Water Right Transfer Experiment and the Impact on the Water Resources Management Policy In China: an Overview

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From at least the sixth century A.D. onward, China maintained centralized control of large water projects, developed them as state enterprises, and managed them with its vast Confucian bureaucracy. The revolutionary states which succeeded late imperial China, first the Republic of China (1911-1949), and especially the People's Republic of China (1949-present) did not change these essential features of water policy (Hucker, 1994). During the 1980's, however, China, began to move away from the planned economy and embraced the global market economy. China retained the structural central command of the national economy, its central bureaucracy, and its planning of titanic state water projects. National governments embarked upon massive water-control and water-supply projects, establishing an unprecedented national presence in distant areas. Such large-scale water development assured the arid regions of much greater and more dependable water supplies, thus attracting unprecedented economic and demographic growth. The development of large-scale irrigation since 1950s has brought higher yields and new development, but created serious water shortage problems and environmental consequences, such as dried up rivers and lakes, declining groundwater levels and land subsidence, salinization and water pollution (Jiao, 2004).

Nonetheless, China's entrance into the world economy has brought about important legal changes in its water law and policy. This change has in turn established a new legal framework for water rights, the 1988 China Water Law and its 2002 revision. Early in the twenty-first century, China has accomplished a new legal framework for water rights and water management that seeks to promote efficient water management and articulate water rights without compromising the centralized administration of water rights and the state's ownership and control of water resources.

In China most of the water is owned by the State, the only exception is that the Water in the ponds of rural collective economic organizations and in the reservoirs constructed and managed by rural collective economic organizations. (Article 3 of China Water Law of 2002) The concept of water rights in China was not generally discussed before 1999. Most of the remarkable water law and policy changes that happened in the last ten years owe a great deal to Mr. Wang Shucheng, who became the Minister of Water Resources (MWR) of China in late 1998. This was a critical time shortly after the extreme flood of the Yangtze River happened in the summer of

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1998, and the dry up crisis of the Yellow River, Heihe River and Tarim River in north and northwest China. The prevailing, water pollution and ecosystem deterioration was getting more and more serious all around China, and there was an urgent demand in China to assess and adjust its water management strategy and policy and formulate the "tenth fiver-year water development plan" to solve the flood, water scarcity, and ecosystem deterioration and water pollution problems with more effective approaches (Zhang, 1999). Mr. Wang advocated the concept and theory of Resource-oriented Water Management and highlighted market mechanisms to improve the rational allocating of existing resources more efficiently under the concepts of sustainable development and harmonious co-existence with nature. (Wang, 2002) Several water use right transfer experiments have been successfully conducted in China since 2000 and obtained general acceptance by water users and managers (Han and Ma, 2008).

However, the term of water rights and water rights transfer are just used in the official documents related to some experimental practices conducted by MWR, and have not been adopted in formal water Laws and Regulations of China. For examples, in the New Water Permit Regulation by the China State Council in 2006, it is stated that the saved water volume of a water permit through adopting water saving techniques under the validated period and water extraction limit designated by the permit can be transferred to others for profit. There is not any term of water rights or water use rights mentioned (See article 27 of Regulation on the Administration of the License for Water Drawing and the Levy of Water Resource Fees of China, CSC, 2006).

The Water Right Transfer Experiment in China

Paid Regional Water Transfer within Province: The Case of Dongyang –Yiwu Water Transfer

On Nov.24, The Dongyang City and Yiwu City of Zhejiang Province signed the first water rights transfer agreement of modern China. According to the agreement Yiwu City invested 200 million RMB to buy the 50 million m3 of water use right every year permanently stored in the Hengjin Reservoir of Dongyang City, while the property rights of the reservoir and the responsibility for the operation and maintenance still belong to the original owner, Dongyang City. In return Yiwu will pay the comprehensive management cost (including water resources fee) to Dongyang at the price of 0.1 RMB per cubic meter based upon the actual amount of water transferred every year. Yiwu is also responsible for the design and investment of the aqueduct system from Dongyang to Yiwu, and Dongyang City is responsible for the construction of the component water diversion project located within Dongyang. Three years after, the water diversion project was completed and the water of the Hengjin Reservoir of Dongyang began to be transferred to Yiwu for use thereafter. Through this transfer agreement, Yiwu obtains a reliable new water supply with good price and Dongyang gains fund from its surplus water resources which would have been abandoned from the reservoir in the flood season without this water rights transfer business.

