CHAPTER 8

Environmental Policies and Water Resource Management

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8.1 Introduction

Due to the rapid economic growth since the transition to a market economy, China has been facing diverse and serious environmental problems, including water, air, and soil pollution and the destruction of the ecosystem. In particular, water is not only a key driver of economic and social development but also an essential element of the natural environment. In China, with the world's largest population, water is a scarce resource as the rapid industrialization and urbanization have put heavy pressure on both the quantity and quality of water, resulting in serious water shortages, as symbolized by the Yellow River cutoff in the 1990s, as well as severe contamination. To achieve sustainable economic growth amid resource constraints, China must improve water quality control to

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increase the amount of available water while improving the water productivity per unit, which is far below that of developed countries, through water conservation and the appropriate allocation of resources among sectors.

Since the first United Nations Conference on the Human Environment in 1972, China has been actively incorporating the environmental policy measures of developed countries. In particular, China learned much from the Japanese experience in shaping its environmental policies through Official Development Assistance (ODA) schemes and academic exchanges.[1] China has selected useful policy tools based on the Japanese experience and has adopted them with considerable modifications to suit China's actual situation, including its socialist political system.

This chapter presents the achievements of China's water environmental policy and resource management as well as its long-term challenges and prospects with comparisons to Japan, which experienced severe pollution incidents, such as Minamata disease, during its period of rapid economic growth. Both countries belong to the Asian monsoon climate zone and share many common challenges related to water, such as water scarcity due to a dense population, a long history of agricultural irrigation, and a rapid economic development that is rare in world history. Of those common environmental policy issues for Japan and China, the author focuses on two topics: the cost sharing of water pollution control and the sectorial coordination of water rights among stakeholders.

The content of the rest of this chapter is as follows. It first briefly reviews the evolution of water environmental policies in both countries to show that they have been shifting from ex post facto regulations adopted after an incident has occurred to Integrated Water Resource Management (IWRM) toward more sustainable and integrated watershed management. It then examines three examples of water environment policies during Japan's and China's periods of rapid economic growth: the emission surcharge system based on the Polluter-Pays Principle (PPP), inter-sectoral water rights transfer, and Participatory Irrigation Management (PIM) at the rural community level. Finally, policy implications from the case studies and the future prospects for the post-economic growth and population decline phases in China and Japan are discussed.

8.2 Research Background

8.2.1 Water Environmental Problem in China

China faces water environmental problems in two aspects: quantity and quality control. First, water is an extremely scarce resource in China. The amount of water resources per capita is about 2000 m^3, which is only a quarter of the world average (FAO, *Aquastat*). Although China basically belongs to the continental monsoon climate zone, there are regions with diverse natural conditions coexisting within the country, ranging from the cold and dry northwestern interior to the warm and humid eastern coastal regions. There are more than 150 rivers with a basin area of more than 1,000 km^2, but the distribution of water volume is concentrated in the southern part of the country. Moreover, there is a large seasonal fluctuation. The demand for water also varies depending on the level of economic and social development in each region.

Figure 8.1 shows the composition of annual freshwater withdrawals by sector since 1982 in China and Japan. Water stress, which indicates the percentage of water resources used for economic activities, or the degree of water scarcity, is also shown. In China in 1982, the agricultural sector accounted for 87.6% of total water withdrawals. In 2017, it had shrunk to 64.4% due to changes in the industrial structure and urbanization. Instead, the industrial and domestic sectors have grown significantly, accounting for 22.3% and 13.3% of the total in 2017, respectively. Water stress increased from 33.6% to 43.2% over the same period, but has remained mostly high since 2012, indicating that utilization efficiency is improving due to recycling and other factors. Rapid industrialization from the 1980s to the 1990s, which caused the cutoff of the Yellow River, posed challenges to the proper allocation of resources among industrial sectors and between upstream and downstream of watershed.

In Japan, due to data limitations, the figure only shows the data in the post-high economic growth period. The agricultural sector remained stable at just under 70%, while the industrial sector declined from 18.5% to 14.3% due to improved use efficiency and lower demand. The domestic sector increased from 16.1% to 18.9% due to urbanization but has been on a slight downward trend since the 2000s, when the population entered a phase of aging and decline. Water stress also exceeded 40% in the 1990s but has since declined to 36.5% in 2017.

As for water quality, Fig. 8.2 shows the mainstream water quality by grade in seven major river basins in 2020. There are six categories of

water quality in China, ranging from Grade I to inferior V (shown as V* in the figure).[2] I to III are water that is suitable for domestic drinking, IV is for industrial use, V is for agricultural use, and V* is heavily polluted water that cannot be used for any purpose. While most of the rivers meet the criteria for water quality above III, the water quality of Songhuajiang, Liaohe, and Haihe is relatively poor, with the percentage of grade IV in the Liaohe accounting for 78.6% and grade V in the Haihe accounting for 50%.

