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Exploring China's approach to implementing 'eco-compensation' schemes: the Lake Tai watershed as case study considered through a legal lens

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For close to a decade China has been implementing 'eco-compensation' mechanisms to address water-related ecosystem issues. This paper examines China's approach to eco-compensation through experience in the Lake Tai watershed. Four typologies of eco-compensation schemes are identified and analysed, primarily through a legal lens. It is concluded that while progress has been made, there is need for improved legal approaches to this complex topic.

Keywords: payment for ecosystem services (PES); eco-compensation; Lake Tai; China; water law

Ecosystem services

Well-functioning ecosystems provide a broad range of services to myriad communities, anthropogenic and others. With growing populations the demands for natural resources are continually increasing, often resulting in dwindling healthy ecosystems. Identifying the significance of ecosystem services and assessing their monetary value are not new or novel ideas; these can be traced back to an influential article published in *Nature* (Costanza et al., 1998). In that seminal study the authors classified ecosystem services into 17 major categories: gas regulation, climate regulation, disturbance regulation, water regulation, water supply, erosion control and sediment retention, soil formation, nutrient cycling, waste treatment, pollination, biological control, refugia, food production, raw materials, genetic resources, recreation and cultural services (p. 254).

The notion of 'ecosystem services' has been mainstreamed over the past decade, referred to as 'environmental services,' 'ecological services' or simply 'investing in nature'. In the first wave of research in this field (1990–96), a survey of the legal literature reveals under 20 important studies that refer to the term 'ecosystem services'. However, during the following seven years, 1997–2003, over 10 times that number of law review articles referred to ecosystem services reflecting the growing legal discourse in this field (Ruhl & Salzman, 2007).

The most influential categorization of ecosystem services comes from the Millennium Ecosystem Assessment (MA). It follows Costanza et al. (1998) in taking both natural and man-made ecosystems as sources of ecosystem services, and follows Daily (1997) in using the term 'services' to encompass both the tangible and intangible benefits that humans obtain from ecosystems, which are sometimes separated into 'goods' and

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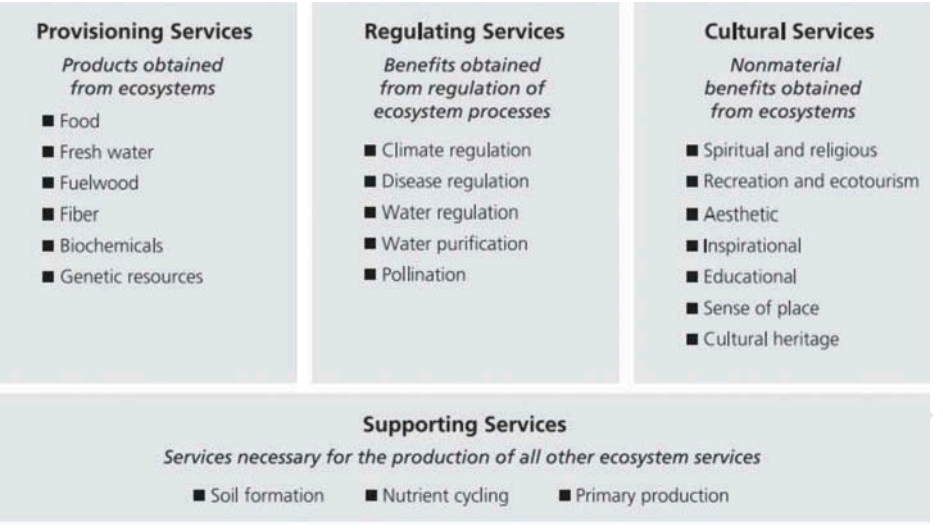

AQ20 Figure 1. Ecosystem services. Source: Alcamo & Bennett (2003), p. 57.

'services' respectively (Alcamo & Bennett, 2003; Daily, 1997). MA categorizes ecosystem services into four groups based on their functional lines: provisioning services, AQ19 regulating services, cultural services and supporting services (Figure 1).

Perhaps the most important basis for supporting a policy that would protect otherwise threatened ecosystem services is the growing evidence that society gains more value from such protection than it gives up (Goulder & Kennedy, 2011). However, valuing ecosystem services is an extraordinarily difficult undertaking, and the economic valuation of ecosystem services at the global level has been a hot topic of debate (Simpson, 2011). For AQ1 example, Costanza et al.'s (1998) suggestion that a 'minimum estimate' of such values was US$33 trillion has given rise to a great deal of criticism, particularly from economists (Ayres, 1997; Simpson, 2011; Toman, 1998). A more fundamental criticism of the Costanza et al.'s work is that it confused marginal and total values (Simpson, 2011). Nonetheless, the universal consensus is that ecosystems are tremendously valuable, regardless of whether or not there are challenges in accurately assessing such value. Thus, while we continue to attempt to calculate the actual value, ecosystems should be managed wisely before they are lost. It is within this context that the legal underpinnings of such schemes are so important, as robust implementing vehicles for policies in this field.

What needs to be kept in mind is that ecosystem processes do not yield ecosystem services until they are used by human beings (Ruhl, Kraft, & Lant, 2007). In other words, without human beings, 'ecosystem services' would not be enjoyed: the food supplied or the water purification processes provided by the ecosystems are simply ecosystem processes in and of themselves. Thus, any law or policy formulated to address ecosystem services should not deal with relations between humans and nature directly, but instead must focus on adjusting relations between humans. For example, compensation for ecosystems cannot be paid to ecosystems directly, but to the person who protects or repairs them. Thus, in this article, although the term 'eco-compensation' – compensating the ecosystem – is adopted, it refers in fact to compensation schemes among people. Only

by adjusting the different interests among different stakeholders of an ecosystem can ecosystem services compensation mechanisms be formulated.