The surplus water transfer from Dongyang to Yiwu has some characteristics of a water use

rights that improves both social and economic efficiency in terms of resource optimization.

The Dongyang –Yiwu Water Transfer case is a breakthrough event in the water resources management reform practice of China. It is applauded by the policy makers and mainstream researchers, since this case broke the monopolization of the administrative water allocation tradition, and symbolized the first of the water market in China. Most importantly it proves that market mechanism is an effective way in water resources allocation. (Wang, 2001; Hu et al, 2002) Because this event happened just at the time China's water management policy started to change from engineering works centered water resources management to resources-oriented water resources management championed by Mr. Wang Shucheng, the new minister of water resources management (Wang, 2002).

However, the Dongyan-Yiwu water transfer agreement is criticized by the Shengzhou City the neighbor of Dongyang City, since Dongyang is building a dam and inter-basin water transfer project to transfer the water from the Zhixi River, the tributary of Changle River to Hengxi Reservoir, whose water has been contracted and is to be transferred to Yiwu. Although the Zhixi River and the total inter-basin water transfer project and two reservoirs are located within Dongyang, their functioned implementation of the Dongyang –Yiwu Water Transfer agreement will inevitably affect the urban water supply of Shengzhou City and the 667 ha irrigation area in Nanshan Irrigation District at the downstream of the Zhixi River as well as the environment of the Changle river (Lu, 2005). It is clear the third party effect has not been carefully addressed in the Dongyang –Yiwu Water Transfer case. At the beginning, the water right and water allocation scheme of Dongyang, Yiwu and Shengzhou City as the Zhixi inter-basin water transfer project should be carefully studied and identified.

The focus is to exercise the market mechanism and legislative approaches to optimize the allocation of water resources and pursue harmonious co-existence with nature. At that time the water rights transfer was not allowed by the old China water law and regulations, which stipulated with strong planning economic characteristics which have been out of work in the rapid developing market economy situation.

Although this agreement is considered the first water use rights transfer in China, both buyer and seller do not have a legal right to surplus water usage. There is also no legal support for the apparently permanent duration of this transfer, which could undermine the transaction later on. As such, this transfer could only be considered a water supply contract (until the permit to use water was transferred, and thus the most fundamental prerequisite of a water right transfer was fulfilled).

Paid Inter-province Water Transfer: the Water Conflicts and Water rights Transfer in the Zhanghe River Basin.

The Zhanghe River passes through three provinces. Its upper reach is located in Shanxi Province, while the lower reach forms the border between Hebei and Henan Provinces. The

living standard along the river is very low, with the population depending on a limited amount of farmland. An increasing population coupled with continuing deterioration of the ecosystem in the basin has created enormous tension between the people living on the two opposite river banks, who have been fighting for the limited water resources and meager arable farmland since the 1950s. The level of conflicts accelerated after 1980, resulting in criminal actions such as explosions, mass fights, and the destruction of hydraulic infrastructure. During the drought season, some villagers construct unauthorized dams to divert limited water resources to their own side, without considering the resulting damage on the other side.

