Watershed Eco-Compensation Mechanism in China

Subjects: Water Resources

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The watershed's ecological environment and water resources contribute significantly to agricultural production and the people's well-being. However, excessive exploitation and utilization of watersheds harm the watershed ecosystem environment. The reduction in biodiversity, water quality degradation, and decline in ecosystem stability have become severe. Watershed eco-compensation (WEC) is considered a significant environmental policy instrument for watershed ecological protection and management.

Keywords: watershed eco-compensation mechanism ; China ; Policy ; Legal basis ; watershed

1. Introduction

The watershed's ecological environment and water resources contribute significantly to agricultural production and the people's well-being [1][2]. However, excessive exploitation and utilization of watersheds harm the watershed ecosystem environment. The reduction in biodiversity, water quality degradation, and decline in ecosystem stability have become severe [3][4][5]. Watersheds are typically public goods for both the upstream and downstream, evidently characterized by non-competitiveness and non-exclusiveness. Therefore, the externalities lie in the public goods, evidently characterized by non-competitiveness and non-exclusiveness. On one hand, for instance, soil conservation and afforestation may generate positive externalities in the watershed ecosystem; on the other hand, phenomena such as discharge pollution and excessive exploitation and utilization have negative externalities in the watershed ecosystem. It is unrealistic to achieve zero externalities [6][7].

Moreover, externalities are often overlooked in individual economic decisions [8]. Meanwhile, it is just for the two attributes of public goods that there will be the phenomena of "public tragedy" and "free-riding" during the use of watershed resources [9][10]. Watershed eco-compensation (WEC) is widely accepted as an effective method for internalizing environmental externalities of conservation and as an economic facilitator of ecological environment management [11][12][13][14][15][16]. Compensatory mechanisms protect natural resources, biodiversity, ecosystem balance, ecological function, ecosystem services, and other ecological values [17][18][19]. Take Xin'an River as an example; without WEC, developers may damage the ecosystem because they can benefit from the ecosystem and evade responsibility for their negative environmental externalities. Meanwhile, ecosystem protectors don't have incentives to protect the environment from which they are unlikely to benefit [20]. Thus, ecological conservation has increasingly promoted the compensatory mechanism [21]. According to the statistics, at least 56 countries have laws and policies in place that are needed for compensatory environmental protection [22].

Eco-compensation is a combination of "Ecological Compensation (EC)" and "payments for ecosystem services (PES)" in China [23]. It can be seen in **Table 1**. EC is a required compensatory method to internalize negative environmental externalities, and its history is concise. EC of wetlands came into existence in the 1970s in America [24]. At present, ecological compensation is frequently applied worldwide [25]. For instance, the German Federal Nature Conservation Act required compensatory measures to be taken to keep the essential functions in nature and landscapes unaltered after a project in 1976. In 2011, there was a New Zealand ecological compensation proposal for Mt. Cass Wind Farm. In 2017, EC policy applied to the Fen River in Shanxi Province in China aimed to control water pollution. Meanwhile, PES are a voluntary deal between suppliers and purchasers through clearly defined environmental services for continuously secured provisions [26]. Additionally, PES are applied to internalize positive environmental externalities and carried out in other countries. However, they are a relatively new economic instrument. Moreover, PES are based on the principle that the beneficiary pays rather than the polluter [20][27]. In reality, most PES cases cannot be applied to all standards in the definition and are closer to the revised "PES-like" cases [28][29].

Table 1. Comparison of theoretical backgrounds of punitive-based and incentive-based eco-compensation in China.

Theoretical Backgrounds	Eco-Compensation in China	
	PECC [a]	IECC [b]
Cause	Negative externalities	Positive externalities
Principle of payments	Polluter-pays	Beneficiary-pays, provider-gets
Driver	Regulatory compliance	Government intermediary payments or voluntary transaction
Scope of implementation	Local, national	Local, national
Target	Maintenance of ecosystems	Improvement of ecosystems
Source of finance ideal	Polluters	beneficiaries
real	Polluters and the government	Mostly from the government
Method of implementation	One-time offsets, in-lieu fee	Payment in cash, payment in kind

[a] Punitive-based eco-compensation in China. [b] Incentive-based eco-compensation in China.