Eco-compensation in China

At the international level, incentive-based approaches for conserving ecological services have been devised as vehicles to contribute to achieving environmental sustainability. In this context the notion of 'payment for ecosystem services' (PES) has become an important strategy in dealing with various challenges in environmental management (United Nations Economic Commission for Europe (UNECE), 2007). According to the UNECE (2007), PES refers to a contractual transaction between a buyer and a seller for an ecosystem service or for a land use/management practice which is likely to secure that service.

The Chinese term 'eco-compensation' (*sheng tai bu chang*) has often been used interchangeably with the international term 'PES' – especially in comparative studies in this field examining China and global approaches (Zhang, Bennett, Kannan, & Jin, 2010). However, although the two schemes share some similarities, they are quite different. The Chinese notion of eco-compensation is broader, encompassing both PES-like policies and also a wide range of other policies and programme types (Bennett, 2009). The Chinese approach is elaborated further below.

PES schemes generally refer to voluntary transactions between service providers and service buyers. When successful, PES creates economic incentives for landholders to conserve or even improve the function of their lands for services as varied as watershed protection, carbon sequestration and biodiversity conservation (Zhang, Lin, Bennett, & Jin, 2010).

Eco-compensation schemes generally create not only incentives but also disincentives. Incentives refer to a reward or compensation for a right that is foregone in order to maintain a certain ecosystem service. Disincentives refer to charges for the loss of or damage to ecosystems and natural resources (China Council for International Cooperation on Environment and Development (CCICED), 2010; Zhang et al., 2010).

Therefore, eco-compensation in China is defined in both narrow and broad terms. The narrow definition, which is comparable with PES, refers to rewards for protecting the environment and natural resources; the broad definition covers not only rewards but also environmental pollution charges (Li & Liu, 2010), e.g. a pollution discharge fee. As there are already a series of laws and regulations that deal with pollution charges in China, this article focuses more specifically on the narrow definition of eco-compensation, as it is a relatively new and innovative development being implemented in China.

In order to develop internal ecosystem services markets, China's central and local governments have rapidly expanded their environmental protection policies, especially during the past few years, largely under the heading of 'eco-compensation' (see Appendix 1). The first official document to stimulate an eco-compensation mechanism (ECM) was a 'Decision regarding Strengthening Environmental Protection' issued by the State Council in 2005, which states that the government 'should improve eco-compensation policy, and develop an eco-compensation mechanism as soon as possible [. . .] pilot projects can be launched at both local and national level'. Following this, many provinces enacted their own regulations and eco-compensation projects. The 'win–win development' principle was later laid down as one of the cornerstones of the ECM by the Ministry of Environmental Protection, which recommended carrying out pilot projects in four fields:

- Eco-compensation for nature reserves.
- Eco-compensation for eco-function areas.
- Eco-compensation for the development of mineral resources.
- Eco-compensation for watersheds.

The number of eco-compensation projects in watersheds alone has increased significantly in only a decade – from eight in 1999 to more than 47 in 2008, with an estimated transacted value of roughly US$7.8 billion, covering some 290 million ha (Stanton, Echavarria, Hamilton, & Ott, 2010; Zhang & Radstake, 2010).

For the purposes of this study, the Lake Tai watershed in Jiangsu province has been selected as a case study. Through a legal analysis of the ECM in this watershed, this article aims to provide an overview of how this scheme has been applied in China. The Lake Tai case study is particularly well suited to this examination – it is one of the eco-compensation pilot schemes in China, one of the most developed and polluted regions, and one of the watersheds where a number and variety of eco-compensation schemes are being applied.

Although eco-compensation schemes are diverse in different watersheds, there are still some common rules that can be distilled from state practice. The Lake Tai example provides ample opportunity for harvesting valuable lessons for national water management regimes in the provision of water-related ecosystem services.

Eco-compensation in the Lake Tai watershed

Lake Tai is the third largest freshwater lake in China. The watershed occupies an area of some 36 500 km^2 and extends across multiple jurisdictions: Jiangsu province (52.6%) (Figure 2), Zhejiang province (32.8%), Shanghai municipality (14%) and Anhui province (0.6%) (Monitor Center, 2013). As one of the most developed regions in China, with only 0.4% of the land territory but 4.4% of the population, the Lake Tai watershed produced 10.3% of gross domestic product (GDP); per capita GDP in this region was 2.4 times more than the national average in 2012 (Taihu Basin and Southeast Rivers Water Resources Bulletin 2011, 2012). The lake connects seven large cities across East China, including Shanghai and Hangzhou, which have populations of 23.8 million and 8.8 million, respectively.

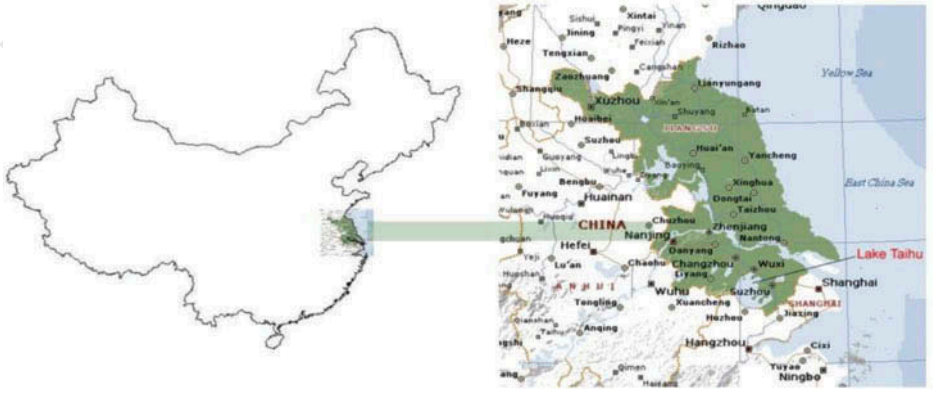

Figure 2. Lake Tai and Jiangsu province.