On June 3, 1989, the adopted Water Distribution Scheme for the Zhanghe River was drafted by the Department of Water Resources. Meanwhile, a special administration bureau was established to conduct the overall management for the 108-kilometer-long river channel located along the borders of the three provinces and coordinate the reasonable distribution of limited water resources of the three provinces. However, due to the continuous drought and water development in upper stream, the available water for the provincial border region was decreasing as well. There was almost no water to allocate and the water conflicts among the villages along the river were intensive. For example, in the spring of 2001, the flow of Zhuozhang River which is the main tributary of the Zhanghe River was about only 3 cubic meters per second, the villages and the four irrigation districts urgently needed water for irrigation and fiercely competed to take the mere water in the river. While the excessive water above the flood-prevent level stored in the reservoirs of Shanxi Province in the upstream had to be released by the beginning of the flood season. Under the coordination the Upper Reach Administrative Bureau, the governments of the three provinces in the border region as well as the related water management institutions reached agreement of paid trans-province water transfer. From April to May, 15 million cubic meters (m^3) of water was transferred from the Zhanghe Reservoir of Shanxi Province to the Yaojin Irrigation District of Henan Province. Then 30 million m^3 of water was transferred from five reservoirs of Shanxi Province to the Hongqi and Yaojin Irrigation Districts of Henan Province and the villages of Hebei and Henan Provinces along the river. In the spring of 2002, the same agreement was reached again, and there were 30 million m^3 of water transferred to the Hongqi and Yaojin Irrigation Districts of Henan Province. The three paid trans-province water transfer cases have not only successfully prevented and resolved the possible water conflicts among the three provinces, but also obtained good economic impacts. Totally, there were 333,000 ha farmland irrigated and over 100 thousand people's drinking water problem was solved. The increased agricultural income was over 50 million RMB, the water institution in Shanxi province earned 1.4 million RMB, the increased income of the hydropower stations along the river was 1.2 million RMB. This shows that the market based mechanism is a promising approach to resolve water conflict and optimize water resource allocation.

One example for the operation of the administrative bureau relates to the 2002–03 winter/spring season. During that irrigation season, the minimum flow of the river channel was only 2.7 cubic meters per second, which threatened normal agricultural cultivation and escalated the existing tensions among water users along the river. Under the coordination of the

administrative bureau, the local governments in the lower reach provided US$90,000 to transfer a total amount of 30 million cubic meters of water from five reservoirs located in the upper reaches to the Hongqi Canal and Yuejin Canal irrigation zones of Henan Province to the villages of the two provinces along the river. This additional water supply mitigated the water resource conflicts during the peak irrigation period and ensured the irrigation of 25,000 hectares of farmland. As a result, corn yields increased by 1,500 kilograms per hectare, and a rapport could be achieved among water users on both sides of the river.

In this case, the water distribution scheme was clearly defined by legal documents, in which key factors, such as the quantity of water to be used, were explicitly stated. This improved the status of the water right. The predictability of where water would be used was advantageous for the maintenance and management of the water in the system. Moreover, the unified management of the water resources in the whole river basin was favorable to achieving a more optimal resource utilization and distribution from upper to lower reaches, particularly in extreme climate events, such as the recent drought.

Water Right Transfer among Farmers within Irrigation District: Water Right Exchange Experiment in Zhangye City of Heihe River Basin

Heihe River the second longest inland river in China, originates from the snow-melted water from the Qilianshan Mountain which lies mainly in the Qinhai province, then flows through Gansu Province in its middle reach, and finally ends in Juyanhai Lake in the desert of Inner Mongolia. Located in one of the driest zones in the world, Zhangye city of Gansu Province is an oasis in the middle reach of the Heihe River and is mainly watered by the Heihe River. The precipitation in the city is 89-283mm per year, while the evaporation of 1,700 mm per year. Zhangye is a typical agricultural irrigation area. The available irrigation area is 257,000 ha, including 212,000 ha of farmland and 41,000 ha of forestland and grassland. The current total grain output is 993,000 tons and it is one of the Top 10 National grain production areas. Almost all the water of the Heihe River is extracted for irrigation use mainly in Gansu. The rapid socio-economic development of the middle stream section has led to a shortage of water, and serious water sharing disputes between upstream and downstream users. The downstream river and lakes dried up and the oases were shrinking. As a result of too little water flowing into Juyanhai Lake, it dried out in 1992 and an area of 200 km^2 around the lake became desert.

