revenue and expenditure reflects the contradiction in the design of the fee system's mechanism. In this collection mode and in view of departmental interests, it is not strange that local environmental-protection departments are unwilling to control pollution for the purpose of obtaining more revenue. Therefore, the actual amount of the water-pollutant discharge fee is embezzled and detained for other purposes. A fairly large amount of the pollutant fee falls outside of supervision, as the financial department is unable to acquire accurate information on the fee situation, which directly slows down the fee system's development and lowers the efficiency of pollutant control.

3. Effectiveness of the Water-Pollutant Discharge-Fee System

3.1. System Performance

Historically, the pollution discharge-fee program has been applied in both developed and developing countries worldwide. This market-based strategy achieved results on air, water, and solids pollution control in different degrees. In France and the Netherlands, the effluent charge is designed to raise revenue for water-pollution-control funding, ultimately achieving improvements in water quality (Tietenberg 1990). Wastewater dischargers in Germany are regulated to meet the minimum pollutant standard and pay for half of the standard-exceeding amount, while the related effluent charge is calculated per pollution unit and increased to control water pollution in the short term (Zhang and Xiong 2012). The practice in European countries explored and developed an independent and mature pollution-management approach involving a legal framework, a political mechanism, organization corporation, revenue supervision (Xiao 2003; Zhou 2006), which achieved significant results in water-pollution reduction. The mar-

ket-based instrument is an incentive by which to correct environmental externality and its implementation needs to be combined with related policies. The diversity of water resources in America determined the different states' water policies. Empirical study support that water-pollution regulations had significant effects on firms' production in water-polluting industries (Chakraborti 2016; Chakraborti and McConnell 2012; Rassier and Earnhart 2015; Shimshack and Ward 2008). The water policy and water quality mutually influence each other and a reverse effect has been observed in that the decline of water quality stimulates the stringency of the permitted discharge level, leading plants to consequently reduce their pollution emissions (Chakraborti 2016). Significant results in water-pollution control were achieved in developed countries that rely on well-defined property rights. The comments summarized that using market instruments and prices as the primary instruments to control pollution in developing countries is fragmented, due to the fact that the range of political, institutional, and administrative rules, practices, and processes is powerless in handling market-based strategies. In India, water governance is a challenge at almost all scales, whereby the states' limited power not only weakens their capacity to solve transboundary water issues but also makes them powerless in the field of domestic water use and pollution (Chokkakula 2012). Evidence in Malaysia suggests the financial condition limits the investment in technical-abatement measures for water-pollution control in the sewage system, and that the lack of cooperation between governments and plants impedes water-quality improvement (Muyibi, Ambali, and Eissa 2008).

Water and its derivative functions serve economic users, so that adopting a market instrument by which to guide water allocation and pollution issues is theoretically considered as a cost-effective approach. Therefore, the market paradigm was introduced and promoted in developed and transitioning countries, including China. To assess the market's power on water governance in China, several questions have been addressed: How successful is the water-pollutant discharge-fee system in controlling water pollution? Which factors are responsible for its success? With regard to the first question, increasing empirical evidence demonstrates that the combination of the fee system and water-pollution regulations reduces pollution-intensive activity (Chen et al. 2018; Yuan, Jiang, and Bi 2010). Additionally, the collection of water-pollution discharge fees directly revealed the system's degree of enforcement, which could be one of the main factors by which to assess its effectiveness. The national grand total pollution-fee amount from 1992 to 2014 is 237.59 billion RMB. The adjustment of the fee system in 2003 can be seen as a turning point: the growth rate of the pollutant discharge fee was below 10% until 2003, after which it doubled to reach its first peak at 17.68 billion RMB in 2008. It subsequently fluctuated due to the decreasing number of enterprises during the financial crisis. The total of the discharge-fee collection corre-