EC and PES have played an essential role in China's environmental management [30]. At present, the focus of WEC research is on the governance compensation model for the water environment from upstream to a downstream area of the watershed [24][31]. The WEC instrument is classified into two types in China: watershed ecological damage compensation (WEDC) and watershed ecological protective compensation (WEPC). WEDC refers to ecological loss from development and utilization activities conducted according to the law and does not include damage caused by watershed pollution or illegal activities [32][33]. It was conceived as being punitive-based to internalize negative environmental externalities and follow the polluter-pays principle in China.

On the other hand, WEPC was designed as an incentive-based policy to internalize positive environmental externalities, following China's beneficiary-pays and provider-gets principles (**Figure 1**) [34]. As a result, WEC has received wide attention as an innovative environmental protection policy. Well-designed policies and mechanisms will effectively reduce hitchhiking in the watershed environment and ameliorate water quantity and quality [12][16]. However, policies and laws relevant to WEC are still imperfect in China, especially the lack of economic policies, resulting in an unequal allocation of ecological and financial benefits among victims, protectors and beneficiaries [10]. In addition, the conflicts of interest in transboundary river basin pollution highlight China's ecological governance strategies [35].

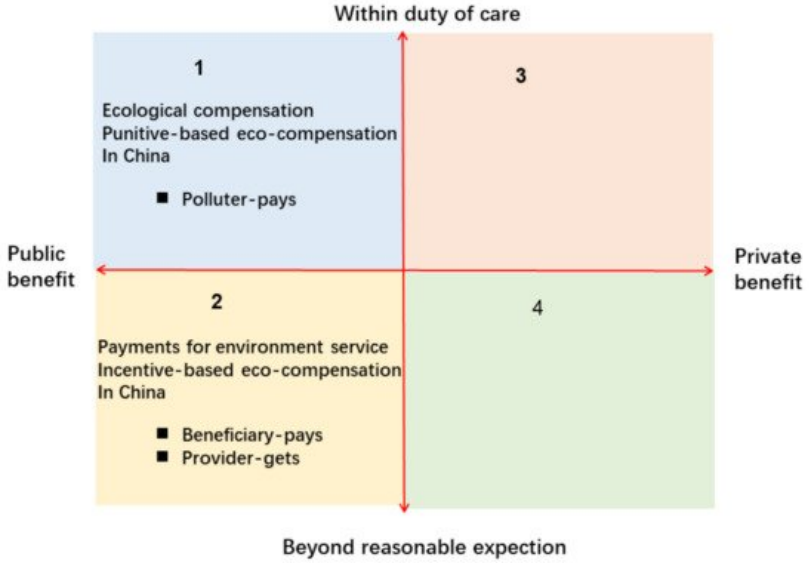

Figure 1. The benefits flow and property rights matrix: interest distribution by property rights and obligations and major policy choices [34]. In China, on the one hand, EC and punitive-based eco-compensation are adopted in the first quadrant, following the polluter-pays principle. On the other hand, PES and incentive-based eco-compensation are adopted in the second quadrant, according to the beneficiary-pays and provider-gets principles.

2. WCE Policies, Legal Basis and Economic Instruments in China

2.1. Policies and Legal Framework of WEC in China

Compared with developed countries, China faces more handicaps for water quality management because of imperfectly designed regulations and policies [33][35] China has not yet drawn up special rules and laws on WEC. The related characterization of the crucial national policy files and regulations in the fundamental laws of watershed conservation can offer a legal basis, policy background, and political impetus for establishing the WEC mechanism.

2.1.1. Policies of WEC in China

The policy of WEC has gained popularity in watershed water quality management in China, which focused on relevant watershed pollution and ecosystem services and encouraged upstream and downstream cooperation [36]. Since 2012, establishing an EC mechanism has been formally confirmed as one of the critical goals for developing China's ecological civilization system. The eco-compensation instrument is available in the primary policy files around the strategic planning for socio-economic development and the establishment of ecological civilization. The reports of the National Congress of the Communist Party of China provide an overview of eco-compensation mechanisms. The Decrees of the Central Committee of the Communist Party of China and Outline of the 13th and 14th Five-Year Plans of National Economic and Social Development of China have laid the policy foundation for constructing and improving the WEC mechanism.

The related concepts, methods, and priorities are elaborated on in the different policy files at the top level, illustrating orientations and goals of formulating future administrative and legislative measures from the above-mentioned significant files. In addition, WEC is considered an important measure to stimulate the establishment of China's ecological civilization. Therefore, the development objectives and general framework for establishing WEC mechanisms are explicit and distinct. Therefore, the primary mission for improving management and legislation is to develop a government-led, public-participatory, and market-oriented WEC mechanism, which should have effective actions, fair results, and sufficient funding sources.