Figure 8.3 shows the change in the ratio of water under Grade V in the mainstream of seven major rivers in China since 1991. As an overall trend, the water quality of the Pearl River and the Yangtze River, located in the southern part of the country where precipitation is abundant, is better than that of rivers in the northern part, and the ratio of water quality below Grade V remains at a low level. From the graph, it can be observed that the pollution of the rivers in the north was quite severe during the 1990s and 2000s. The percentage of pollution below Grade V reached nearly 80% in the Liaohe and Haihe and around 60% in the Yellow River and Huaihe. From the 2010s onward, the percentage declined, but the Liaohe remains the only river that has not improved. Note that only the water quality of the mainstream of each river is shown here; the pollution is more serious in the entire watershed, including tributaries.

There are many reports on the health hazards and ecological damage caused by the deterioration of water quality due to industrial and domestic wastewater in China. For example, the discussion of the water crisis in the heavily polluted Huaihe in Economy (2010) attracted worldwide attention.

Finally, let us compare China's water productivity with that of Japan and other developed countries. Table 8.1 shows the change in GDP per cubic meter of water since 1982. While China's productivity has increased significantly from 0.8 USD in 1982 to 17.2 USD in 2017, Japan's has doubled from 36.6 USD to 75.7 USD, and the average for high-income countries has increased from 22.2 USD to 57.6 USD in the same period, indicating that there is still a large difference from developed countries.

8.2.2 Environmental Policy in Rapid Economic Growth Era

8.2.2.1 Japan

The history of Japan's postwar environmental policy can be divided into four major phases (Kojima et al., eds. 1995; Japan Society on Water

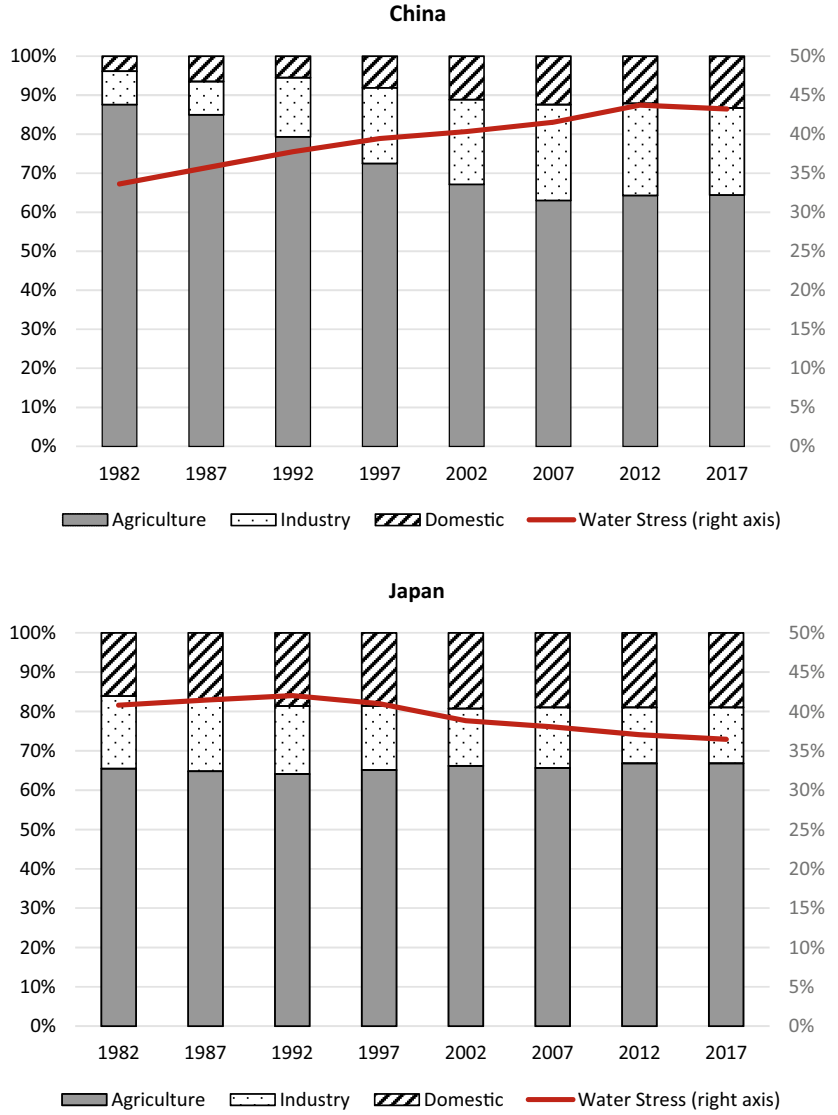

Fig. 8.1 Freshwater withdrawals by sector in China and Japan (Unit: %) (*Note* Data show the share of freshwater withdrawal in each sector. "Water Stress" is the ratio between total freshwater withdrawn by all major sectors and total renewable freshwater resources after taking into account environmental water requirements. *Source* The World Bank, FAO *Aquastat*