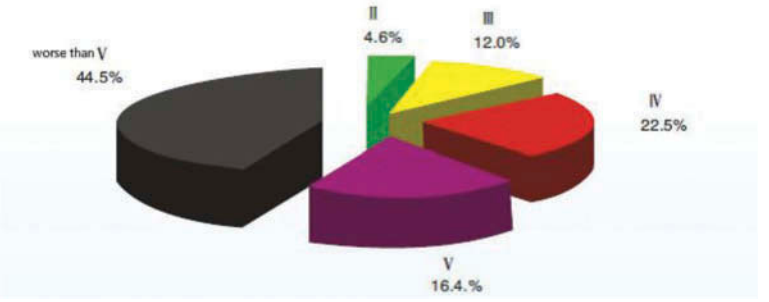

Figure 3. Water quality of Lake Tai in 2011. Note: There are five classifications of water quality in China: Class I, water source, national protection areas; Class II, centralized drinking water supply spawn grounds for rare fishes and shrimps, nursery areas for larvae, juvenile and young fishes; Class III, grounds and migration paths for common fishes and shrimps, aquaculture areas and swimming areas; Class IV, general industrial water areas, entertainment areas; and Class V, farmland areas, general landscape. Source: Retrieved from http://218.1.102.107:9001//tba/content/TBA/lygb/szygb/0000000000003585.html

Serious water pollution has been caused by unprecedented economic growth and rapid urbanization in the Lake Tai watershed region (Figure 3). The entire lake has suffered from eutrophication since 1993, the most serious crisis coming in 2007 when dozens of centimetres-thick algal blooms covered the entire lake and tap water turned yellow and was foul-smelling (Liang & He, 2012). Transboundary water pollution problems ('transboundary' in this article refers to as water bodies that cross two or more administrative regions) are persistent issues in this watershed as it extends across three provinces and one municipality.

In 2008 alone, China's Central Government allocated more than RMB111 billion (US $17.9 billion) to improve national lake water quality from Class V to Class IV, with an overall goal to achieve Class III status by 2020 (Liang & He, 2012). The government of Jiangsu province – which is covered by more than half of Tai's total watershed (52.6%) – has worked to improve its legal framework in order to improve water quality in the lake. Over the past decade eco-compensation schemes have been significantly developed across this region.

Four types of eco-compensation have been developed and applied in the Lake Tai watershed: eco-compensation between governments, eco-compensation between governments and farmers, eco-compensation between governments and industry (Luo, Qu, Feng, Shi, & Jiang, 2011), and eco-compensation among industries. These are explored in more detail below.

Eco-compensation between governments

Bidirectional intergovernmental eco-compensation between upstream and downstream areas within one watershed is a newly developed mode of eco-compensation, aimed primarily at addressing transboundary water pollution problems. It can motivate both the upstream and downstream jurisdictions to act jointly in protecting their shared water resources.

Jiangsu province selected four cities – Nanjing, Changzhou, Wuxi and Zhenjiang – as pilot schemes for applying governmental eco-compensation instruments, beginning in 2007. Seven monitoring areas were selected in the four cities, where water quality standards were set by the provincial government. Using these standards as baselines, the provincial government combines the environmental protection responsibility of city governments with financial incentives. For example, in the Xu River in Changzhou City (one of the sub-watersheds of Lake Tai), a monitoring site was established by the provincial Administrative Department of Environmental Protection. The department records the water quality on a weekly basis and calculates the monthly average. If the result exceeds the baseline, meaning the water quality is below the standard set, the upstream city (Nanjing) has to compensate the loss suffered by the downstream city (Changzhou) in accordance with Jiangsu provincial regulation. The rationale for this approach is that the extra pollution caused by Nanjing City results in extra expenditure on pollution control for Changzhou City. Up to 2008, Nanjing City had compensated Changzhou City by RMB18,000 (US$29,032), and Changzhou City had compensated its downstream city Wuxi City by RMB180,000 (US$29,032) due to the recorded water quality results in the monitoring areas below the standard set (Internation Consumer Rights Forum, 2012).

In order to enhance the motivation for water quality protection, the compensation level is set at twice the pollution control cost. The compensation is incorporated into special environmental protection funds or pollution prevention and control funds for water pollution control and ecosystem restoration (The Compensation Method of Regional Environmental Resources of Jiangsu Province (Trial Implementation), 2007). In another case, if the recorded results in the monitoring areas between the upstream and downstream cities are above the designated baselines, the downstream city has compensate the upstream city, which stated by the State Council: 'if the upstream cities achieve the water quality targets in the monitoring areas of administrative boundaries, the downstream regions should compensate the upstream regions' (Regulation on the Administration of the Tai Lake Basin, 2011). However, the legal nature of such compensation gives rise to further discussion (see the fourth section).

Eco-compensation between governments and farmers

Diffuse water pollution is a main contributor to water pollution in the Lake Tai watershed (see Map 2). If total nitrogen (TN) and total phosphorus (TP) – two main pollutants in diffuse agricultural pollution – had not been included in the evaluation of water quality, most of the surface water in Lake Tai would have reached Class III (Figure 4–2). However, when TN and TP are taken into account, the water quality drops to a level worse than Class V (Figure 4–1), especially in Jiangsu province.