To save the ecology of the downstream section, the State Council carried out short term Heihe basin management projects and conducted unified water allocation and regulation in 2000. According to the basin water allocation scheme the Zhangye City has to reduce its water extraction and increase discharge of 255 million m3 water to the downstream reach annually. By conducting the unified water allocation and regulation, the water use of the Heihe river basin is now well managed. For example, the east Juyan Lake in the Ejina Qi in Inner Mongolia has been refilled and no longer dries up, and the oasis appears to be vigorous. The successful management of the Heihe basin has had a close relationship with the development of water rights (MWR,

2004).

In March 2002, the Ministry of Water Resources decided to make Zhangye the first pilot area for water-saving society development. The aim of the project of the water-saving society development is to set up water resources management and operation systems compatible with the market economy mechanism in order to optimize water resources allocation and encourage efficient use. The main focus was to establish a new tradable water use rights system by conducting the hierarchy total water extraction volume control at all administrative levels from city, county, town to village based on the basin water allocation scheme and regional social economic development plan, and establishing sector-based water use quotas control and accumulating volumetric water pricing mechanism for all water use sectors to encourage water saving and optimizing water allocation through temporal and permanent water rights transfer. Four irrigation districts, namely Liyuan River irrigation area in Linze, Hongshui River irrigation area in Minle, Yingke irrigation area in Ganzhou, and Luotuocheng irrigation area in Gaotai and Shandan county and Minle county were selected as pilot areas for water rights reform. The government invested extensive capital to build a water-saving irrigation system and installed water meters for water users (including irrigators), and tried to discourage farmers from wasting water by accurately metering and charging for irrigation water. Farmer water right license and water coupon is designed to identify initial water use right and water trading.

Taking Liyuanhe Irrigation District as an example, the initial water rights of each farmer and the water market is designed as follows (MWR 2004):

First, according to the baseline social economic data of 2000, such an actual irrigation area of crops and grassland, population of urban and agriculture, GDP of industry, numbers of the large livestock and small livestock and corresponding water use quotas of each. The hydrologic model analysis of the relation of groundwater and surface water of the river system and canal system, the total water use quota and water allocation scheme of the Liyuanhe Irrigation District is estimated according to the water allocation Scheme of Heihe River and total water quota of Zhengye city and identified by the water extraction license to the irrigation district. Then the water quota of the irrigation district is further distributed to the towns and villages or water user associations as the total intake water volume at township or village level intake gates of the canal system based on the canal water transfer efficiency. Finally, the quota of village level water user association is distributed to each farm family based on the irrigation farmland area of the farmer and number of livestock in the form of water use right license issued by county level government. The water volume stated in the farmer's water use right license is the initial water use right of the farmers, which is designed as a kind of property right can be sold or let by the farmers separate from his land by the form of water coupon.

Based on the water use right and the irrigation water needs of each farmer, the farmer can buy the water coupon at the maximum amount of water equal to his water use right from the Liyuanhe Irrigation Management Institution in advance at the unified water price decided by Zhangye City Government. Then the coupon functions as money lent the farmer to buy the amount of water stated in the coupon from the irrigation district or he may sell all the coupons or

part of them to other farmers within the irrigation district at a higher price with maximum limits of 3 times as the original price.

Through the water use right and water coupon mechanism, the value and importance of the scarce water is further reorganized by the farmers. Farmers do their best to try to save and use the water more efficiently in order to obtain maximum profit. On the other hand, the mechanism also forces the farmers to pay the irrigation water fee fully to the revenue of the irrigation management institution. The irrigation water service and water use efficiency have been greatly improved. For example, the total water extraction of Liyuanhe Irrigation District in year 2003 was reduced 25 million m3 compared with Year 2001, with average reduction of 12,000 m3 per hectare. Farmers are eager to grow the high water efficient and economic value crops, and the water conflicts among farmers have been greatly reduced. However, the water use right trading is not popular because water is short for every farmer and no one would like to sell it. Also because irrigation water service is not good enough, because the water price can not cover the full maintenance and operation cost. The farmers can not get the water at the right time, partly because the water user association keeps the water coupon in its hand and does not distribute it to each farmer, in order to reduce the work load of the water user association. On behalf of the farmers of a village instead of each individual farmer to buy the coupon and contact with the irrigation management institution to deliver the water to village's canal. (Zhang, 2005; Qiu, 2009).