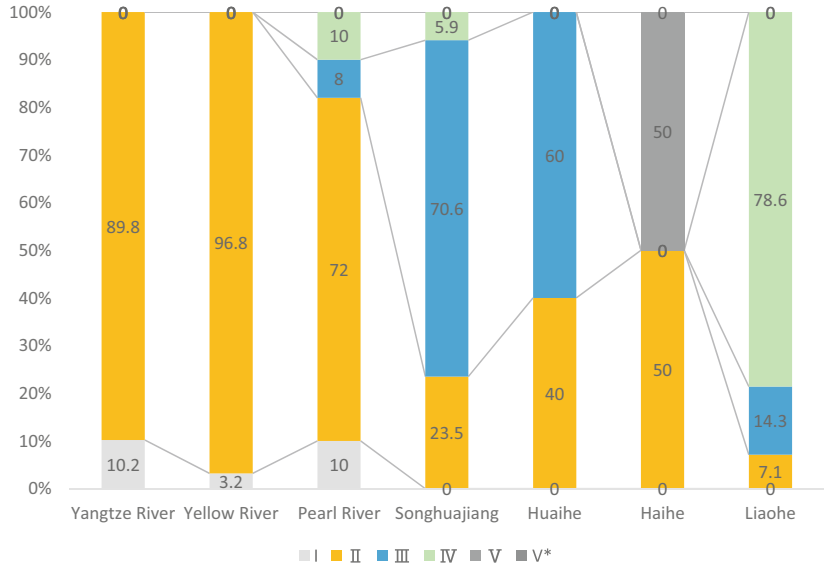

Fig. 8.2 Water quality in China's seven major rivers in 2020 (Unit: %) (*Note* The data reflect water quality of mainstreams. *Source* Ministry of Ecology and Environment, *Report on the State of the Ecology and Environment in China 2019*)

Environment eds. 2009). The first phase (1945–1963) was a period of postwar reconstruction when pollution problems became more serious and diseases, such as Minamata disease and Ouch-ouch disease, occurred in many areas due to factory wastewater containing heavy metals. The Water Quality Protection Act and the Factory Wastewater Regulation Act, or collectively referred to as "Old Two Law Concerning Water Quality Control," were enacted in 1958 in response to health hazards and damage to fisheries and were epoch making in that they regulated wastewater discharges into public waters for the first time; however, the law's effectiveness in preventing water pollution was limited, partly because it was an ex post facto type of law that allowed water quality standards to be set only after pollution had occurred.

In the second phase (1964–1974), environmental policy was formed and developed. The Basic Act for Environmental Pollution Control (BAEPC) was enacted in 1967 as a result of the residents' movements against pollution, the subsequent pollution trials, and the efforts of

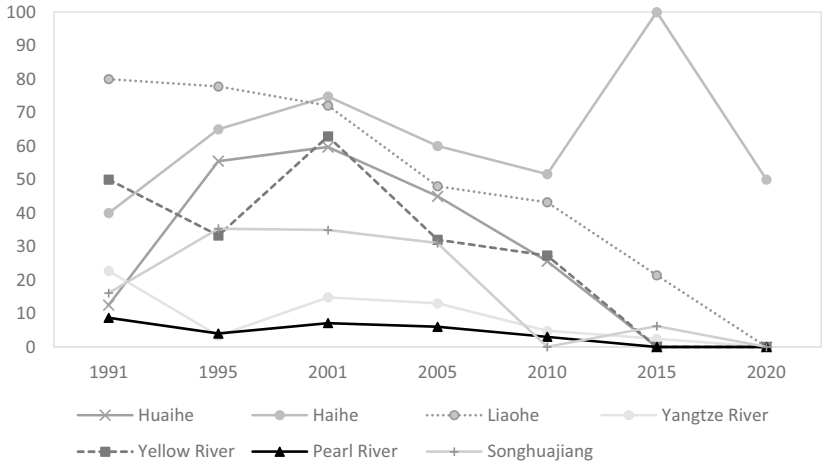

Fig. 8.3 The Ratio of Water under Grade V in Seven Major Rivers in China (1991–2019) (Unit: %) (*Note* The data show the total ratio of Grade V and V* in the mainstream. *Source* Data of 1991 and 1995 come from Wang (2005) in which only the data of Yangtze River, Yellow River, Songhuajiang, and Liaohe reflect the water quality of the mainstream. The rest were drawn from Ministry of Ecology and Environment, *Report on the State of the Ecology and Environment in China*, various years)

