Reviews of the research on water resources management system at home and abroad

YAN Tai-xiang¹, DUAN Qing-wei², CAO Wen-wen², ZHANG Cai-xia³

(1. College of Agronomy, Agricultural University of Hebei, Baoding 071000, China; 2. College of Economics and Trade, Agricultural University of Hebei, Baoding 071000, China; 3. Agricultural University of Hebei, Baoding 071000, China)

Abstract: The reform of the system of water resource management abroad has started since the 50s of last century, it has left us a lot of experiences in many aspects with the innovation of system, such as the legal environment in water resources, water rights, water market theory, and the “participation” management of water resources, these experiences has been promoted in more than 40 developing countries. Based on analyzing the theory and experiences of water resources management both at home and abroad, especially the theory and experiences of agricultural water resources management, this paper puts forward the main problems waiting for further investigation in China’s water resources management and provides some reference and inspiration for the innovation of the system of water resource management in China.

Key words: water resource; water resources management; management system

1. Introduction

Water resources management generally refers to a process of institution innovation using integrated measures at system and sustainable development point of views. This definition has been researched by many scholars at home and abroad combining with their own national or regional water features, political and economic systems and historical experiences etc., they explore and demonstrate it both in theory and practices which promote the innovation and development of water resources management. With increased water scarcity, there is a gradual increase in the research to solve the shortage of water resources from institution levels in recent years, many countries have adopted a series of reform activities (ZHOU Yu-xi, 2005). This paper has a research on the water resources management at home and abroad, especially on the status and contents of agriculture water management system innovation, as well as a summing-up and comprehensive analysis on the innovation of system and policies aiming to provide some useful references to the research of China’s water resources management system innovation.

2. Foreign research on water resources management
2.1 Research on the status and contents of the water resources management

In June, 1992, Environment and Development Organization convened by the United Nations suggested that the specific measures of water resources management should be organized and implemented by the state through demand management and pricing mechanism etc. to achieve reasonable allocation of water resources, meanwhile it put forward 16 measures to enhance the dissemination of water resources management knowledges and education (RUAN Benqing, et al., 2001). The United Nations’ “United Nations Project Environment Water Resources Management” pointed out that water resources management was a major problem in water crisis. In 1996, “sustainable water resources management” was defined by international Hydrological Program Work Group of UNESCO as the management and use which not only made the water resources satisfy the society’s present and future demand, but also maintained its hydrological cycle and ecosystem integrity. At the same time, the work group advanced that the point of system innovation was to change the water resource management from “supply management” to “demand management” and achieved centralized management. In agriculture, the transfer of irrigation management rights from government to farmers organizations became an important strategy of reform. During 1950-1970, this reform firstly took place in the United States, France, Colombia and China’s Taiwan, in 1980-1990, it extended to Chile, Peru, Mexico, Brazil, Turkey, Pakistan, India and Philippines more than 40 developing countries(GUO Shan-min, 2004). The experience of this reform was: Firstly, legal and policy support were the prerequisite for the success of irrigation management reform; Secondly, making a clear water management transfer agreements which decided the extent of farmers’ participation; Thirdly, rising farmers’ awareness; Fourthly, brought in flexible implementation model, water resource management should be different at different countries. Vermillion (1997) pointed out that the reasons for the reform of the system was government agencies’ lack of incentives and responsibility to optimize the irrigation systems; The farmers would be more willing to bear the cost of irrigation management and to improve its operating efficiency if given a certain rights and incentives; Irrigation management system innovation would alleviate governments’ financial burden. By studying the influences of the abolition of national subsidies to irrigation systems, in Philippines, Svendsen (1993) found that these changes lead to decrease in the number of staff of water supply organizations and operating costs, and on the condition that the irrigation water supply remained unchanged, the irrigation area increased by 13%. Fohnsonm’s (1997) studies on the irrigation management reform of Mexico showed that water users associations had succeed in operating and maintaining of irrigation system.