In 2011, the State Council introduced a special regulation aimed at tackling diffuse water pollution in Lake Tai (Regulation on the Administration of the Tai Lake Basin, 2011), which required local governments to take measures such as the following:

- Constructing an ecological protection forest within a 500-m area around the shoreline of the lake.
- A 1500-m area around the drinking water source protection zones.
- Within a 200-m area along both of the river banks of the shore of the lake.

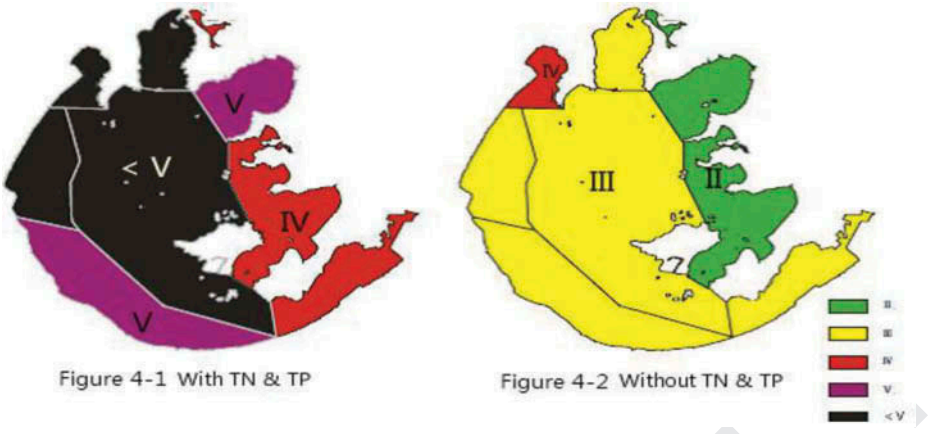

Figure 4. Diffuse water pollution of Lake Tai in 2011. Source: Author-edited map retrieved from http://218.1.102.107:9001//tba/content/TBA/lygb/szygb/0000000000003585.html

Local county governments

- Should provide subsidies and support to farmers who have to change their jobs due to the ban on aquaculture and livestock breeding, and the projects of returning the cultivated land or fishery to the lake.
- Should guarantee a basic life for those farmers by skill training or incorporating them into the social security system.
- Should provide subsidies for farmers whose income has decreased or whose expenditure has increased due to the projects to reduce pesticide and fertilizer use.

In fact, Jiangsu province had already formulated its own regulation in 2007 to address pollution problems caused by algal blooms (Opinions on Energy Conservation and Emission Reduction in Jiangsu Province, 2007). It requires the cities within its jurisdiction 'to return the cultivated land to the lake, to plant forests and to remove livestock breeding and traditional planting within 5-kilometres around the first-grade protection zones of Lake Tai'. This proved to be a difficult exercise in practice. For example, the East Lake Tai in Suzhou City, an 180,000 mu (12,000 ha) bay on Lake Tai, was occupied by enclosed fish farms with 165,700 mu (11,048 ha) (Han, 2010), which accounted for more than 90% of the surface water of the East Lake Tai, and more than 80% of the total enclosed fish farm area in the Lake Tai. The intensive enclosed fish farms were one of the main causes of the algal blooms due mainly to the excessive use of fish feed. In order to achieve its water quality target for 2012 (from Class V to Class IV), the government of Suzhou City reorganized its intensive enclosed aquaculture. The city's governmental policy requires the decrease of enclosed aquaculture from 300,000 mu (20,000 ha) of water areas to 45,000 mu (3000 ha) (Suggestions on Implementation of Reorganizing Intensive Enclosed Aquaculture, 2008), which resulted in significantly improved water quality.

However, problems arose since the rural fish farmers were seriously affected as a consequence of this massive reorganization. For example, in the Wuzhong District of

Suzhou City, 426 fish farming families (252 professional and 174 non-professional) were directly affected when 22,521 mu (1501 ha) water areas were reclassified. The government provided RMB793.3 million (US$128 million) in total as compensation subsidies for those farmers who had suffered financial losses (Fisheries Supervision and Management Station, 2008), and some of them were compensated by resettling fish farms in other locations. However, the compensation system did not run smoothly, as the actual situation was very complicated, with some unsatisfactory outcomes, discussed in more detail in the fourth section below.

Eco-compensation between governments and industry

According to the Water Environment Comprehensive Management Plan for the Lake Tai Basin, there are some 2.10 million industries in the Comprehensive Treatment Region of the lake. Of this total, around 1.04 million are in Jiangsu province and 1.06 million in Zhejiang province; 0.56 million of these industries belong to the six major pollution industries (textile industry; manufacture of paper and paper products; petroleum processing industry; coking and nuclear fuel processing; manufacture of raw chemical materials and chemical products; manufacture of medicines and the manufacture of chemical fibres), which also contribute significantly to the economic development in the Lake Tai region.

To control the water pollution caused by its intensive polluting industries, Jiangsu provincial government has implemented an approach that evaluates the receiving capacity of the surface water in water environmental function zones, applies a scheme of pollutants loading cap control, and a scheme of the discharge credits paid-use (is only limited to chemical oxygen demand (COD) discharge so far). The Price Bureau of Jiangsu province set different charging standards for emission credits for different industries. Under the pollutants loading cap control system, the amount of the pollution discharge credits is limited, which means that once the government has allocated all the credits, new applicants cannot purchase any from the government, but can only either buy surplus credits from other dischargers via an emissions trading platform (see the third section) or improve their own pollution prevention facilities to save credits themselves. It is a so-called 'bubble policy', where polluters are free, within an imaginary bubble, to offset excess emissions from one source by a reduction made in another source, as long as the overall quantity is not exceeded (Kraemer, Kampa, & Interwies, 2004).