2.1.2. Legal Basis of WEC in China

The Environmental Protection Law (EPL), the Water Law, the Law on Prevention and Control of Water Pollution of the People's Republic of China, and the Guiding Opinions on Accelerating the Establishment of River Basin Upstream and Downstream Lateral Ecological Compensation Mechanism provide a significant legal foundation for WEC. These fundamental laws stipulate the general duties of enterprises and individuals to mitigate, control, and prevent watershed environmental ecosystem destruction. Furthermore, the Law on Prevention and Control of Water Pollution of the People's Republic of China highlights the river leader's responsibility for managing and organizing water resource protection of rivers and lakes, water pollution prevention, waterfront management, and water environment management within the administrative region in stages. Generally, a series of related provisions in industry regulations and legislation on watershed ecosystem protection, management, and rehabilitation has constituted the legal infrastructure of WEC.

In short, attention should be paid to protecting river basin sources and transboundary river basins as well as planning and applying protection and governance methods for development activities in the functional protection zone. Furthermore, according to the Environmental Protection Law (2014) and the Law on Prevention and Control of Water Pollution (2018), the government has the leading role and primary responsibility in establishing and improving the eco-compensation system. Notably, a means of financial transfer payment with funds in compensation is also essential.

In the field of WEC development and utilization, WEC has been closely associated with the environmental impact assessment (EIA) system [37][38][39]. According to China's watershed EIA system, large-scale water conservancy construction should be predicted and assessed for ecological security risks before the EIA to avoid causing ecological degradation. After its completion, a certain percentage of its profits should be used to repair the environment. If the conservation, restoration, or eco-compensation approaches ineffectively control and prevent the damage to the watershed ecosystem, in that case, the competent authorities will not approve the EIA. Regarding the restoration of ecological damage in the watershed, the main forms of statutory liability include restoration, civil compensation, criminal liability, and compulsory administrative measures.

According to the laws and regulations mentioned above, one can conclude that those who cause cross-basin water pollution must bear responsibility for compensation, which reveals the principle in the environmental legislation. In other words, whoever caused pollution must handle the pollution. The downstream economic loss should be compensated by upstream polluters, complying with the regulations mentioned earlier. Therefore, China's WEC has a profound legal basis.

WEDC mainly focuses on the compensation mechanism for downstream environmental damage and pollution losses caused by upstream sewage discharge; this is an up-and-down compensation mode. On the other hand, WEPC is primarily concerned with the compensation mechanism for the upstream protection and governance of the watershed so that the downstream can enjoy good water quality. Therefore, it is a down-to-up compensation mode [40]. Thus, the combined use of WEDC and WEPC will positively impact the use of natural resources and minimize the externalities of the ecological environment.

2.1.3. Relevant Economic Instruments in WEC

The economic tools of WEC function mainly consist of the river occupation fee, the river engineering construction and maintenance fees, the sand mining management fee in a river, and the environmental protection tax (covering the costs of dumping and discharging pollutants) in China. These economic tools are the primary sources of financial income.

Specifically, first, the river occupation fee refers to the units and individuals involved in engineering construction projects and other facilities paying fees to the water conservancy department for occupying water surface, river beach, and embankments within the scope of river management. The fee is calculated according to the actual area of the water surface, river beach land, and embankment land occupied by the project. Second, river engineering construction and maintenance management fees refer to the fees that industrial and commercial enterprises, farmers, and individual industrial and commercial households should pay to the river competent authority for the construction, maintenance, and management of river projects within the scope of benefits from embankments, revetments, irrigation and drainage sluice gates, dikes, and waterlogging drainage facilities. The levy standard shall be determined according to the project construction and maintenance management fees. The specific standards and methods of charging shall be determined by the people's governments of provinces, autonomous regions, and municipalities directly under the central government. Enterprises with sales and operating income shall be levied at 1‰ of monthly sales or operating income. For large commercial enterprises with a sales volume of more than CNY 10 million and a price difference rate of less than 10% in the previous year, it is calculated by 0.5‰ of the monthly sales volume. River engineering construction and maintenance management fees belong to local fiscal revenue, and the local tax rates are different. Third, the sand mining management fee in the river refers to the sand mining, earth borrowing, and gold panning within the scope of river management that must be carried out following the approved scope and operation mode, and the management fee must be paid to the river competent authority. The charging standard of the river sand mining management fee shall be reported by the water conservancy departments of all provinces, autonomous regions, and municipalities directly under the central government to the price and financial departments at the same level for verification. For example, the Tianjin Water Resources Bureau will charge the unit issuing the river sand and soil sampling license at the standard of no more than CNY 0.70 per cubic meter, and the stone will be charged at 10–25% of the local sales price of the quarry. Fourth, the environment protection tax is formulated to protect and improve the environment, reduce pollutant emissions, and promote the construction of ecological civilization. According to the provisions of the environmental protection tax law, the tax basis for taxable air pollutants and water pollutants shall be determined according to the pollution equivalent converted by the pollutant emission, the tax basis for taxable solid waste shall be determined according to the emission of solid waste, and the tax basis for taxable noise shall be determined according to the decibel exceeding the national standard.