2.2 Research on water resources management system

The trend of water resources management reform at abroad is the institutionalization of organization means and structures starting from water resources management organizations and the implementation of irrigation management transfer system. With the implementation of participation irrigation management, many international institutions (such as the International Water Institute, the World Bank, International Food Policy Research Institute, etc.) carried out extensive researches on this (GUO Shan-min, 2004). Rnagesna Narayanna (1988) categorized the agricultural irrigation organizations in the western United States and found the control-oriented trends. Sam Johnson, Max Shwendt, et al (2002) proposed that the reform orientation of irrigation water was that a comprehensive national regulatory agencies would allow to a number of specialized agencies. Easet and Wiseh (1986), Wade (1987) pointed out that participation management was a global trend, which incorporated the establishment of water users associations (WUA). WUA's management and operation was based on the interests of water users, its monitoring and implementary costs was significantly reduced. In the study of the influence factors of WUA, Easetr and welsh (1956), Meinzen-nieketal (1997) pointed out that property rights had an key
impact on WUA, the organizations which do not have water rights couldn’t make decisions to water resources usage and management. Jules, Hugh (2001) proposed three-stages theory in the development of water user organizations. Aankoppenetal (2002) confirmed to that the irrigation management system reform was useful to improve the poor’s access capacity irrigation water.

2.3 Research on water resources management system

System innovation of water management is the process of institutionalization of water rights, water trading market, the price of water and water users’ conducts. The defines of system are not identical in academia. Veblenian believed that system was essentially general thinking and habits of individual or community to certain relations or functions. North believed that the system was a series of rules, law-abiding procedures and moral and ethical norms, it is aimed to restrict behaviors pursuing individuals welfare or utility maximization. In the study of water resources management system, Cornel (2001) pointed out that there required corresponding system changes in the water resources management transfer from supply management to demand management. Vermillion (1998), Samad and Vermillion (1999) had shown that the establishment of necessary policy support system had an important influence on the success of irrigation management system reform.

In the research on water rights, Johnson (1997), Helmi (2000) believed that the clarity of the water rights and implementation of efficient allocation of water resources was a necessary condition for its success. Delegation to Canada and the United States of Ministry of Water Resources (2003) pointed out that foreign maturity legal systems provided water resource management professional constraint as well as legal protection. Singh (1991) proposed “firstintime” (firstinright) principle about riparian water rights. After the research on proportional water rights in Chile and Mexico, Rosegrantnad Seheleyer (1994) believed that proportional water rights was the water resource’ fair allocation among relevant water users according to certain proportion (Eirik G. Furubotn & Rudolf Richter, 2002). K. Wlliime Easter thought that the tradable water rights would lead to maximum efficiency in the lack of water resource. Through analyzing the characteristics of water markets, water rights and water transfer, Bonnei Colby (1990) putted forward influential conclusions about the market value and price of the water resource. Michael L Katz (1999) believed that the reason for the external effects of water resources management was that the property rights were not completely exclusive, or that some resources could not be effectively allocated through the market mechanism. In the research on water rights market, Garnde and Fullertno (1968), Hmna and Seasotne (1970) thought that the market provided a water resource allocation method according to opportunity costs. Colby (1988) believed that water resource market not only made water users’ allocation and more efficient usage of the water resources, that was to say, both buyers and sellers of water resources regarded water resources as economic goods, it would improve the economic efficiency of water resource allocation and encourage farmers to adjust crop planting structures. In the study of water price, Hewittnad Hnaemnna (1995) pointed out that the progressive water price system or price raising or a combination of both would lead to water-saving. With regard to irrigation water price, Johanssonetal (2002) thought that although marginal cost of water supply and scarcity rents paid by water users would achieve more efficient use of water resources, but this policy couldn’t be measured by value, and fair tradable water quota might be a better choice.

Dinarand Subranlan’s (1998) study found that in all the developing countries and some developed countries, the charge to cities and agriculture sectors were taken on average price rather than marginal cost of water supply. HONG Yang, et al (2002) chose irrigation areas in northern China as a case and found that raising water price was not an effective way to encourage water conservation. Berbela and Gomez-Limon’s (2000) study pointed out that water price as a single tool of water use control was not an effective tool to substantially reduce agricultural water
consumption. Poseter (1999) pointed out that “to raise the water price may be an act of political risk”.