In the Lake Tai watershed, 1357 dischargers (annual emission > COD 100 tons) have been selected in the programme of discharge credits paid-use until 2010. The purchase amounts of COD achieved 49,700 tons per year during 2009–10, and the collected payments from discharge permits reached RMB175 million (US$28.2 million) (Li, Fan, Yan, & Gao, 2010). The revenue, which is managed as governmental non-tax revenue, allocates 10% to a provincial special fund for environmental protection, and 90% as local (Price Bureau, 2008). This special fund is used exclusively for environmental governance, the establishment of environmental monitoring, and the construction and maintenance of the emission credits trading platform in the Lake Tai watershed within Jiangsu jurisdiction.

Eco-compensation among industries

On the basis of the scheme of the discharge credits paid-use, the emissions trading system has been initiated in a few pilot cities in the Lake Tai watershed since 2008, but limited to COD emissions too. The governments of local cities set maximum limits on the total allowable emissions of COD, and then allocate these to the governments at county levels,

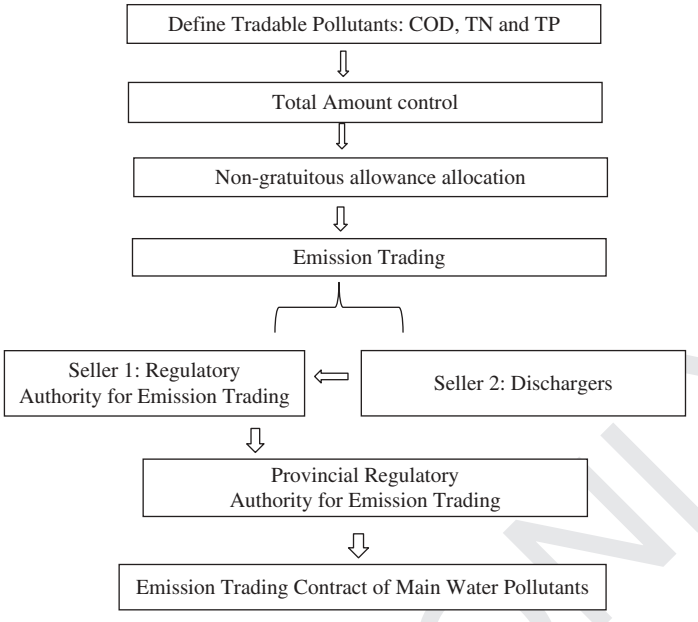

Figure 5. Process of emission trading in the Lake Tai watershed. Source: Interim measures of emission trading of main pollutants in Tai Lake Basin of Jiangsu province

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which allocate their credits to selected industrial dischargers for a specified period of time. After receiving a written notice from the local environmental protection bureau, the selected industrial dischargers can buy discharge credits from governments which are embodied in discharge permits. With these permits comes the right to use the environmental capacity resources and to buy or sell their discharge credits.

Emissions trading occurs only in one 'bubble' – in which the total maximum amount of pollutants is determined, which means that purchasing from out of the region is not allowed for the city or county whose total discharge pollutants have already exceeded the control targets, or where the receiving water body has failed to reach the required water quality standards. Trading can be initiated between the dischargers and the Regulatory Authority of Emissions Trading or among the dischargers themselves on a specified trading platform monitored by the Provincial Regulatory Authority (Figure 5).

Jiangyin City is one of the pilot cities for emissions trading in the Lake Tai watershed. In 2010, 158 dischargers (annual COD emission > 100 tons) discharged 6930.7 tons COD, and paid RMB18.7 million (US$3 million) for discharge permits. Among these 158 industrial dischargers, 68 received extra discharge credits by emission trading with a total turnover achieved of RMB6.7 million (US$1.2 million) (Li et al., 2010). As well as the collection from discharge credits paid-use, the revenue from the trading is used exclusively for environmental protection measures, the establishment of environmental monitoring facilities and the maintenance of the emission credit trading platform.

Legal issues arising from eco-compensation schemes in the Lake Tai case study

This section considers each of the four typologies of eco-compensation implemented in the Lake Tai case study.

In the first type of scheme (government to government), the upstream jurisdiction is required by law to compensate the losses of the downstream jurisdiction when the monitoring data show that the water quality is below the legally defined standards in the monitoring areas. But is this a true 'eco-compensation' scheme – in fact, from a legal perspective, this compensation is more akin to payments for illegal water pollution, a legal liability approach, not as compensation per se for ecosystem services.

The national Environmental Protection Law states that:

> Enterprises and institutions discharging pollutants in excess of the predetermined national or local discharge standards shall pay a fee for excessive discharge according to the state provisions and shall assume responsibility for eliminating and controlling the pollution.

Therefore, the 'designated discharge standards' are actually compulsory standards regulated by the law; polluters that discharge pollutants exceeding the standards should bear legal liability (Du & Chen, 2013). Given this reading, the compensation paid by the upstream city to the downstream city is not really eco-compensation. It neither provides rewards for protecting the environment and natural resources nor does it introduce pollution charges, i.e. water use fee or waste water discharge fee and thus cannot be considered to qualify as a true 'eco-compensation' mechanism.

Under this same line of reasoning, asking the downstream city to compensate the upstream city when the water quality does not exceed the standards also lacks legal support as a true ECM, because again the standards imposed are compulsory regulations – nobody should be compensated for merely abiding by the law.

One approach to transforming this approach into a true eco-compensation scheme would be to establish a 'negotiable water quality' (Du & Chen, 2013) instead of referring simply to the compulsory regulatory standards. By agreeing on a certain water quality (must be better than the compulsory quality) in monitored areas, the upstream and downstream cities may voluntarily agree to an eco-compensation contract: if the recorded results in the monitoring areas are above the contractual water quality, the party who puts efforts into making this should be compensated by the other one. Through such means, supplementing and building upon the existing regulatory requirements, a more holistic and functional eco-compensatory scheme can be formulated and implemented.