Inter-sector Water Right Transfer: Water Rights Transfer in Inner Mongolia and Ningxia of the Yellow River Basin

The areas along the Yellow River in the Inner Mongolia Autonomous Region (IMAR) and Ningxia Hui Autonomous Region (NXAR) are short of water resources, and total water usage has reached its allocated quota within the basin. Due to the growth of inefficient irrigation in the large arid land area along the edge of the desert, both Inner Mongolia and Ningxia have exceeded the water quotas allocated to them by the central government. Even after 1999, these withdrawals have nearly run the River dry during the irrigation season. Between 1999 and 2005, the average water consumption diverted from the Yellow River in the NXAR and IMAR was 24% and 39% higher than their respective quotas. At the same time, the water use structure of the two regions is unbalanced, with industrial water usage only 3 percent of total water usage, much lower than the national average of 20 percent. Agriculture uses more than 95 percent of the water, with the aged irrigation infrastructure resulting in lower water use efficiency. There is thus great potential for agricultural water saving. In the recent years, the economy has developed quickly in the two regions, with increased industrial and urban water requirements along the Yellow River. In 2002, the Yellow River Conservancy Commission (YRCC), for the first time, suspended the issuance of new water permits in the region, to force these regions to improve irrigation efficiency and to ensure streamflows (YRCC[1], 2008). Thus, water has become a key constraint on economic transformation and development. Since it is difficult to increase total water availability, the Yellow River Water Resources Commission, together with the water

administration departments in the two regions, began to conduct water rights transfers in 2003 to solve the industrial and urban development water requirements. The idea is to encourage industrial enterprises to invest in irrigation water-saving projects, according to the approved irrigation district's water saving plan. Such a plan is intended to save water that would have been lost in the canal water transportation process and on farmland in previous low-efficient irrigation systems. Part of the saved water will contribute to reducing the total water use of the NXAR and the IMAR, and prevent these two regions from exceeding their corresponding water quotas. The remainder of the saved water can then be transferred for industrial development under the condition of guaranteeing the domestic, food-security, and basic ecological water requirements, with compensation based on mutual benefits. This will realize the optimal allocation of water resources.

To ensure that the amount of water in the field used for crops will not be less than the amount used before the water transfer project, the farmers will be compensated in dry years, since according to China Technical Code of Irrigation and Drainage Engineering Works Design (GB 50288-99) the designed water supply security rate of industry is protected to 95% to 97% of its needs, while that of irrigation is only 50% to 75%. Likewise, water losses to the ecosystem, which would otherwise benefit from recharge and return flows, needs to be addressed.

The water transfer experiment is a government-conducted process. To guide, formalize, and promote water rights transfer, the Ministry of Water Resources issued The Guiding Opinions of the Ministry of Water Resources on the Yellow River Main Stream Water Rights Transfer Tentative Work in Inner Mongolia Autonomous Region and Ningxia Hui Autonomous Region (YRCC). This document defined the procedures and pricing considerations in water rights transfer.

YRCC formulated the "Yellow River Water Rights Transfer Management Method (Tentative)," for the Inner Mongolia Autonomous Region (IMAR) and Ningxia Hui Autonomous Region (NXAR). The YRCC first requested the governments of the NXAR and the IMAR to carry out feasibility studies and to establish the Yellow River water right transfer plan at the provincial level. Provincial governments are responsible for managing both the funds provided by interested industrial enterprises and for ensuring the quality of water saving projects. Furthermore, governments determine temporal water rights transfer duration (25 year) and the price of the transferred water, based on the cost estimation code formulated by the MWR. The water rights transfers are not based on a free market, and the irrigation district which is the water user rights owner of the irrigation district and holds the water abstraction licenses issued by YRCC will not profit from the transfer process; indeed, its revenue may shrink, since its farmers will use less water after the transfer. For example, the revenue of the South Bank Irrigation District of IMAR fell by 1.1 million RMB between 2005 and 2006, due to the construction of water-saving engineering works and the water transfers that followed (YRCC[2], 2008).