3. Domestic research on water resources management

3.1 Research on the status and contents of water resources management

There are three different points of views about water resources management currently in China which are integrative view, systemic view and sustainable view (ZHOU Yu-xi, 2005). (1) Integrative view. CHEN Jia-qi (1987) believed that water resource management is the organization, coordination, supervision and scheduling of water resource using a series of comprehensive means including administration, law, economy, technology and education, the development and utilization of water resources of the organization, coordination, supervision and scheduling. JIANG Wen-lai (2004) believed that water resources management is a series of measures aiming to meet the water demands of human and maintain a sound ecological environment. (2) Systemic view. REN Hong-zun (1990) believed that water resource management is the organization, supervision and control of water resource’s development, utilization and deployment using legal, administrative, policy, technical, economic and educational means; SUN Guang-sheng, et al (2001) divided the development, management and distribution of water resource into five links including evaluation, development, supply, use, protection and three levels including macro, medium-view and micro. (3) Sustainable development view. HE Wei-cheng (1989) believed that water resource management is a comprehensive control to water resource using administrative, legal, economic, technological and educational means and in order to maintain a virtuous circle of water resources and long-term development and utilization of water resources to satisfy the increasing water demands of society; Zhou Yuxi(2005) believed that water resources management is a dynamic process the contents of which should adjust according to the changes of supply and demand.

3.2 Research on the management system of water resource

The research on the management system of water resources in China focuses on water resources management system and farmers irrigation behaviors. In the research of water resource management system, QI Jia-yin(2000), LIN Hong-xiao (2003) et al advanced that water resource management should not be charged by one department to control the whole affairs of water resource on behalf of the government, it should be implemented in an integrated water management system. ZHOU Yu-xi (2003) proposed to establish a market-oriented system for water allocation. HU An-gang (2001), YANG Guo-hua (2002) et al suggested to introduce mechanism of “quasi-market” and democracy to the allocation of water resources. In the research of water using behaviors of rural households, HAN Qing and TAN Xiang-Yong (2004) showed that farmers generally use traditional water technologies of low utilization rate of water in the production of food crops, and commonly introduce modern technologies of high utilization rate of water in the production of cash crops. GUO Hui et al (2007) believed that farmers participation irrigation management is a transform of management system and operational mechanism in irrigation areas, it plays a significant role in reducing the state’s financial burden and optimizing water resource allocation etc.. ZHOU Yu-xi et al (2002) believed that water users associations in Self-reliance Irrigation and Drainage District (SIDD) will promote farmers to save water and increase the investment of construction and maintenance of water conservancy facilities. ZHANG Bing and WANG Yi-Qiu (2004) indicated that the core of SIDD is farmers’ participation with the ultimate goal of water-saving. JIANG Dong-hui (2007) pointed out that the government should clear and rationalize its functions, guide and encourage the participation of everybody, especially the farmers. HU An-gang and WANG Ya-hua believed that same as a wide information disclosure, a
wide participation of water users can reduce transaction and management costs, it is an institution aiming to break the monopoly of water supply and reduce water supply costs.

3.3 Research on the management institution of water resources
The research on the management institution of water resources in China focuses on water property rights and water price. The definition in “Water Law” of China is unclear. Scholars’s definitions about water property rights are various. JIANG Wen-lai (2000) and MU Xian-qing (2004) believed that water property rights are a combined rights (including ownership, management rights and usufruct) of water resources when water resources are fixed. In the research of water trading, ZHONG Yu-xiu (2001) proposes the basic conditions of the establishment of tradable water rights system and legislation principles of the establishment of the water market. ZHOU Yu-xi (2004) suggests to integrate land property right and water property right in the irrigation and allow its succession, transfer and sale, he also think that the farmers could have all the rights in irrigation facilities and irrigation water, so they can sell the water of their own to others. In the research of water property rights trading market, WANG Shu-cheng (2000), HU An-gang (2000) considered that it is the trend to allocate water resources under market mechanisms in the future reform and development of water resources allocation system in China. People in the market could transfer all or part of their own water property rights to others, ZHOU Zhen-min (2007) emphasized the legal protection of the interests of management departments and farmers in the irrigation districts in the trading of water rights. WANG and HU (2000) also believe that the water market is a “quasi-market.” After the initial allocation of water property rights, people could obtain more water beyond the initial quantity through trading (HU Ji-lian, GE Yan-xiang & Zhou Yu-xi., 2005). Pursuing maximum economy benefits impels the water trading, water property rights trading system in the limited total amount causes the profit rate of water resources tend to be the market average rate of return (ZHANG Ren-tian & TONG Li-zhong, 2002). The assume that initial allocation of water resources can not achieve the effective allocation reveals in theory that the tradable extent of water limits the efficiency of water allocation, and water trading system will achieve high efficiency in water resources allocation (ZHOU Yu-xi & GE Yan-xiang, 2006). In water property rights market, supply and demand are in connection with the governments and the water users, whose interactions decide the price of water, affect the competition in the market and determine the water users’ behaviors.