For this type of voluntary eco-compensation to work in practice, however, more scientific and legal research is needed in order to address a broad range of complex issues, such as monetizing the target ecosystem services, governance mechanisms for stakeholder involvement, adequate legal frameworks, as just some of the most pertinent examples.

In the case study examining the farmer compensation schemes, the governments compensate the farmers for changing their water-use practices, which is aimed at improved water quality. The eco-compensation relationship seems to be comparatively clear – the ecosystem service buyers are the Jiangsu provincial government, the Suzhou City government and the related district/county governments, and the ecosystem service providers are the fish farmers. The compensation payments include compensation through direct cash payments and fish farm resettlement.

However, these schemes have proved to be problematic in practice, with apparent divergent approaches for professional and non-professional farmers. While the former category is permitted to select their type of compensation – either cash compensation or resettlement, non-local fish farmers and non-professional fish farmers have only one choice – direct cash payments. Thus, this category of farmers is required to give up their

primary livelihoods. This unequal treatment led to protests by some non-local farmers, who challenged this discriminatory approach by the governments. Another shortcoming of this scheme is the fact that the city government dominated the entire compensation process, with a marked absence of market party participation, with no third-party evaluations and assessments. This resulted in some poor decision-making, i.e. many of the newly resettled areas were not suitable for aquaculture (Han, 2010). This situation meant that farmers had limited options because signing the contract was a precondition for the new farm resettlement, with the new aquaculture zones already planned by government, making the cost of reorganization too high in many respects. Given this reality, the compensation for resettlement made no sense at all for those farmers whose newly allocated farms produced substantially lower yields; it was made even worse in light of the fact that they had given up the option of cash compensation. This has given rise to new social conflicts, although water pollution has been improved to a certain extent.

Another issue relates to the compensation criteria that is used. For example, in the forest rehabilitation project in Lake Tai region, 68.18% of farmers interviewed were not satisfied with the government compensation because the farmland was productive as the irrigation was sufficient and the soil was fertile. Before rehabilitation farmers could get RMB13,890/hm^2 (US$2240/hm^2) income per year by growing ordinary vegetables, but after rehabilitation they could only get RMB6000–9000/hm^2 (US$968–1452/hm^2) from the government as compensation (Luo et al., 2011). This is not a minor loss for a farmer whose per capita disposable income is RMB38,459 (US$6203) in 2012 (National Bureau of Statistics, 2014). If rational decision-makers are assumed to be participants, they would be unlikely to accept a payment unless it exceeds the sum of the opportunity costs they face (Wunder, Engel, & Pagiola, 2008). In light of all this, it seems that the 'win–win' objective set forth in the regulations has not been achieved.

In the third and fourth typologies, the eco-compensation between the government and industry and among the industries, these have succeeded in making considerable contributions to various environmental protection funds. The scheme of discharge paid-use works appears to work quite efficiently. Nonetheless, it must be noted that this system is actually different from the scheme of national pollution discharge fees. Under the scheme of discharge paid-use, governments set pollutants loading cap for a 'bubble' and allocate discharge credits. Dischargers buy credits guided by the principle of the 'user pays'; it reflects the dischargers' right to use natural resources. Under the latter scheme of national pollution discharge fees, dischargers pay fees whether they discharge pollutants into the water in excess of discharge standards or not. The difference from the former scheme is that instead of governments setting pollutants loading cap and allocating discharge credits, dischargers in the latter scheme report to and register with the local governments about the variety, quantity and density of discharged pollutants and wait for the governments' approval. Dischargers pay fees based on the principle of the 'polluter pays'; it reflects the dischargers' liability for using the natural resources.

Under the former scheme of discharge paid-use, dischargers are more motivated than under the scheme of national pollution discharge fees, as once they save discharge credits, they can keep them for the following year or sell them on the market. Dischargers themselves are the main pollution control bodies; governments only design and control the 'bubble'. Under the scheme of national pollution discharge fees, dischargers normally do not have enough motivation to reduce emissions if their discharges do not exceed the discharge standards approved by the governments. Governments are the main pollution control bodies. It is less cost-efficient than under the former scheme.

Although dischargers who have legally purchased the emission credits still have to undertake the legal responsibility of pollution control, but the two different charges should not be repetitively collected, i.e. who buys the discharge credits should not pay pollution discharge fees. However, in practice there are no published legal guidelines to address this problem, leaving it unclear how the governments have managed this in practice.

In the scheme of discharge paid-use, the governments play the role of ecosystem service providers for the purpose of maintaining a healthy water ecosystem and ensuring that the ecosystem can provide continuous eco-services, they set the pollutants loading cap for a 'bubble', monetize the pollutants and allocate the discharge credits. The selected dischargers are service buyers. In the COD emission trading system, those selected dischargers become service providers, who save discharge credits and provide certain ecosystem services by improving their pollution prevention facilities or inputting some other efforts, those who buy credits from other dischargers are service buyers.

As new and experimental instruments, both the scheme of discharge paid-use and emissions trading have some shortcomings. For example, it is uncertain how the provincial governments adjust their pollutant discharge targets and how they allocate or set prices for the emissions in the next five years, while central government adjusts national pollutant targets every 5 years. This lack of transparency leads to considerable uncertainties for the key actors in these schemes; as a result industrial dischargers face considerable risks in making decisions such as whether or not to buy the discharge credits, or how many to buy. In addition, the current emissions trading in the Lake Tai watershed within Jiangsu province is limited to COD emissions only; while the prices for TN and TP emissions trading were announced in 2011, there is not yet a specific legal regulation covering these. Furthermore, it is also very difficult to evaluate the environmental benefits from the emissions trading alone as it is generally applied together with many other policy instruments. According to research, tradable discharge permits are actually among the most challenging regulatory policies in terms of both their design and implementation (Kraemer et al., 2004).