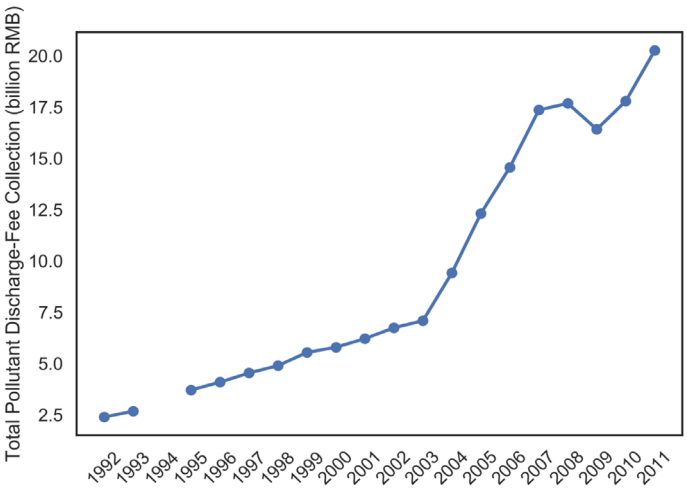

Figure 1. Total pollutant discharge-fee collection in China (Source: *China Statistical Year Book*)

sponds to the country's economic development and transition in industrial structure. With gradual economic recovery, the revenue increased to reach another peak at 20.48 billion RMB in 2013 (Figure 1).

Data on the water-pollutant discharge fee collected within the total pollution fee reveals more information (Figure 2). Before 2003, the water-pollutant discharge-fee revenue increased at a stable rate, as it is collected under the single-factor charging principle and not many types of pollutants are defined in the standard. The promulgation of the 2003 regulation completely altered the collection and the revenues from the fee increased to three times higher than ever before, reaching their peak in 2007. Economic factors can lead enterprises' productivity to drop, as well as the wastewater-discharge amount and the fee. In general, the water-pollutant-discharge revenue is doubled after the pollutant's equivalent charge, but with more exposed the revenue issues. As shown, the water-pollutant fee accounted for over 50% of the total pollutant-discharge fee. Theoretically, the actual water-pollutant fee amount should lie far from the total pollution fee amount. However, neither the water-pollutant discharge fee nor the total pollution fee was fully collected. Regulations do help to promote fee collection, but implementation without supervision contributes to the fee breach and absence of revenue management.

3.2. Assessment on Pollution Control

The results of the water-pollutant discharge-fee system are demonstrated by pollution control. Before the system was implemented, the wastewater-discharge amount increased rapidly without charge. The situation was curbed and further deterioration was avoided since with promulgation of the temporary regulation. Subsequently, the wastewater discharge surged in line with the boost in economic growth,

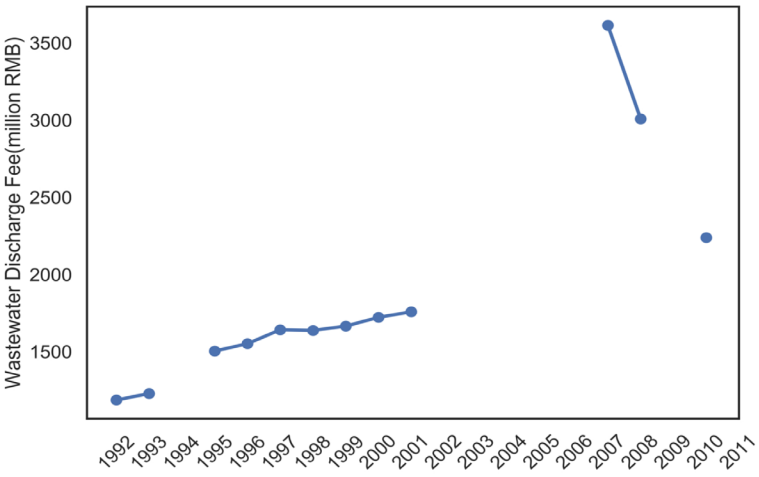

Figure 2. Water-pollutant discharge-fee collection in China
(Source: *China Statistical Year Book*)

increasing from 1988 to 1994. The pollution amount was jumped from 1995 to 2001. Apparently, the approval of the 2003 regulation retarded the increasing rate of pollution, after which the total amount of water pollutant continued to grow, but comparatively more gently from 2006 to 2013, when the rate dropped from 8.7% to 2.3%. During the 10 years of rapid industrial development, the total wastewater discharge was not doubled but did maintain an increasing rate (Figure 3).