At this early, experimental stage of the water transfer program, the main water saving project is the lining of irrigation canals. Based on the life spans of conservation works and industrial equipment in the region, the term of any water transfer is twenty-five years (YRCC[2],

2008). By the end of 2006, the YRCC had approved five water rights transfer experimental projects in the NXAR and the IMAR. The water saving engineering works of the first experimental project have been finished, and they passed inspection in November 2006. A total of 42 km of irrigation canals have been lined, which is expected to save 21.73 million m^3 of water per year, from which 18.8 million m^3 water use right (which is part of the water use permit of the irrigation district) was transferred to a coal-burning electric plant investing in the water saving works.

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Based on the Opinion, the Yellow River Water Resources Commission formulated the "Yellow River Water Rights Transfer Management Method (Tentative)," for the Inner Mongolia Autonomous Region and Ningxia Hui Autonomous Region. In this case, through the government's guidance to realize the partial transfer of agricultural water to the industrial sector, with compensation, the process functions as a form of water rights transfer under government regulation. This is a sign of how water rights practices in China are gradually being formalized and supported by legislation.

Impacts of Water Right Transfers on Water Allocation Efficiency, Food and Environmental Security and Livelihood of Farmers

Water Rights and Water Rights Market Mechanism Is a Effective Tool to Improve Water Allocation Efficiency in China

There are four different types of water rights transfer experiments in China introduced above, including the regional transfer within a province, trans-province water transfer, farmer water rights transfers within irrigation districts and inter-sector water transfers from agriculture to industry. Although the aim and situation varied a lot among each other, all of the four cases have innovatively adopted economic measures instead of the prevailing administrative measure to solve the different water shortage problems and obtained win-win situations for the water provider and receiver. All the four cases have a strong government coordination background and are not fully free market activities. Since the activities of the four cases are ahead of the regulation of the water laws at that time, the definition of water rights, water use rights and if the water rights are transferred in the four water rights transfer cases are still in hot argument by the water policy maker, researchers and law experts (Cui, 2002; Liu, 2003; Liu et al, 2004; Wang, 2007). However, the four water rights transfer practices have achieved promising social and economic impacts, and have a greatly positive impact on the water resources management reform of China. It has been the prior policy in China to develop market mechanism and promote water

rights and water rights transfers of water resources management in order to optimize water resources allocation and improve water use efficiency.

Many new water right transfer practices have been conducted or ongoing in China. Such as Water Rights transfer from Hebei Province to Beijing of Haihe River Basin, the initial water rights allocation in Dalinhe River in Inner Mongolia of Songliao River Basin, Shiyan River in Gansu Province, etc (Gao, 2007) . And the water rights transfer from irrigation district to industry users almost becomes a regular management practice in the Yellow River. For example, after posting the routine check procedure by the provincial water management department and YRCC, on May 8 2009, the Jingdan Irrigation District Management Bureau signed a Yellow River water use rights transfer agreement with industry in Gansu Province to Datang Electric Company, Datang Company pays 34 million RMB to Jindian Bureau to invest in an irrigation water saving project, and 0.4 million RMB every year for maintenance and operation costs of the water saving project. There will be 5.4 million m3 water use rights of Jingdian to be transferred to the Datang Company every year. The valid period of the transfer is 20 years. (Liu, 2009)