However, the principle, relevant regulations, competitive sectors, and calculation basis of fee amounts of each economic instrument are different. The relevant subjects of obligations are directly reflected following the principles applicable to the four economic instruments. These economic tools with different focuses and goals are implemented according to various legal regulations. Each evaluation criterion is used for each economic instrument in terms of calculation methods. The calculation of the number of charges is mainly according to the elements of ecological environment management rather than integrating all the ecosystem elements. The effectiveness of eco-compensation will be affected by the difference in the fiscal revenues used for eco-compensation. Both the river occupation fees and the river's sand mining management fees are natural resource revenue. A large portion of the revenue is used to conserve the ecological environment or resources of the watershed. This revenue cannot be spent on ecological compensation in other areas. The fiscal administration system manages the river area's use fee and environmental protection taxes. Therefore, the expenditure should be assigned in accordance with the government budget rather than being dedicated to ecological rehabilitation such as the river sand mining management fee, river resource fee, and compensation for damage to river basin protection.

2.2. Discussion of Significant Challenges and Opportunities

2.2.1. Discussion of Significant Challenges in WEC

It will be impossible to construct watershed eco-compensation without investigating the effectiveness and adequacy of existing legislation and policies. According to the present and long-term political situation, the establishment and improvement of the WEC mechanism face many challenges.

Firstly, according to the present situation, China does not have complete regulations and laws, nor does it specialized and national-level legislation. It shows that the WEC regulations in the above-collected government files may not be faithfully carried out in reality. The regulations and policies of WEC are formulated mainly by administrative departments and regional governments according to their demands. Therefore, their authority and constraint are restricted. The requirements of present regulations and policies for WEC are prescribed in principle, but they can't provide specific and direct guidance for WEC implementation. Therefore, relevant practices will inevitably face legality issues without sufficient legal foundation from upper-level law.

Second, compared with foreign PWES projects, China's eco-compensation is still the government-led model and lacks market-led model eco-compensation in the watershed, and the WEC model is relatively rare [41][42][43]. The government-led eco-compensation model has deficiencies, as follows. First of all, the importance of eco-compensation is closely related to the recognition of local managers. Therefore, changes in managerial positions will affect the stability of eco-compensation-related policies and measures. Furthermore, the primary funds of WEC only relying on government financial transfer payments will lead to a shortage of compensation funds. Therefore, it is tough to maintain eco-compensation development and project construction in the watershed.

Thirdly, the existing economic tools are insufficient for WEC. On one hand, although the river occupation fee includes the cost of ecological environment damage, the proportion of funds for watershed ecological restoration is flexible. According to the financial management system for watershed environmental restoration, a complex approval process is required, from the assessment of the budget for watershed ecological damage to the implementation of watershed environmental restoration. Therefore, the time lag of WEC is not promptly beneficial to the rehabilitation of the damaged watershed ecological environment. Aspects such as the water resource revenue and taxation being included in the government's revenue and expenditure budget management system should be planned in an integrated manner in terms of investment scope. Meanwhile, the proportion and scope of the watershed environmental protection expenditures change every year. In conclusion, the available sources of WEC funds cannot be managed in an overall manner, forming a steady and lasting WEC fund support rather than only playing a supplementary function.

Fourthly, the available economic instruments in China have developed their corresponding technical criteria, but the calculation basis and methods of the fees are not uniform. On the one hand, because of the absence of comprehensive watershed-ecosystem-based assessment methods and compensation standards for ecological losses, the results for the demonstration practices are unsatisfactory, which must be adjusted and improved. On the other hand, it also reveals the flexibilities of the WEC mechanism, which requires careful consideration of natural conditions, the level of productivity, the intensity of utilization and development, the management level and capacity of the watershed, and other factors.