Pollutants such as COD and ammoniacal nitrogen within wastewater can explain water quality in detail (Figure 4). The fee system operated effectively since its reform. With slight fluctuations, the amount of COD was stable in 2008, at 13.2 million tons, after which it increased sharply from 2011 to 2014 to almost double than ever before. While the amounts of ammonium and nitrogen appeared quite stable until 2010, they doubled in 2011 at 2.604 million tons and then decreased in the following three years to 2.385 million tons. The concentrations of ammonium and nitrogen were more clearly controlled than the COD concentration during the period of rapid economic growth. Though the water quality cannot be fully determined by the levels of COD, ammonium, and nitrogen, the fee system's stimulation of pollutant reduction still contributes to the gradual improvement of water quality, though not as obviously as expected.

Water quality is also assessed from a macro perspective in seven major river basins nationwide (Figure 5). The percentage of surface water with good quality and less contamination (levels I–III) sharply declined in 2001. The amount of healthy river bodies almost equals that of contaminated rivers. The fact that the amount of healthy and unhealthy rivers increased at the same speed illustrates that the effect of the fee program was insufficiently effective in

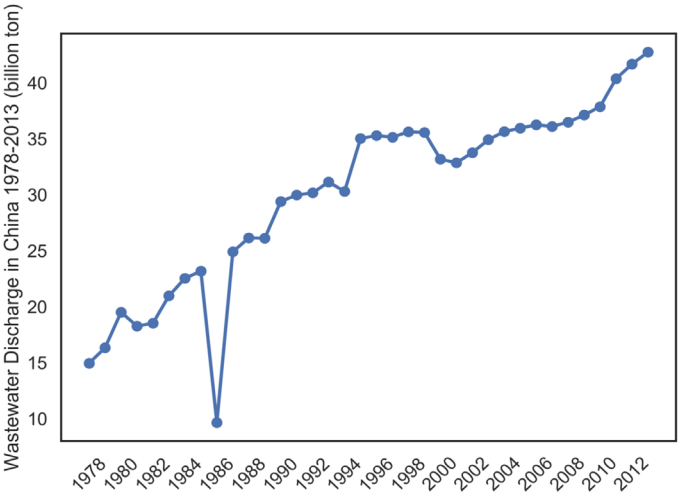

Figure 3. Wastewater discharge in China
(Source: *China Statistical Year Book*)

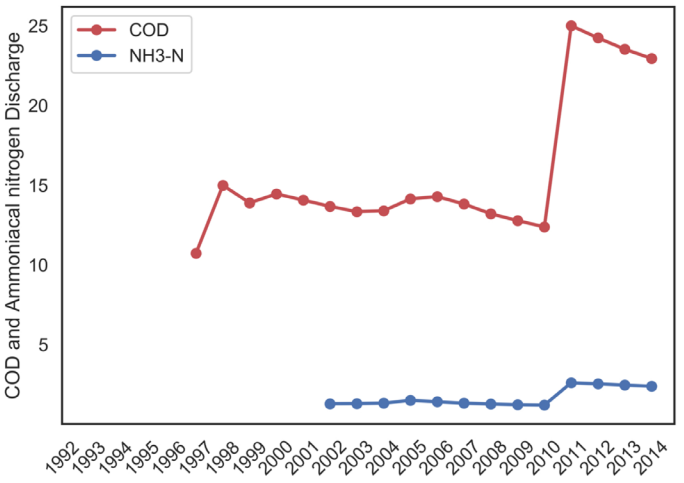

Figure 4. COD and ammoniacal nitrogen discharges in China
(Source: *China Statistical Year Book*)

controlling pollution before the policy reform. The most contaminated rivers boost to occupy a large amount of all seven river systems at that time, but they were identified and their water quality was largely improved since 2003. The number of rivers with good water quality experienced sharp increases twice before 2014, during which time the rivers with the worst water quality (levels IV–V) were controlled to achieve a decrease in contamination. The amount of river waters with the lowest quality levels still amounts to 30% of all river waters.