Table 8.1 Water productivity in China, Japan, and high-income countries (GDP per cubic meter, USD)

	1982	*1987*	*1992*	*1997*	*2002*	*2007*	*2012*	*2017*
China	0.8	1.4	2.0	3.3	4.8	8.1	12.0	17.2
Japan	36.6	44.4	53.7	59.2	63.7	70.7	71.1	75.7
High income countries	22.2	27.3	32.0	35.8	40.5	48.5	52.2	57.6

Note GDP per cubic meter of total freshwater withdrawal calculated with a constant 2010 USD price
Source The World Bank

progressive local governments. At the so-called Pollution Diet held at the end of 1970, 14 pollution-related laws were enacted, including the revision of the BAEPC. The following year, the Environment Agency was established to centralize environmental administration. The Water Pollution Prevention Act enacted in 1970 by the Pollution Diet aimed

to achieve the environmental standards set under the BAEPC. This set environmental standards for public waters as administrative targets and penalties were applied for violations. Monitoring of water quality in public waters was also initiated, and to protect the quality of closed waters, such as lakes and inland seas, regulations on total load were introduced in addition to concentration regulations for wastewater. Of particular note is the Act on Compensation for Pollution-Related Health Damage (ACPHD) enacted in 1973. This established a policy system centered on pollution control and relief for pollution victims based on the PPP, which was highly regarded in international society.

However, even with these brilliant achievements, Japan's environmental policy was forced into recession by the global depression following the first oil crisis in 1973. In the third phase (1975–1992), as Japanese society increasingly prioritizes economic development over environmental conservation, environmental policies have come under increasing pressure from industries. Consequently, in the late 1970s, environmental standards for atmospheric nitrogen oxides were significantly relaxed, and in 1987, the law was amended to revise the ACPHD, resulting in a major setback in relief measures for victims.

The fourth phase, which was after the Basic Environment Law was enacted in 1993, included increased interest in global environmental issues. Domestically, the pollution movement has subsided, and the aim shifted to building a recycling-oriented society and nature conservation for an era of low growth and a declining population.

In the international discussion, environmental policy is defined as a public policy aimed at environmental conservation, and it refers to a comprehensive system consisting of pollution control, nature conservation, and amenity improvement (Teranishi, 1995). In general, developed countries are actively using not only regulatory and technical instruments in their environmental policies but also economic instruments, such as emission surcharges and environmental taxes, and institutional instruments, such as cross-compliance, where compliance with environmental regulations is a requirement for obtaining subsidies. In contrast, due to socioeconomic reasons, such as bureaucratic political systems, environmental policies in Japan have been criticized for giving priority to industries and being biased toward technological and regulatory measure.[3]

Nevertheless, it is gradually working toward a comprehensive environmental policy. Specifically, the enactment of the Basic Law on the Water

Cycle in 2014, which aimed at the maintenance or restoration of the sound water cycle as well as the healthy development of the economic society and the stability and improvement of people's lives, is a step forward toward IWRM (Ono, 2015).

8.2.2.2 China

Even before the transition to a market economy, serious pollution incidents occurred in the 1970s, but information disclosure was inadequate, and measures taken were extremely limited. The participation in the United Nations Conference on the Human Environment in 1972 provided the impetus for China's environmental policy. In the following year, 1973, China held its first national environmental protection conference.

China's environmental policy was fully developed in the 1980s and 1990s, when environmental problems became more serious. For water-related issues, State Environmental Protection Administration (SEPA) and the Ministry of Water Resources (MWR) were responsible for water quality conservation and quantitative water resource management, respectively. SEPA, established in 1998, was ungraded to the Ministry of Environmental Protection in 2008 and further reorganized into the Ministry of Ecology and Environment (MEE) in 2018.

First, let us examine the policies related to water quality protection. Since the late 1970s, in response to the pollution caused by state-owned enterprises and township and village enterprises, the Environmental Protection Law (tried in 1979 and implemented in 1989) and the Law on Prevention and Control of Water (enacted in 1984 and revised in 1996) were enacted. The Three-Simultaneous Systems and the Pollution-Discharge Fee System (PFS), enacted under the above two laws, characterized the PPP in Chinese style. The Three-Simultaneous System requires that the design, construction, and operation of pollution control equipment must be carried out simultaneously with the construction of the main body of a factory or other facility. In addition to total load control for key pollutants, the PFS allows provincial governments to set additional standards and to collect pollution fees from violator; however, in practice, the effect was limited due to poor implementation.

Next, regarding quantitative control, the cornerstone of water resources policy is the Water Law, which was enacted in 1988 and revised in 2002. The Water Law regulates the recharge, development, and use of water resources (basin planning, flood control), coordination of water

rights among sectors (water withdrawal permits, paid transactions), and the establishment of water for ecological and environmental use. In the 1990s, frequent cutoffs in the Yellow River and floods in the Yangtze River created the need to integrate water use and conservation administration, which had previously been fragmented by province and by department. Basin committees were established for some major rivers, and basin-based water management began.