2.2.2. Political Dynamics and Opportunities in WEC

The WEC mechanism aims to solve the problems faced by ecological environment protection and governance of watersheds and adjust and balance the environmental and economic interests of the upstream and downstream of the river basin. Moreover, it can mobilize stakeholders' enthusiasm for watershed protection and governance. The WEC mechanism has been incorporated into the national watershed ecosystem protection and strategic development layout. The Chinese government has put forward a scientific development concept. It insists on people-centered, integrated, coordinated, and sustainable development through various policies and measures, attaches great importance to ecological construction, and significantly contributes to improving the country's environmental conditions [41]. From this point of view, the current national strategic concept of watershed management and administration will provide impetus and opportunities for constructing and developing the WEC mechanism.

Firstly, The Chinese government has promulgated many policies and regulations concerning ecological civilization construction in the watershed. For example, the Environmental Protection Law of the People's Republic of China, which was revised and passed in 2014, clearly stated the construction of an improved eco-compensation system and provided legal support for the eco-compensation practice [42]. Furthermore, President Xi Jinping proposed at the 19th National Congress of the Communist Party of China that establishing a market-based and diversified eco-compensation mechanism pointed in the direction of developing the eco-compensation mechanism [43]. Therefore, the decision-making level has a strong political will and would like to place more emphasis on the exploration and demonstration practice of the environmental protection mechanism; it will be conducive to accelerating the process of the institutionalization of WEC.

Secondly, China is making new reforms to its watershed governance system. In 2019, nine departments, including the National Development and Reform Commission, the Ministry of Finance, and the Ministry of Natural Resources, jointly issued and implemented the “Action Plan for Establishing a Market-oriented and Diversified Ecological Protection Compensation Mechanism”, which designed and arranged the promotion measures and other aspects. It aims to realize the market-oriented operation and diversified participation of the eco-compensation system and promote the proper operation of WEC. Diversified participation and a coordinated watershed administration system will be more beneficial to constructing watershed mechanisms and the legislation of WEC [44].

Thirdly, weak enforcement is the main reason that most existing watershed environmental protection policies and regulations have little practical effect. However, on one hand, the national environmental and river leader supervision system has promoted implementing the environmental protection responsibility system in the watershed. On the other hand, the protection of watershed ecological governance has become an essential indicator of the effectiveness assessment of government management. It is conducive to strengthening the political motivation of the relevant authorities to ensure environmental safety and maintain sustainable ecological services.

Under the current situation, cross-regional and transboundary eco-compensation pilot schemes have achieved significant results. A diversified eco-compensation mechanism has been initially established, and entities have fulfilled environmental protection responsibilities [45][46][47]. The function of government has changed from micro-regulation to enhancing the guidance and planning of macro-regulation. The emphasis of management has also changed from pre-permitting restriction to post-permitting supervision of the overall procedure. The effect has promoted the further improvement of the WEC mechanism. In addition, the more coordinated interaction between the environmental protectors and the beneficiaries in the watershed has provided strong policy support.

3. Domestic WEC and Foreign WEPS Practices and Comparisons

Building a WEC mechanism is essential to considering the overall situation according to the ecological priority and green development from the perspective of the comprehensive protection and sustainable utilization of the watershed ecosystem as a precondition to meeting the watershed’s economic and social development needs [45]. In addition, WEC should be guided by the national long-term strategic plan, and regional governments should adjust implementation strategies and explore regionally appropriate measures according to their own circumstances. Thus, the desire to pursue an excellent ecological environment in the watershed can be realized.

3.1. Current Practice of WEC in China

WEC mechanisms and policies have received widespread attention from society. Large amounts of funds, material resources, and labor have been invested in protecting the watershed ecosystem to ensure the ecological security of the watershed and the sustainable use of water resources. WEC is mainly implemented by the local and central governments, including government financial subsidies for critical ecological functional regions such as protecting water sources. Following the “Polluter pays” principle, WEDC is negotiated on and determined based on the cost of water pollution control and the economic loss caused by water resource protection. Most WEDC mechanisms are carried out according to the environmental control measures supervision system or the environmental impact assessment (EIA) framework. Compensation is usually implemented through negotiation under the supervision and guidance of the competent authority. However, the inter-regional agreements and cooperation reflect the market-oriented mechanism to some extent. Nevertheless, purely market-oriented or economic approaches have not been entirely applied [48][49][50][51][52] The governmental “red-headed” documents are the main forms that the higher-level government uses to formulate payment requirements and related compensation regulations. They represent official regulations and are an essential and ordinary means by which eco-compensation schemes originate in China.