Pollution control has been assessed through water quality at both the micro and macro scales, and can also be interpreted from the perspective of industry structure. Within the rigid demand of economic development, the

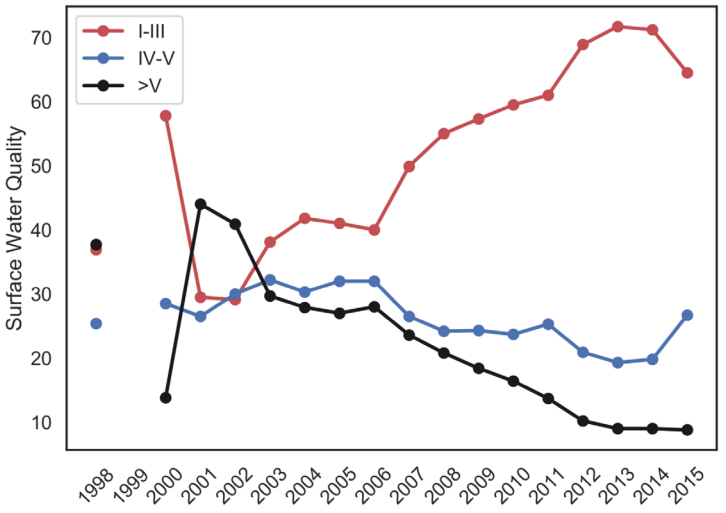

Figure 5. Surface water quality.
(Sources: *China Statistical Year Book*, *China Environmental Statistical Bulletin*)

discharges of COD and ammoniacal nitrogen in industrial wastewater dropped by 48.8% and 36.1%, respectively, with a particularly strong decline after the 11th five-year plan. Additionally, the reuse rate of industrial water gradually increased. The average pollutant concentration in industrial wastewater continues to decline in accordance with the changing macro-pollution situation. The average COD concentration in industrial wastewater also appeared to decline (MEP 2015), though its levels are still far from those required by the water-environment function. More generally, the water quality in most areas does not meet the aquatic-environment standard. The water-pollutant discharge-fee system adopts an integrated approach and is emphasized throughout policies and legislation, planning and management, wastewater quantity and concentration, surface and underground water quality, and so forth. However, the pollution facts interpreted above illustrate the limitation in the implementation of the fee system, and the disconnections of range links within the system impede its efficiency. No direct evidence indicates improvements of integrated wastewater management.

4. Driving Forces of the Water-Pollutant Discharge-Fee System

With regard to the second question, several factors relevant to the fee system require examination throughout the implementation environment. From the analysis above, the results obtained in the evaluation of the fee system show its deficiencies from a multi-scale perspective. For instance, regarding the management of the water-pollutant fee, polluters' behavioral regulation and administrative support are not fully realized. Regarding factors affected by the

effective enforcement of the system, it is essential to identify the strengths and weaknesses of the process. Though the water-pollutant discharge-fee system in China underwent reform and adjustment, several thorny issues appeared within the application process, such as differences in the total fee amount, which consequently led to the derivation of the policy goal. Each element is implemented based on the legal, administrative, socioeconomic, and political circumstances. As a linking procedure, the policy's implementation relies on executors to realize the policy target through explaining, propagating, testing, conducting, and supervising. Integrated management of water resources is required to enhance the system.