Under the amended Environmental Protection Law of 2002, MWR enacted the Water Function Zoning Management Measure in 2003, which zoned major watersheds by use. In response, SEPA has established the Water Environmental Function Zoning Plan from the perspective of preserving the ecosystem. It is expected that these two concepts will function like two wheels on a car in watershed management from the different perspectives of water resource utilization and environmental conservation (Kataoka, 2008).

Recent changes in Chinese water policy took place partly due to the influence of IWRM, which has been gaining recognition in the international community as a concept for equitable and sustainable development. IWRM is a concept that includes not only targeting the quantitative and qualitative control of water but also the integrated management of rivers, lakes, and groundwater bodies at the watershed level. Under the concept of IWRM, China's water resources management is also changing from a conventional, fragmented scheme to a more integrated one based on basin-based water use planning and zoning by use while taking environmental capacity into account.

Furthermore, under China's hierarchical political system, patron–client relationships between governments at each level through performance appraisals and personnel systems have a profound influence on environmental governance. To strengthen the enforcement capacity, the achievement of environmental targets was added to the key criteria for the promotion of local officials set by the central government (one-vote veto) in 2006. The policy enforcement, which has been the biggest difficulty, is expected to be strengthened by the revised Environmental Protection Law in 2015. The main revisions include strengthening the responsibility of local governments for environmental goals, increasing their authority to punish pollution-emitting enterprises, and establishing a system for the disclosure of environment-related data and reporting by residents (Kitagawa, 2018a, 2018b).[4] The "river chief system" was introduced in 2016,

for which each level of officials is responsible for the conservation of whole watersheds of each level.

IWRM aims to shift from top-down management by governments and technocrats to decentralized watershed governance with broad stakeholder participation, including governments, businesses, local communities, media, and NGOs, viewing the entire watershed as a common. In recent years, although policy enforcement has been strengthened dramatically by making environmental policy goals directly linked to bureaucratic personnel evaluations and more rigorously at achieving them, public participation in environmental policy seems to be limited.

8.3 Case Study

8.3.1 Qualitative Control

The Polluter-Pays Principle (PPP) is a widely recognized economic principle for allocating the costs of pollution control adopted by OECD in 1972. Although PPP essentially means that those who produce pollution should bear all costs of damage to human health or the environment incurred, the interpretation of costs to be borne slightly varies from country to country. In the theory of environmental economics, when the costs incurred by environmental pollution are not imposed on polluters, their costs are externalized to society by so-called "market failure." Thus, such social costs, which otherwise would be borne by an economic agent other than the polluter, should be charged to the polluter to "internalize" the cost. According to the definition of OECD, the polluter should bear the expenses of pollution prevention and control measures decided by public authorities "to ensure that the environment is in an acceptable state." Initially, the PPP covered costs of pollution prevention and control, costs of monitoring, and other administrative measures, and later, costs of damage to pay compensation to victims were added through the expansion of the concept (OECD, 1992).

While the OECD conceived of the PPP as a market mechanism to resolve externalities caused by pollution, Japan created its own PPP philosophy to realize social justice and fairness through its experience with pollution problems. Japan's PPP was developed in the late 1960s, prior to OECD, covering a wider range of costs, including stock pollution costs or restoration costs for accumulated pollution in addition to the OECD definition. The Act on Entrepreneurs' Bearing of the Cost of

Public Pollution Control Works, enacted in 1970 under the Basic Act for Environmental Pollution Control (1967), stipulates that business operators bear all or part of the costs of pollution prevention and restoration of stock pollution to its original state. It was succeeded by a subsequent law, the Basic Environmental Law (1993). The payments for stock contamination were considered a unique system in Japan but were also referenced in the U.S. Superfund Law enacted in 1980 regarding cleanup costs for contaminated soil.[5] For compensation for victims, ACPHD was enacted in 1973.

Kin (2016) attempts to compare the Chinese PPP with those of OECD and Japan (Table 8.2). In China, the Three-Simultaneous Systems and PFS basically cover the costs for pollution prevention and control under the PPP, although there are difficulties related to enforcement. The cost for the restoration of stock pollution is partly covered by the Time-Limited Pollution Control Measures attempted by the Ministry of Environment in 2009, which enforced mandatory removal of contaminants, shutdowns, and plant closures of enterprises causing severe pollution within a specific time frame. At present, health damage compensation and other relief costs are not covered by the polluter in China.