The positive incentives mainly include social honor, financial rewards, and promotion. The downstream beneficiary should compensate upstream residents for their sacrifices to preserve the water ecological environment. In China, the WEPC (**Table 2**) mechanism has mainly been applied to compensation in transboundary watersheds, mainly through signed agreements and financial transfers between governments to achieve ecological protection of the watershed. The scope of WEPC implementation includes two provinces or two cities of a transboundary river. For example, the Anhui and Zhejiang provinces established a horizontal eco-compensation mechanism in the Xin’an watershed in 2011, and the Shandong and Henan provinces established a horizontal ecological compensation mechanism in the Yellow River Basin in 2021. In practice, adhering to the “Beneficiary compensates” modality, most WEPC cases are usually implemented by governmental financial assistance and subsidies.

Table 2. The WEPC pilot schemes in China.

Province	Major Policy or Legislation Documents	Funding Source for WEPC	Principles and Approaches of WEPC	Targets
Shandong (Nansi Lake watershed, 2013)	Measures for eco-compensation in the Nansi Lake Basin	Finance Bureau of Shandong Province	"Who benefits who compensates" principle	To explore the market-oriented operation mechanism of eco-compensation To establish a co-construction and sharing ecological mechanism in the watershed To establish a long-term mechanism for ecological compensation To promote the "off-site development" policy in the river basin
Anhui and Zhejiang Xin'an River watershed (2011)	Pilot implementation plan for water environment eco-compensation in Xin'an River watershed	Government financial transfer payment Horizontal financial transfer payment	"Who benefits, who compensates, Who pollutes and compensates"	The central government provides financial support to promote cross-provincial watershed compensation. To formulate classification assessment methods for city and county governments To establish Xin'an River Watershed Ecological Construction and Protection Bureau To establish a compensation mechanism system for mutual communication, joint monitoring, and joint prevention and control between the two provinces
Henna and Shandong Yellow River watershed (2021)	The Yellow River Basin (Lu-Yu Section) Horizontal Ecological Protection Compensation Agreement	Government financial transfer payment	"Who benefits, who compensates",	To improve and perfect the horizontal ecological compensation mechanism of "shared responsibility for protection, co-governance of river basin environment, and sharing of ecological benefits" To expand cooperation in the ecological field To improve water environment quality
Shaanxi and Gansu Wei River (2011)	Framework Agreement of Environmental Protection Cities Alliance of Wei River Basin	Central Government Finance Ecological Compensation Fund Government Horizontal financial transfer payment	"who protects and benefits" principle	To establish a special fund for ecological protection in the Wei River basin To explore the establishment of an inter-provincial ecological compensation mechanism To explore the establishment of a market-based ecological compensation mechanism To assess the Wei River basin's ecological value reasonably and establish a life-long accountability system for ecological environment damage

The punitive-based WEDC for construction programs concerns watershed users and related government departments. The negative incentives involve mandatory punitive measures, with priority given to administrative or economic penalties. Administrative penalties mainly involve the removal of officials who fail to meet the assessment standards of the relevant departments, and economic penalties involve the reduction of financial transfers for poor local environmental protection. According to their conditions, most critical ecological functional areas have implemented various WEDC mechanisms. As a result, there are similarities and differences in the legislative progress or policy, such as the source of compensation obligation, compensation modality, implementation framework, and specific contents, such as Qingshui River, Pinghu, and Nansi Lake.

In existing WEC pilot practices (**Figure 2**), WEC is applied in a WEDC–WEPC mixed mode. On one hand, excessive discharge of upstream pollutants causes damage to or deterioration of the downstream water environment, which is the most intuitive and obvious phenomenon; therefore, the "up to down" and WEDC compensation modes are proposed, and related research results are abundant [46]. On the other hand, some protection facilities to maintain or improve water

quality should be built in the upstream area so that the downstream can indirectly enjoy better water quality. Therefore, the downstream beneficiaries should provide reasonable compensation to the upstream, namely a “down to up” and WEPC mode [48][49].