4.1. External Factors

4.1.1. Social Factors

The water-pollutant discharge-fee system is implemented to correct the market failure and guide water use and allocation. The main objective of the water-pollutant discharge-fee system is to protect water resources' capacity and productivity. Society provides the platform for the system's implementation. System-policy enforcement refers to the two main parties: the policy executor who represents the government's behavior (Yang and Wang 2013) and the water-pollutant dischargers, which include individuals, units, and plants. Most of the system's procedures are highly reliant on governmental officers. The water-pollutant fee-collection work is not only limited by understaffing, but also by the noncompliance operations and related individual behaviors of local officials. Therefore, different extent of pollutant-fee arrears such as pollutant-fee negotiation and relationship-fee collection, less payment are quite common. The national average fee-collection rate is only 50% and government interference is also detected in the policy-enforcement process. Local protection greatly contributes to increasing the pollution intensity (Jiang, Lin, and Lin 2014). Administrative interference under regional protection can be expected to generate more space and uncertainty in the policy's implementation, which is likely to lead to rent-seeking behavior within the system's operation. Reversely, pollution behavior also affects the system's efficiency and proper implementation. False consciousness of pollution and the idea of emission as "more payment, more discharge" are formed within the discharger group by the confused relationship between the system-enforcement authorities and dischargers' noncompliance operations. Certain phenomena such as false or concealed reports in pollutant-amount applications are sure to impact the collection of the full pollution-discharge fee amount. Simultaneously, the pursuit of economic growth, which was local governments' most important target and assessment index, significantly impeded the system's implementation.

Whether firms and plants actively pay for their pollution discharge is determined by their net profit. The implementation of the fee system may alter enterprises' production activities (Wu 2015) and increases production

costs, which subsequently reduces profit. Firms would choose the cheapest way to solve the pollution issue: either by discharging or adopting advanced technology. The fee system regulates the relationship between enterprises and the environment in order to offset the cost. Correspondingly, the decline in recorded dischargers since the system's reform in 2003 proves the stringency of the regulations and related standards. The declining number of enterprises versus the increasing wastewater-fee amount in the following decade implies an increase in the fee amount, which indirectly demonstrates that the standard also became more stringent, motivated by the aim of forcing enterprises to adopt abatement technology. Simultaneously, the severe environmental deterioration within that decade not only increased public concern about water-resource scarcity, but also strengthened the importance of the fee system's follow-up monitoring.

4.1.2. Economic Factors

As an economic incentive, the water-pollutant discharge-fee system could not be implemented independently without taking into account the macro-economic circumstances. The economic structure and its development drive the water-pollutant discharge-fee system, as revealed in the changing trend of the GDP (Figure 6). The GDP stably increased at the rate of 14.2% until its peak in 2007, after which it fluctuated, decreasing until 2014 during the economic recovery from the financial crisis, which correspondingly affected the water-pollutant discharge-fee system. The relationship between the GDP and the water-pollutant discharge fee is demonstrated by the same though more obviously changing trend in the former. This means not only that the fee program is implemented at a specific scale, but also that it has a strong correlation to the macro policy and strategy.

4.2. Internal Factors

4.2.1. Data Management

The pollution fee is calculated based on monitoring data. There exists difficulty in obtaining data accuracy, even in the same river basin area, data monitored by different sectors with different methods do not match with each other. The water-pollutant discharge data are monitored by executors and/or the dischargers. From a governmental perspective, the data are rarely shared or combined with different data-monitoring methods, which makes it difficult to conduct further data analyses. Additionally, pollution data are also difficult to access, data sharing and transparency are low, and the coverage of the pollution monitoring system is limited, which intensifies the uncertainty and confusion. As the data for several pollution areas are absent, unified and comprehensive pollution-data management needs to be pursued to fill the gap.

4.2.2. Enforcement Transparency

The procedures in the apply–verify process are complex and limit the system's full promotion, and the information asymmetry for executors constrains the development of the water-pollutant discharge-fee system. The accuracy and re-