China's PPP shares similarities with those of the OECD and Japan in that they require polluters to bear the costs; however, the difference between China and the others is that the biggest polluters during the period of environmental legislation were state-owned enterprises. Therefore, in effect, the state finances bore the cost of environmental measures, and the administration cost was financed by incorporating environmental measures into the business plans of state-owned enterprises (Kin, 2016, 68), which is totally different from the PPP in other countries that aim to increase the incentives of private enterprises or individuals for environmental protection and to promote technological innovation in the market economy.

8.3.2 Quantitative Control

8.3.2.1 Water Right Transfer Among Sectors

In Japan and China, both of which have a long history of agricultural irrigation, the pre-modern water use order was primarily shaped by the agricultural sector. As economic development and urbanization led to a rapid increase in water demand in the non-agricultural sector, it became necessary to save less productive agricultural water and to redistribute the

Table 8.2 Comparison of PPP cost coverage in Japan, OECD, and China

Type of cost	*Pollution prevention and control*	*Compensation for pollution victims*	*Restoration of stock pollution*
Japan	The Basic Act for Environmental Pollution Control (1967), the Basic Environmental Law (1993)	The Act on Compensation for Pollution-Related Health Damage (1973)	The Act on Entrepreneurs' Bearing of the Cost of Public Pollution Control Works (1970)
OECD	Yes	Partly	U.S. Superfund Law (1980)
China	The Three-Simultaneous Systems, the Pollution-discharge Fee System under the Environmental Protection Law (1989), and the Law on Prevention and Control of Water (1984, revised in 1996)	None	Partly covered by Time-limited Pollution Control Measures (2009)

Source Prepared by the author with reference to Kin (2016, 67)

surplus to more economically valuable sectors. This section first discusses water rights transactions among industries at a river basin level (Yamada, 2005).[6]

The past Japanese policy presumably referred to in China is the Agricultural Water Rationalization Project (AWRP), for which water use was diverted from agricultural water to urban water in the suburbs of metropolitan Tokyo and other large cities after the 1970s. The aim of the project was to divert a portion of agricultural water use rights to urban use by rehabilitating irrigation facilities that have become difficult to operate and maintain due to the decline in the rural population. In exchange for bearing a portion of the renovation costs, the urban side received a reallocation of water rights.

The reasons that this project was implemented in the 1970s, when the high economic growth period had already passed, are as follows. In Japan, the demand for urban and industrial water, which increased significantly during the 1950s and the 1960s, was procured not by redistribution of existing water rights but mainly by the development of new

water resources, such as dam construction. The demand for water began to decline after the recession following the first oil shock in 1973, but conversely, the demand for domestic water increased in the suburban areas that developed as bedroom towns in the Tokyo metropolitan area. At this time, opposition from residents and rising costs made it difficult to construct new dams, so the diversion of water from agricultural use became a policy issue (Moritaki, 2003, pp. 273–281).

The following are two Chinese cases similar to Japan's AWRP (Kataoka, 2008, pp. 52–55). The first water rights transaction in China took place in Zhejiang Province in 2000, where Yiwu county bought permanent water use rights of a 50 million m^3 dam reservoir from Dongyang county. The agreement was made subject to a one-time payment of 200 million Chinese yuan (RMB) and an administrative fee of 0.2 RMB per cubic meter of water supply. Yiwu, famous for its huge wholesale market of general merchandise, was facing a shortage of water for domestic use due to rapid urbanization. This transaction was beneficial to both parties. Yiwu was able to procure water at a lower cost compared to developing a new water source, while Dongyang was able to finance another water development project with the profits from this deal. Overall, the diversion of water from agricultural use to urban use has improved water productivity; however, the deal later led to government mediation due to inadequate compensation for farmers in Dongyang, who lost part of their water rights, and another city downstream was disadvantaged by Dongyang's new water development.

Another example is the water transfer case from agriculture to industry in Inner Mongolia and Ningxia Autonomous Region in the Yellow River basin, which occurred in 2000. More than 90% of the water used in both autonomous regions was for agricultural use at that time, but the efficiency was quite low due to large losses in water delivery. Therefore, power generation and industrial companies paid for water-saving projects, such as concreting irrigation facilities in irrigation districts, and acquired water rights for the surplus water generated. Unlike the first case in Zhejiang Province, in this case, the Yellow River Water Committee and the local provincial government's water department worked together and communicated with other provincial governments involved in Yellow River water utilization. In addition, representatives of the Water User's Association (WUA), a farmers' organization involved in water saving, are providing information, which is discussed in more detail in the next section. This case involved a paid transfer of water resources between

stakeholders under government supervision. Remaining issues include determining how to compensate for future shortages of water for agricultural use during droughts and how to consider the environmental impact of the change of use.