In summary, the case study undertaken here reveals that four types of ECMs have been deployed across the Lake Tai region (Table 1). The common feature in each case is the dominant role played by governments (especially in the first three types). The main financial source for compensation is governmental payment. For example, at the time of the algal bloom in 2007, Jiangsu was spending RMB2 billion (US$322 million) per year to address Lake Tai's pollution problems (Liang & He, 2012). Since 2008, Jiangsu provincial government has contributed RMB0.2 billion (US$32 million) per year to a special fund to control water pollution in Lake Tai, with local governments asked to contribute 10–20% (He, 2014). Governments are the main actors in formulating and implementing eco-compensation schemes. Although commercial actors also contribute to the fund (e.g. the revenue of COD trading), this amount is insignificant when compared with the level of governmental payments. The single financial source from government might weaken the expectations of the eco-compensation projects. An example is the 'Three-North' Shelterbelt Project (see Appendix 2).

Conclusions

Well-functioning ecosystems provide human beings with a broad range of important services, many fundamental to sustainable development. Effective eco-compensation schemes can contribute to the preservation of ecosystem services and lead to more sustainable development both within and outside China, the subject of this study.

AQ17 Table 1. Types of Eco-compensation mechanisms (ECMs) in the Lake Tai region within Jiangsu province.

Types	Water problems	Water-related eco-services	Providers	Buyers	Payment	Laws/regulations[a]
ECM between governments[b]	Pollution, disputes	Provision of higher water quality than compulsory standards	Upstream city/ downstream city	Downstream city/ upstream city	Cash, others	None
ECM between governments and farmers	Pollution	Improved water quality	Farmers	Governments	Cash, farm resettlement	Opinions of Energy Conservation and Emission Reduction in Jiangsu Province, No. 63 (2007) Regulation on the Administration of the Lake Tai Basin, State Council, No. 604 (2011)
ECM between governments and industry	pollution	Pollution control in certain cap	Governments	Industries	Cash	Implementing measures for:Main Pollutants Discharge and Emission Trading in Pilots of Lake Tai Watershed in Jiangsu Province, No. 8 (2008) Administration for Charges for Credits of Main Pollutants Discharge in the Lake Tai Watershed of Jiangsu Province (Trial Implementation), (2008)Regulation of Jiangsu Province on Prevention and Control of Water Pollution in the Lake Tai region, No. 113 (2012)
ECM among industries	Pollution	Improved water quality[c]	Industries	Industries	Cash	Implementing Measures for Main Pollutants Discharge and Emission Trading in Pilots of the Lake Tai Watershed region in Jiangsu Province, No. 8 (2008) Interim Measures for Main Pollutants Emission Trading in the Lake Tai Watershed of Jiangsu Province, No. 4 (2010)

Through examining the four types of eco-compensation schemes applied across the Lake Tai watershed, a number of observations can be made.

Eco-compensation schemes in Lake Tai watersheds are dominated primarily by governments through primarily governmental-sourced financial transfers. Although market-based eco-compensation, e.g. the emissions trading of COD, has been experimented with, it is still at a very early stage and needs to be further developed. The single source of governmental financial transfers might lead to a risk of a fund shortage in the future. A shortfall could, in turn, weaken the sustainability of the mechanism itself revealing a critical overall risk.

Constructing effective ECMs in watersheds is a long-term project requiring multidisciplinary expertise. As has been discussed here, designing a robust legal framework capable of anchoring true eco-compensation schemes (as opposed to pollution liability regimes) requires careful consideration of a range of issues, focusing only on the mechanism itself is far from sufficient. Attention must also be paid to the preconditions in each case, such as: water management system details; the public's willingness to participate; and the collaboration between or among provinces and regions and such other conditionalities that might support or impede the mechanism. Even across the legal domain, eco-compensation schemes cross a complex matrix of legal regimes – a multidimensional construct of rules, laws and regulations, including (but not limited to!) administrative, corporate, contractual, public, private, regulatory and trade matters (Wouters, 2007).

Despite these challenges, the eco-compensation schemes being implemented in China provide a meaningful platform for addressing the complex issues related to eco-system services. More legal research is required to address the gaps identified in current domestic practice.

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Appendix 1: Development of the eco-compensation mechanism (ECM) in China.

Year	Date	Congresses	Recommendations
Political speeches			
2005	8 December	5th Session of the Sixteenth Central Committee of the CPC	Recommends that ECMs should be established soon, based on the principle of developer protects, and beneficiary compensates
2006	5 March	Central Government 2006 Work Report	Comprehensively mobilizes all means available, and in particular economic instruments, such as pricing and taxation, to promote the rational and sparing use of natural resources and to develop an ECM as soon as possible
2007	5 March	Central Government 2007 Work Report	Calls for a reform of important natural resources prices and pollutant charges and an acceleration in the development of the ECM
	15 December	17th National Congress of the CPC	Establishes and improves the resource use paid system and ECMs
2008	5 March	Central Government 2008 Work Report	Reforms the natural resources tax and fees system, and improves the system of paid natural resource use and of ECMs
2009	5 March	Central Government 2009 Work Report	Accelerates the establishment of sound ECMs, and reforms and improves the natural resource tax system
2010	5 March	Central Government 2010 Work Report	Accelerates important watersheds management
2011	5 March	Central Government 2011 Work Report	Improves water conservation facilities; makes progress in better controlling important tributaries of large rivers as well as lakes and small and medium-sized rivers
2012	5 March	Central Government 2012 Work Report	Establishes a sound system of compensation for ecological damage, strengthens ecological protection and restoration and strictly protects river sources, wetlands, lakes, and other priority functional ecological zones

(Continued)

Appendix 1: (Continued).