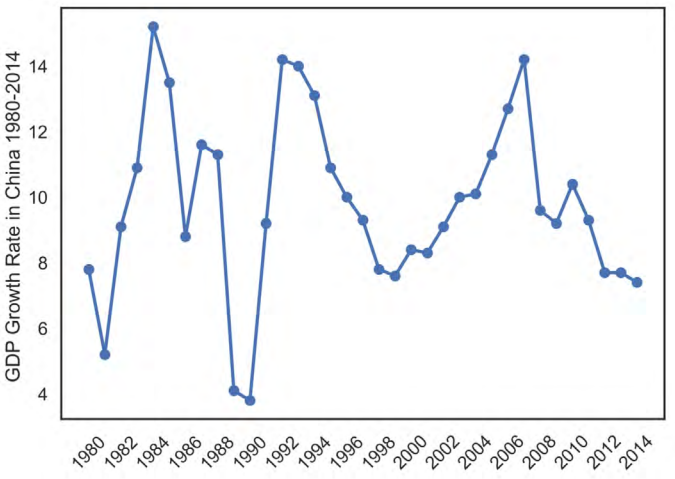

Figure 6. GDP growth rate in China from 1980 to 2014 (Source: *China Statistical Year Book*)

liability of related information strongly affect the system and policy conduction. Obstruction from dischargers, governmental interference, and noncompliance operations mask the actual pollution situation and hamper the fee-collection work Also with institutional barrier, the information cannot be transferred fluently and accurately. The disconnection caused by information asymmetry indicates the absence of information platforms across governmental authorities, dischargers, and benefit-related parties.

4.2.3. Supervision and Cooperation

Despite the reform, the water-pollutant discharge-fee system still has a long way to go in achieving efficiency, equality, and effectiveness in pollution control. The fee system takes an adaptive-management approach, the power and effectiveness of which are reflected in the actual implementation. The pollution discharge-fee program lacks supervision and a cooperation mechanism across executive authorities. Not only the fee-expenditure direction but also the fee-system operation needs supervision from other departments or a third party. Supervision and cooperation are antithetical and mutually complement each other. The supervisory participation from each side is significant for strategic cooperation. The question of how to connect different units and promote the departments' synergy becomes the challenge that needs to be addressed in order to fill the gap. Such synergy requires that the prospective management faces dynamic indicators, including industry change, policy adjustment, and technical improvement. Therefore, it not only needs to meet the rigid demand of pollution control but also better conduct the fee system's implementation. Moreover, institutional barriers lead to both external and internal conflicts during the system's operation. Such problems and disconnections reflect the passivity of pollution control, which also largely increases the cost of the fee system's implementation.

5. Conclusion and Discussion

This article evaluates the water-pollutant discharge-fee system in China, which adopts a progressive approach to pollution control. The system has achieved staged results and undergone reforms in multiple aspects, including fee-standard improvement, fee-calculation innovation, and pollutant-indicator construction. It is highly contextual and influenced by economic, social, and political external factors, as well as by internal theoretical and operational contexts. Through the system's reform in 2013, it was redefined as a comparatively comprehensive system with the ability to face and handle the complex pollution situation. However, problems arose due to the limited scope of legal measures and technical support, and weaknesses appeared in the system regarding departmental conflicts of interest, the contradiction of increasing environmental pollution versus decreasing fee collection, and other problems during the design, implementation, and supervision of the fee system, which adversely influenced the system's efficiency and the water quality.

With the recognition of these deficiencies, the pollution fee transitioned to an environmental tax in 2018. The levy of environmental tax may enhance the rigor of law enforcement, avoid administrative intervention and rent-seeking, and strengthen the implementation. Three lessons can be drawn from the fee system in view of better implementing the new environmental tax. First, data collection and management should be significantly improved. Data are the basis for the implementation of essentially any environmental policy, but their deficiencies plagued the fee system's implementation. The pollutant-discharge monitoring system should be fully developed according to legal requirements. Data should be shared among stakeholders, including polluters, environmental-protection agencies, and taxation departments. Second, an effective linkage needs to be developed with the pollution-emission permit system that since recently is being fully implemented. The permit system could serve as a key foundation for the levy of environmental tax. Third, environmental-protection agencies should coordinate well with taxation agencies. Since the pollution fee-to-tax reform, collection agencies are no longer taxation agencies instead of environmental-protection agencies. The collection procedures and rules for environmental tax should be made to fit with general tax-collection principles. The coordination between the two agencies should thus focus on both data sharing and tax-collection procedures/rules.

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