8.3.2.2 Participatory Irrigation Management (PIM)

After WW II, many large water facilities were built by international aid agencies, such as the World Bank and governments in developing countries, but by the 1970s and 1980s, operation and maintenance (O&M) began to face difficulties. Therefore, a method called PIM attracted attention as a means of the proper O&M of water facilities and collecting fees from beneficiaries. The World Bank defines PIM as "the involvement of irrigation users in all aspects of irrigation management, and at all levels" (World Bank, 1996).[7] Some PIMs are based on existing traditional water users' organizations, as in Japan, while others are newly created artificially as a counterpart organization of the project. Increasing the efficiency of agricultural water use, which is the largest water-using sector and is located upstream in the watershed in many countries, has two important implications: proper resource allocation among sectors and a stable food supply.

In China, agricultural water utilization facilities were constructed rapidly during the era of the planned economy, but after the collapse of the People's Commune System, the facilities were neglected, and in many areas, water loss occurred due to aging facilities and poor management. The first PIM in China began in the early 1990s, when the World Bank was required to introduce PIM models as a condition for loans for the construction of water conservancy facilities in Hunan and Hubei provinces (Yamada, 2015).

The international aid organizations, based on the arguments of Ostrom (1992), insisted that the PIM in China should be run autonomously and democratically by the beneficiaries in each basin and that beneficiaries' participation in the decision making and transparency of the organizations should be strengthened (Xie et al., 2009); however, the low cost-bearing capacity of farmers and the political system in China made it difficult to create this autonomous system of governance.

China has been promoting the slogan of "Building a Water-Saving Society" since 2000, and the central government's emphasis on water conservancy, as evidenced by the 2011 Central Number One Document on "Accelerating Water Conservancy Reform and Development," led to a

significant increase in investment in irrigation, from 33.4 billion RMB in 2010 to 139.2 billion RMB in 2015. The WUAs were established mainly in the government's model irrigation districts to raise farmers' awareness of water conservation through appropriate water fee collection and to ensure the proper management of facilities at the village level. Most of China's WUAs are not voluntary organizations by farmers but rather top-down organizations. Their performance is often harshly evaluated, and not much information on them has been available since the 2010s. Li (2009), for example, states that two-thirds of WUAs need improvement or are poor. According to Kikuchi (2018), while investments in water facilities and water-saving technologies have made remarkable progress in recent years, the management system has not always been well-organized, and Chen Lei, the head of the MWR, said at a conference in 2012 that water loss in "the last one kilometer" is significant due to the insufficient maintenance of the terminal canals.

Internationally, Japanese water users' associations called Land Improvement Districts (LIDs) are regarded as a good example of PIM and were said to be introduced to China through ODA. Japanese LID is organized by the beneficiaries of governmental Improvement Projects under the Land Improvement Law and responsibly manages irrigation water.[8] LIDs are autonomous, participatory organizations of farmers that distribute water, operate and maintain water facilities, collect water fees, arbitrate disputes, and respond to emergencies, such as droughts. They have a democratic decision-making mechanism and serve as recipients of government water projects.

Figure 8.4 presents the number of LIDs, the number of association members, and the area under management during 1955 and 2020. The number of LID organizations peaked in 1961 with 13.16 thousand organizations and has since been merged due to depopulation, decreasing to 4.32 thousand in 2020. Similarly, the number of members fell dramatically from 5 million to 3.46 million. The area under management only slightly decreased, and the area per LID more than doubled from 270 to 574 hectares. Currently, 73% of the LIDs mainly engage in the O&M of facilities, and they manage 60% of the key irrigation facilities in Japan. The national and local governments are bearing some of the costs, such as dispatching technical staff, as LID's cost-bearing capacity has declined due to labor shortages and an aging workforce.

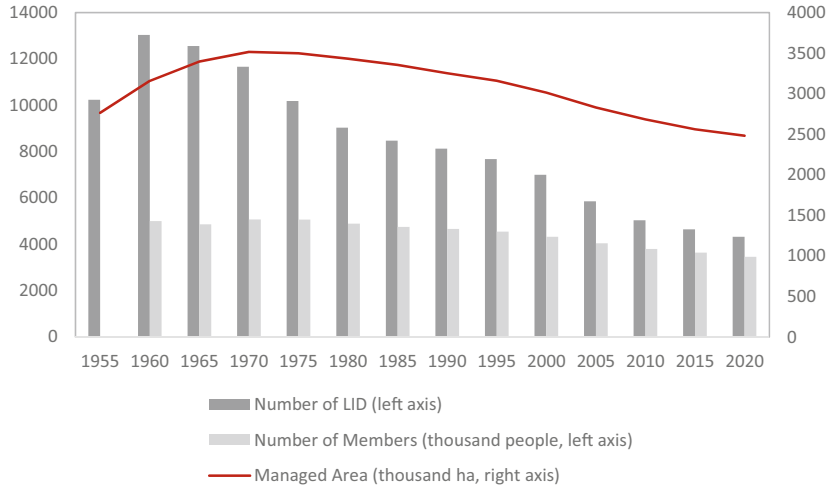

Fig. 8.4 Development of LID in Japan (1955–2020) (*Source* Ministry of Agriculture, Forestry, and Fishery (MAFF), Japan: https://www.maff.go.jp/j/nousin/kikaku/dantaisidou_riyouchousei.html)