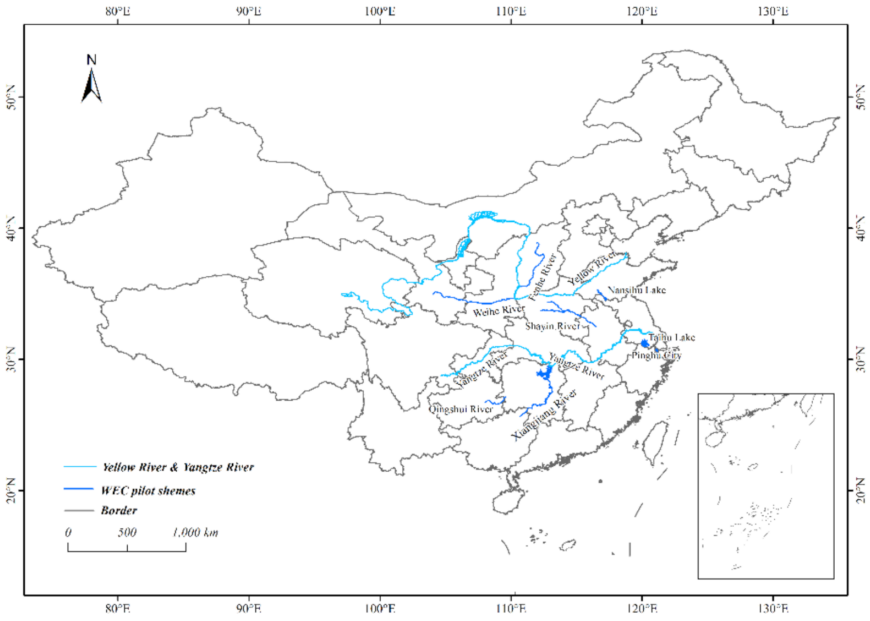

Figure 2. Geographical distribution of 10 pilot schemes for WEC in China.

In short, the local practice of WEC has the following characteristics: (1) In the current watershed EC, the improvement of watershed legislation or policies is considered an essential means and development goal to improve the water environment quality watershed at this stage. According to the analysis of local practices in China watersheds, it is proposed that no matter whether it is at the national or regional level, there is a lack of legal basis for EC in watersheds. Therefore, strengthening and improving legislation is considered the basis for establishing, developing, and improving the WEC mechanism [50]. (2) In current practice, WEC includes two basic types: WEPC and WEDC. The legislation of WEPC lags behind WEDC. (3) Most inter-provincial WEC practices are in the attempt stage. The compensation mechanism still has an insufficient legal basis and a lack of ecological compensation consultation platform and relevant financial system. Although it emphasizes implementing diversified ecological compensation methods, the implementation structure has not yet been developed [51][52][53]. (4) In the application model of WEC, the effectiveness of WEC has been mainly dependent on the leadership of the government and enterprises. The application of the WEC market-based mechanism is not yet sufficient. Though the report of the 19th National Congress of the Communist Party of China clearly stated that “The establishment diversified and market-oriented eco-compensation mechanism” is listed as one of the crucial objectives “To accelerate the reform of ecological civilization system and build beautiful China.”, such as “Measures for Eco-Compensation in the Nansi Lake Basin” in Shandong and “Framework Agreement of Environmental Protection” between Shaanxi and Gansu province, which propose exploring the market-based method, there are fewer practices available for reference [54]. It is still necessary to further examine the watershed eco-compensation theory and successful experiences in foreign countries. The main aspects of the payment for watershed ecosystem services’ (PWES) practices will be discussed as follows.

3.2. The Practices of PWES in Foreign Countries

The earliest payment for watershed ecosystem services (PWES) (**Table 3**) projects were watershed management and planning projects in foreign countries, such as the Tennessee Watershed Management Plan in 1986. More than 180 PWES projects have been carried out in at least 56 countries around the world [55][56]. There are about 40 are developing countries, and about two-thirds of the total number of cases are in developing countries. The number of successful cases is around 46. In addition, the marketization of PWES projects abroad was relatively quicker, had a wide range of products, covered a wide range of areas, and showed a strong link with other water management practices. These characteristics enabled foreign PWES practices to better address basin variability and improve the applicability and efficiency of PWES.

Table 3. Typical cases of Payment for Watershed Ecosystem Services (PWES) in foreign countries.