Third Party Effect must be highlighted in Water Rights Transfer Process

As introduced before, third party effects have not been carefully addressed in the Dongyang –Yiwu Water Transfer. The urban and irrigation water supply of Shengzhou City as well as the environmental flow of the Changle river might be affected. However, in the water rights transfer experiments, the possible negative effects to the ecosystem and agricultural water use have been carefully addressed in the project design and policy making process. For example, MWR and YRCC ordered that the compensation to the ecosystem and agriculture should be properly addressed and the cost for the ecosystem and agricultural compensation should be included as a cost of water transfer fee pricing system and paid by the industrial enterprises and special hydrological monitoring system that has been established to evaluate if the amount of water is really saved as designed in order to check that the water for irrigation farmers and downstream users will not be affected However, in the implementation practice the government of Inner Mongolia did not ask the industrial enterprises to pay to the compensation fund for the ecosystem and agriculture, thus there will be great risk to affected farmers or organizations that will not get compensation when they have not received the promised water (YRCC[2], 2008).

During the Dongyang-Yiwu, Zhanghe, and Yellow River water transfer experiment all are conducted by governmental water management institutions, there is not a democratic mechanism for the related end water users to participate in the decision making process. It is difficult for the public to be involved in the third party checks. The public hearing mechanism and the democratic decision making process of the Kansas State in the United States to check water permits and air-quality permits regarding the Sunflower Power Plant set a good example for China (Peck and Griggs, 2008).

Water Law and Water Rights Management System Need Improvement

Relation of the water rights of irrigation district management institution and water rights of end users within the district should be further indentified

Under the present water permit management system, it is the irrigation management institution that holds the water extraction permit of the irrigation district. The irrigating farmers who belong to that irrigation district have no corresponding individual water permits. Thus, in the Yellow River water rights transfer case the entities in the water transfer cases are the irrigation district management institution and the industrial enterprise. If it is allowed to obtain profits from the water right transfer business in the future, which should be the normal case since economic incentive is the primary goal of the water provider just like the Dongyang – Yiwu case or the Zhanghe River case, all the profit will be the revenue of the management institution of the irrigation district without any share paid to the end users (mainly farmers) in the irrigation district. As there are not clear water rights for end users in an irrigation district, it is impossible for the end water user (farmers or farmer water user association) to exchange its water in the market to get profits. The policy of the irrigation end user not having a water right in the Yellow River Basin should be improved to increase the marketability of individual allocations, and to prevent possible loss of rights and profits of the end users.

MWR deliberately use the term of detailed distribution of water extraction ration instead of identifying original water rights when conducting the provincial government to allocate the water quota to city level and county level government in order to enable better water rights management and encourage water saving in recent years. YRCC is pushing the provinces and regions in the Basin to divide the provincial water quota to prefecture level, and YRCC has issued its suggested plan on prefectural level water quota allocation of each province and region. However, there still needs further negotiation between the provincial government and YRCC to further modify the plan and finalize it before it is ratified by provincial government (Du and Zhang, 2007).

However, suppose that the agriculture to industry water rights transfer happened in the Liyuanhe Irrigation District of the Heihe river where the water use rights of the irrigation district have been distributed to end users (individual farmer). Questions will be raised, should the irrigation district management institution or the water users association of farmers sign the contract with the industrial enterprise? What is the relation of the water rights of the irrigation district and the water rights of the end water user (individual farmer or farmers water user association), especially the right of saved water by investment of the water saving projects? How should the water rights and benefits be shared by the irrigation district and the end users?

By contrast, members of an irrigation district in prior appropriation states of the United States hold shares in that district, and so have a vested property interest in the water rights held by the district (*See, e.g.*, In re Water Rights of Central Colorado Water Conservancy Dist., 147 P.3d 9 (2006)). Their benefit sharing mechanism should be a good example for China.

The Water Rights between Irrigation District and the Industry Enterprise should be clearly identified

In China, all water permits (or water abstract licenses) are temporary water permits with a maximum five years valid period, although the license can normally be renewed before the expiry date. However in the Yellow River water rights case the transfers was allowed for twenty-five years. Also, it is not clear if the transferred water rights should continue to belong to the industrial enterprise or return to the irrigation district after twenty-five years when the transfer contract is expired. Thus, there is a discrepancy regarding the validity of the period of a water right transfer. Further amendment and a clear legal procedure are needed to address these issues.