8.3.3 Conclusions: Policy Implication

As discussed, environmental policy in China and Japan has shifted from symptomatic regulations and technical responses to more comprehensive watershed management. In China, the management of water quantity in China has been greatly improved through the collaboration between the MRW and the MEE and the establishment of the Watershed Committee. Water Function Zoning Management Measure under the amended Water Law in 2002, combined with the Water Environmental Function Zoning Plan by MEE, is expected to enable further balanced basin management. To improve water productivity, which is still considerably lower than in developed countries, the recycling rate for industrial and urban water needs to be increased. The low water use efficiency in rural areas, where water loss is significant, should be increased by an appropriate level of public investment in water use facilities and support for O&M systems. Although water quality has also improved considerably in comparison to previous years, China still has fairly serious water pollution problems.

The Japanese experience that was referred to by China was primarily a policy response to pollution control during a period of rapid economic

growth. Japan has already entered a period of post-high economic growth and an aging society with a declining birthrate. China also has entered a post-growth era called "the New Normal" since the 2010s during the President Xi administration. Japan is anticipating the challenges that China will face in the future. For example, there is the problem of aging water utilization facilities in rural areas and in determining how the cost of facility renewal should be borne as well as who should take over for the O&M activities that have been undertaken by local communities in the period of depopulation and aging.

As Kitagawa (2018a, 2018b) pointed out, the revised Environmental Protection Law of China, which came into force in 2015, put great emphasis on the enhancement of the disclosure of information by the government and enterprises, public participation, implementation of environmental impact assessment, and strengthening the responsibility of leaders for the environment conservation through political schemes, including the retrospective pursuit of liability. Reflecting on the Japanese experience, in addition to environmental policy and policy implementation by the public administration, the role of residents' movements, mass media, local government initiatives, and pollution trials, although they later regressed, was significant in the process of forming proper environmental policy. China's environmental administration has been basically government-led, but it is expected that the issues, such as information disclosure, the reform of the judicial system, and the steady implementation of policies, will be improved in the future to build a sustainable water environment policy.

Notes

1. There are some articles on Japanese environmental policy written in English to share its experience with developing countries, such as Kojima et al. eds. (1995), OECD (1977; various years), and JIID (2003). The following are some examples of studies on China's water environment problems from the perspective of international comparisons with Japan: Turner and Otsuka eds. (2005), OECD (2006), Otsuka eds. (2008; 2010; 2012), Mori et al. eds. (2008), Bi et al. eds. (2011), Imura (2013), Kitagawa and Kubota eds. (2015), Kitagawa eds. (2018), Otsuka (2019), etc.
2. According to the definition in Report on the State of the Ecology and Environment in China 2019, "Grade I or II standard of water refers to the water in Class I protected areas of drinking water sources, habitats of rare aquatic species, fish and shrimp spawning grounds, and feeding grounds of

fry and young fish. Grade III standard of water could be used for Class II drinking water source protected areas, fish and shrimp wintering grounds, migration channels, aquaculture areas, and swimming sites. Grade IV standard of water could be used for general industrial water use and recreation without any direct contact with the human body. Grade V standard of water could be used for agriculture and landscape related irrigation, and waters failing to meet Grade V standard hardly have any function except adjustment of local climate."

3. China has learned about economic instruments in the environmental sector mainly from the experiences of Western countries (see OECD, 1997).
4. Revised law contains advanced features, such as a daily penalty system, which imposes a daily fine for illegal emissions until improvements are made, and the introduction of Environmental Public Interest Litigation, which does not exist in Japan (Kitagawa, 2018a, 2018b).
5. The Superfund Law, one of the U.S. environmental protection laws, was enacted in response to the problem of contaminated soil cleanup caused by the Love Canal incident. The law establishes a trust fund (Superfund) for contaminated soil cleanup costs, clarifies liability for compensation for contamination, and provides for prior investigation regarding the presence of contamination.
6. Water rights in Japan consist of two types of water rights: Customary Water Right and Approved Water Right. The former harkens back to the seventeenth century and is a historically created water right, primarily for agricultural use. The latter is a water right granted to water users by river administrators under the River Law enacted in 1964 (Kataoka, 2005).
7. All aspects include planning, design, construction, operation and maintenance, financing, decision rules, and the monitoring and evaluation of the irrigation system. All levels include the primary, secondary, and tertiary levels (World Bank, 1996).
8. For the historical change of LID and irrigation management in more detail, see Yamada (2005) and Takeda (2021).

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