Project	Purpose and Main Contents of Compensation	Compensation Mode and Methodologies	Characteristic
New York City: Clean Water Supply Agreement	**To protect the drinking water quality of New York City, New York City has invested the US 1–1.5 billion in the upstream Catskill basin within 10 years to improve the land use and production mode in the basin.**	(1) Market transaction mode (main), government compensation mode. (2) Financial compensation, which comes from the surtax, public debt, and trust fund of New York City water residents.	**The downstream compensated the upstream. After the government made a decision, the responsibilities and compensation standards of both parties would be determined by the water authority through a consultation mechanism.**
Ecuador: Quito Water Conservation Fund	**To promote river basin protection, improve watershed water quality, and reduce the pressure of various industries on water resources demand, the fund is funded by fees imposed on water users, donations, and state financial expenditures and then improves water quality through watershed protection investment.**	(1) Market trading mode (realized by establishing a credit fund system). (2) Capital compensation (main), project compensation.	**The fund was independent of the government and managed by private managers and the board of directors. NGOs played an important role in the fund. The project was implemented by professional groups and involves local participation.**
Germany and the Czech Republic: Ecological Compensation Project in Elbe River Basin	**To regulate the Elbe River, improve water quality, reduce pollution, and protect biodiversity, the Czech Republic (upstream) and Germany (middle and downstream) signed an agreement to establish bilateral cooperation organizations and eight working groups, and Germany built 7 national parks and 200 nature reserves.**	(1) Government compensation mode. (2) Financial compensation (from German financial loans, research subsidies, sewage charges), policy compensation, and project compensation.	**The downstream made capital compensation to the upstream. Transnational watershed ecological compensation. Germany has also achieved a win–win situation in ecological compensation to the Czech Republic.**
Colombia: Valle del Cauca Watershed Protection Project	**To alleviate the shortage of water resources and the shortage of public financial funds in the basin, 12 water resource utilization associations, 3 water resource management foundations, and 3 river companies have been established in the basin, involving 97,000 families. The funds come from member donations in the form of consumption payment for water resources, and the participation of local communities ensures the sustainability of the action.**	(1) Market transaction mode and watershed service payment mechanism. (2) Project and fund.	**The beneficiaries of watershed protection paid to the providers; extensive community participation and high enthusiasm. The association has received strong support from farmers.**

In brief, the analysis of typical foreign PWES products and projects shows that PWES practices are characterized by the following features: (1) Diversified and market-based compensation models. Most of PWES projects adopted payment for services mechanism in a market transaction model, supplemented by a government compensation model; (2) the sources of funding for PWES projects were diversified, with funds coming mainly from taxes and fees on the use of watershed services, fiscal expenditures, donations, loans, sewage charges, public debt, and trust funds; (3) compensation methods were diversified, mostly in the form of financial compensation (i.e., payments or compensation to watershed service providers and protectors), and to a lesser extent in the form of project-based compensation (i.e., investment of compensation funds or funds in watershed protection projects), complemented by policy compensation and Chilean technical compensation; (4) the abroad PWES funds were managed by private administrators and independent from the government, but the objectives of the fund's operations were consistent with national planning, and various associations

and NGOs played an important role in the implementation of PWES projects; and (5) the local community was widely involved, with various stakeholders participating in the PWES projects, and there was a high level of enthusiasm for the PWES projects.

3.3. Comparative Analysis of Domestic and Foreign Watershed Eco-Compensation

A comparative analysis of typical WEC practices in China and PWES projects abroad shows that there are significant differences. The main differences in the practice can be seen in the following aspects: (1) Different compensation models. The main mode of compensation is market transaction compensation in foreign countries, while the main mode of compensation is the government's transfer payment in domestic. (2) Different sources of compensation funds. Foreign compensation funds come from a variety of sources, while domestic compensation funds are mainly government expenditures, which is relatively singular. (3) Different compensation approaches. Most domestic compensation is in the form of project compensation, while foreign compensation is mainly financial compensation, supplemented by project compensation, policy compensation, technology compensation, etc. (4) Different compensation criteria and methods of determining compensation standards. (5) The groups in WEC and PWES are different; there are many groups involved in PWES in foreign countries, including upstream and downstream residents, government, enterprises, NGOs, associations, communities, etc., while in China, the groups involved are mainly government and enterprises. (6) The beneficiaries of compensation are different (mainly water protectors in foreign countries, but fewer in China). (7) There is a large difference in the efficiency and effectiveness of compensation, with foreign PWES generally adopting a market-based trading model, which is efficient and effective. In contrast, WEC in China relies too much on the government, which has a heavy burden on the government, resulting in low efficiency and ineffectiveness.

The reasons for the difference are not limited to the late start of WEC practice in China and the lack of experience. Some other factors also constrain the practice of WEC in China, such as an inadequate legal system and inadequate compensation mechanisms.

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