Year	Date	Documents	
Policies			
2005	3 December	State Council Decision Regarding Implementing the Scientific Development View to Strengthen Environmental Protection. National Issue [2005] No. 39	Calls for the improvement of eco-compensation policies and the establishment of an ECM; recommends the consideration of eco-compensation factors in central and provincial fiscal transfer payment systems
2006	14 March	Outline of the 11th Five-Year Plan	Calls for policy-makers to innovate in environmental policy, establishment of ECMs (especially intraregional and watershed-related ECMs) based on the principle of 'who develops protects, who benefits subsidizes'
	19 March	State Council 2006 Work Outline. National Issue [2006] No. 12	Develops ECMs, and gradually resolves and improves the evolving mechanisms for pricing natural resources and primary commodities
2007	24 August	Guiding Opinions on the Development of Eco-compensation Pilot Work. Ministry of Environmental Protection (MEP) Issue [2007] No. 130	Basic principles of eco-compensation: those who develop and exploit resources should also protect the environment; those who benefit from it should subsidize it; and who pollutes should pay; recommends carrying out eco-compensation pilot projects preferentially within four areas: natural protection areas, key ecological areas, mining resource areas and watersheds.
	22 November	The National 11th Five-Year Plan for Environmental Protection (2006–2010). National Issue [2007] No. 37	Proposes a target responsibility system for watershed pollution control and a water quality examination system for trans-province boundary waters, and speeds up the establishment of ECMs
2008	29 March	State Council 2008 Work Outline. National Issue [2008] No. 15	Improves the paid natural resource use system and ECM
	22 July	Views Regarding Work on Deepening Economic Structural Reforms for 2008. General Office of the State Council Issue [2008] No. 103	Reforms the system for distributing the benefits of natural resources; establishes a system for natural resource compensation for underdeveloped areas; and promotes the establishment of pilot projects for inter-provincial watershed eco-compensation

(*Continued*)

Appendix 1: (Continued).

Year	Date	Documents	
2011	16 March	Outline of the 12th Five-Year Plan	Improves the system of equalization transfer for key ecological function areas; sets up a special fund for national eco-compensation; promotes a reverse system for the sustainable development of resource-oriented enterprises; encourages, guides and explores an ECM whereby downstream areas compensate upstream areas, development areas compensate protection areas and ecological beneficiary areas compensate ecological protection areas; explores a market-based ECM; and speeds up the formulation and implementation of an Eco-compensation Regulation
2011/12	15 December	The National 12th Five-Year Plan for Environmental Protection (2011–2015). National Issue [2011] No. 42	Accelerates the research on, the formulation and implementation of the Eco-compensation Regulation; establishes an ECM for watersheds and important ecological function zones
	12 January	Opinions of the State Council on Applying the Strictest Water Resources Control System. National Issue [2012] No. 3	Conserves and restores the ecological system; conducts health assessment for national key rivers and lakes; establishes and improves eco-compensation mechanisms for water ecology

(Continued)

Appendix 1: (Continued).

Year	Authorities	Name	
Laws and regulations			
Adopted in 1984, revised in 2008	Standing Committee of the National People's Congress	Water Pollution Prevention and Control Law	Article 7: the state sets up an ECM, with a public financial transfer, to protect the drinking water source areas and headwaters of rivers, lakes, and reservoirs
Adopted in 1991, revised in 2010	Standing Committee of the National People's Congress	Water and Soil Conservation Law	Article 31: the state strengthens the prevention and treatment of soil erosion in river source areas, drinking water source protection zones and headwaters; raises funds through different channels; eco-benefits compensation for water and soil conservation into state ECM
Drafting		Eco-compensation Regulation	

Appendix 2: 'Three-North' Shelterbelt Project

The 'Three-North' Shelterbelt Project is the biggest eco-compensation/PES project in the world, with a total plan area of 6103 billion mu (406.9 million ha), some 42% of China's total land area (Bennett, 2009). The project runs from 1978 to 2050 and aims to control desertification in northern China. The funds for compensating farmers who return farmland to forest rely mainly on state financial transfers. During the past 30 years the 'Three-North' project has demonstrated certain ecosystem benefits, like farmland protection, soil and water conservation, wind reduction and sand dune fixation (Li, 2012). However, the project is now in a difficult stage as the compensation fund is not sufficient. Since the implementation of the project in 1978, the state has not increased the compensation rate while overall living expenses are continually increasing. The cost of afforestation is RMB250–310 (US$30–38)/mu (0.07 ha), but the subsidy from the state is only 2–4% of the actual cost. For example, the Inner-Mongolia Autonomous Region during the past few decades has invested at least RMB2250/ha (US$363/ha) to control the soil desertification of around 2298 ha; by comparison, the state has only invested less than RMB150/ha (US$24/ha), 15 times less than the actual cost (Li, Ding, & Zhao, 2010). In this case, it is very difficult or unfeasible to ask for more local government investment as those provinces/autonomous regions are comparatively underdeveloped.

In the field of eco-compensation for watersheds, the same problem exists, as many water function zones and water sources are located in the west of China. Many of them are relatively underdeveloped, therefore relying on large-scale local government investments is almost impractical. It is essential to promote further research on other types of eco-compensation, e.g. market-based compensation, as governmental compensation alone is never be enough in the long run.

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