Since Inner Mongolia and Ningixa have been fully or even over allocated, water becomes one of the most scarce natural resources for economic development. It is the only way for any users in the region to obtain new water extraction permits through the water rights transfer. There is a large demand from the coal-based electric and chemical industries to obtain water permits from water rights transfer. Some enterprises are interested to invest in water savings projects and obtain more water than their present need for possible future use and sell for profit. However, this kind of application is not approved by YRCC at present for fear that one company may occupy too much water and may sell the water at a much higher price. However, since there is still a huge and urgent demand for funds to invest in water saving projects of the irrigation districts, which are far beyond the budget of the government funds, it is strongly recommended to make free for any person or institution to invest in water saving projects, and allow the water rights transferred from the irrigation district through water saving to be traded again for profit, in order to encourage more funds to invest in water savings projects and improve the overall water use efficiency.

Further Improve the Institutional Management of the Irrigation District Management

The water rights transfer policy in the Yellow River has helped to solve some water problems for industrial enterprises, and it has also created a new investment channel for irrigation water savings. However, the irrigation districts which hold the water permits have not profited from these transfers. Worse, they may lose profits by supplying water to the farmers, who use less water due to the improvements in the canal system efficiency, thereby reducing the districts' water fees. As water is the main source of income for the irrigation management institution, just like the Liyuanhe Irrigation District in Heihe River and The North Bank Irrigation District in the Yellow River, the poor financial condition has already undermined the irrigation service of the irrigation district of China (YRCC[2], 2008；Qiu, 2009,). A policy modification should be considered to protect the interests of the irrigation districts. First the water price should rise to the actual cost recovery water price of the Irrigation district in order to provide for the sustainable development of the irrigation district. Second the government may

exercise compensation to farmers for the raised water fee or directly pay the water fee by the government, just as what has been done by Yiwu City. In order to reduce the financial effect on the farmers and encourage crop production, Yiwu City of Zhejian Province stopped collecting water fees from the farmers in 2005, instead to direct paying of a corresponding amount of the water fee to water management institutions from the government revenue. According to the actual irrigation area and irrigation water use estimated by the water management bureau, totally 1.165 million RMB has been paid for water by the middle of December 2005 (Cao, 2005).

Conclusions and Recommendations

China is promoting water rights and water rights transfers in water resources management, in order to optimize water resources allocation and improve water use efficiency. There are four different types of water rights transfer experiments in China that were introduced in this paper. These include the regional transfer within a province, trans-province water transfers, farmer water rights transfers within irrigation districts and inter-sector water transfers from agriculture to industry. All of the water rights transfer practices have achieved promising social and economic impacts and have a positive influence on water resources management reform of China.

Practices prove that the market mechanism is an effective tool to improve water allocation efficiency and water productivity in China. However the water right law and irrigation water management system should be improved to further promote the water rights transfer. The water rights should be recognized and clearly identified, the relation between the water rights of irrigation district management institutions and water rights of end users within the district should be further identified, and a profit sharing mechanism needs to be defined. The transferred water rights between irrigation districts and industrial enterprises should be clearly identified. The democratic decision making process should be introduced in the water rights transfer process in order to prevent any third party effects. There is a discrepancy regarding the validity of the period of a water rights transfer, the water rights relation of the water rights provider and water rights receiver in the Yellow River the irrigation distinct water rights transfer case. Further amendment and a clear legal procedure are needed to address these issues. It is strongly recommended to make free for any person or institution to invest in a water saving project, and allow the water rights transferred from the irrigation district through water saving can be traded again for profit, in order to encourage more funds to invest in water savings projects and improve the overall water use efficiency. And incentive policy should be studied in order to protect the interests of the management institutions of irrigation districts from losing through decreased water use after water saving.

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