In the research of water price, HAN Hong-yun and ZHAO Lian-ge (2001) believed that a reasonable water price includes price of water resources, production costs, environmental costs and normal profit. ZHENG Tong-han (2002) believed that the water’s supply and demand can not exceed the carrying capacity of water resources and water environment. JIANG Wen-lai thinks that the water price making should be in favor of water-saving, such as marginal cost pricing method and progressive pricing system. LIANG Hui-wen and WANG Hui-min (2002) establish optimal water price model under the goal of seeking water company’s maximum profits. WU Hua-guang (2006) thought that for a long time China’s agricultural water price is generally low, so that there are no incentives for farmers to adopt water-saving irrigation techniques. Because farmers’ awareness to the irrigation water’ commodity property is not enough coupled with the lift of water charges and local governments’ financial cut-off, water price, especially the agricultural water price is lack of flexibility or is of rigid mechanism, and policy-conditioning is hard. The farmers’ weak awareness of water environment and the consideration of food self-sufficiency coupled with low-income are the main constraints to the agricultural water price reforms and the effectiveness of policy.

4. Reviews on the research of water resources management at home and abroad
4.1 Reviews on the research of water resources management at home and abroad

Domestic and foreign scholars researches about water resources management system relate to water property rights and its trading and market, the price of water and agricultural water, water management organizations, farmers’ irrigation behavior etc.. It can be summarized into four aspects: (1) Up to the system from organization. The establishment and development of WUA at abroad are the result of the changes of management system. Since the beginning of the last century 90’s, the establishment of self-management organizations in irrigation areas such as water users associations of farmers has had important influences on water management. The development and continuously improvement of water users’ organizations, in addition to the support of government and the “quasi-market-ization” of water property rights indicate that water resources management system in our country has been changed or is changing. (2) Up to system from conducts. Participatory management abroad promotes the improvement of water property rights and water trading market, and plays an important role in the maintenance of a fair water price policy. Water users association clears the original vague concept of water property rights, advances the development of the institution mechanism of water resources management, stimulates “progressive price” and other forms of pricing, it also brings the “administration plus technology” management into the market rules and makes the researches about behaviors of water users up to the study of system. (3) From centralization to decentralization. At abroad, the transfer of water resources management is a process in which the government’s water management rights are transferred to water users’ organizations, that is a process of separation of powers. The “integration management” which is implemented by self-management associations in irrigation districts in China is aiming to obtain the assets remaining ownership in irrigation areas, which is an actively system evolution from centralization to decentralization. (4) From decentralization to system. Water resources management is a system management project at abroad which has a relatively perfect laws, fully developed market mechanisms, flexible policy environment and abroad public participation. In China, water resources management system is transforming to be a new system which is of “classification management, clear duty and right, effective monitorition, flexibility configuration” and new mechanism with “authorized operation, reasonable compensation”; this transformation is a process of “developing the useful and discarding the useless” to the original management system (DU Wei-xuan, 2005). There are currently still some different ideas and defects in theory researches in China mainly focusing on: (1) Various understanding of the water resources management concept and unclearly described connotation and boundary; (2) Agreeing on the market-oriented water resources management but inconsistent ideas about the content, approach and order of reform; (3) Different understanding of water property rights and unclear regulations; (4) Agreeing on the water users participation management but divergent views on participation patterns, management contents and water users’ status in the management of the; (5) Different angle and ideas about the nature of water prices, pricing basis, methods and keystones of the reform etc..

4.2 Issues waiting for further studies

Water management system in China formed in the traditional planned economy era and has a development in the transition from planned economy to market economy. With the development of economy, there will be greater challenges to water resource management. For the old institution is unfit for the new environments, the conflicts between environment and system is worse and worse. In order to achieve the sustainable use of water resources and sustainable development of economy, society and ecosystem, system innovation has become a necessary and inevitable thing (DU Wei-xuan, 2005). In the specific research of institution innovation, we should focus on the following points: (1) Improve relevant laws and regulations; (2) Achieve integration management of river basin; (3) Enhance the feasibility study of water markets and explore a variety of price formation mechanism; (4)
Strengthen the protection of water resources and its environment and the propagation and education of water-saving; (5) Strengthen the exploration and practice of water-saving measures combining engineering, technologies and system; (6) Pay attention to water users’ especially farmers’ opinions and establish self-management water organizations.

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