

Changes in Irrigation as a Result of Policy Reforms in China: A Case Study of North China

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INTRODUCTION

ECONOMIC REFORMS AND a dramatic opening to the world economy in China have been in process since 1978. One important aspect is policy reform which has had a major influence on agricultural irrigation management. Those changes and developments are still in progress and are being perfected as further requirements are identified.

Since 1970, the situation in North China has been influenced by a continuous drought and a reduction in overall rainfall. The gap between demand and supply for available water supplies has become acute. Even South China, with more abundant rainfall, is also under threat of drought now. Annual grain in production has decreased by more than 10 billion kilograms in the country due to water shortage. Yet, agricultural water use is often wasted in China because of various reasons. Irrigation systems in most irrigation districts continue to use flood irrigation; in many cases, system efficiency is only 25-40 percent.

According to the National Situation Report No. 2, prepared by the Chinese Academy of Sciences, the population of China has reached more than 1.1 billion, and it will reach about 1.3 billion by the year 2000. At that time, it is estimated that grain production would need to be 0.52 billion tons to meet the requirements of 400 kg per capita per year. Therefore, agricultural production efficiency must be increased significantly in order to ensure the needed future grain supply. To increase grain production, it is necessary to expand the irrigated area. At present, two-thirds of the total grain in China is produced from irrigated land, now covering more than 0.7 billion Chinese mu (1 ha = 15 mu). It is estimated that the total potential irrigated land in China is less than 1 billion mu. The amount of irrigation to be developed by the year 2000 is restricted by the land resources condition and available water resources supplies.

Therefore, there are two measures for increasing agricultural production. One is the rehabilitation of existing irrigation systems (which include low-yield land of approximately 0.3 billion Chinese mu), including the popularization of water-saving irrigation techniques. The other is to develop water-saving irrigation on dry land. In either case, effective irrigation management is the key to successful implementation.

DEVELOPMENT OF AGRICULTURAL IRRIGATION IN NORTH CHINA

The annual precipitation is about 500 mm in most parts of northern China. This rainfall can basically meet the rainfall requirements for rain-fed agriculture. But the precipitation distribution is uneven within the year, and 60-70 percent of it occurs in the summer flood season. Spring drought and autumn floods have become the major constraints to increased crop growth. If these problems are solved, especially spring drought, agricultural production in northern China will be more secure and less variable.

Agricultural irrigation in North China has had a long history due to drought as well as the natural conditions of low rainfall, but it did not develop rapidly until after 1950. Reviewing irrigation development in North China, four stages can be generalized:

1. Before the 1950s, agriculture was mainly rain-fed with a very small area of irrigated land, with an irrigation ratio of only about 5 percent (total irrigated area to total arable land area).
2. From the early 1950s to the 1960s, was a period of rapidly exploiting surface water for canal irrigation with an irrigation ratio of 25 percent.
3. From the mid 1960s to the late 1970s, was a period involving intensive exploitation of underground water and rapidly increasing well-irrigated area with an irrigation ratio close to 60 percent.

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4. From the late 1970s up to now has been a period of struggle and persevering for irrigation due to water shortage and financial problems.

At present, North China is one of the most serious water-short regions in the country and, as a result, a large percentage of the arable land in North China suffers drought and, therefore, low and uncertain yields.

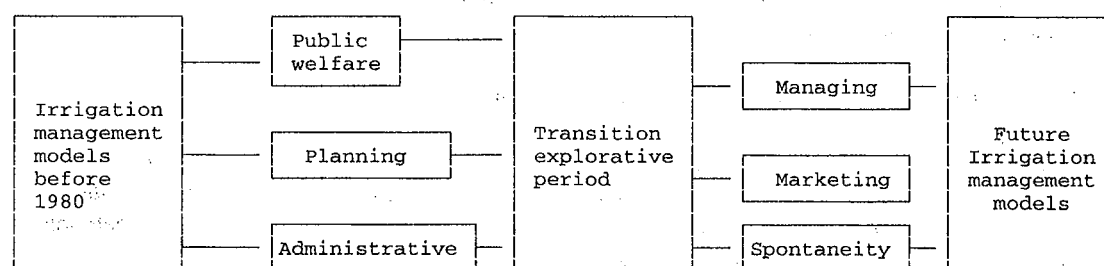
Agricultural water consumption accounts for more than 85 percent of total water consumption in North China. Though the water supply has decreased in recent years and some water-saving measures have been adopted everywhere, the situation of water wasting is still serious due to deterioration and disrepair of irrigation systems, complicated by poor field conveyance systems. As a result, the coefficient of water use in the canal systems is only 50-60 percent in North China on average. It is close to 60 percent in the better irrigation districts and 70 percent in well-irrigated districts.

The irrigation allocation norm is usually higher in surface irrigation districts. In contrast, the irrigation rate per time often reaches 70-100 m³ per mu in irrigation districts served by well-irrigation. As a result, it is necessary to develop scientific and rational agricultural irrigation management; the encouragement of increased irrigation efficiency has become a key means of promoting water-saving in agriculture.

MAIN CHANGES IN IRRIGATION MANAGEMENT OF CASE STUDY DISTRICTS

Before the 1980s, the relationship between irrigation management departments was out of harmony, resulting in many subsequent problems. For example, water supply and water use were managed by two different units, which was unfavorable to unified planning and synchronized management. The beneficiaries did not perform their obligations because of an unresponsive management system. The common property relationship of drinking water from a single large water canteen widely existed.³ Irrigation management was in a vicious circle resulting in serious deterioration and disrepair of the irrigation engineering structures. However, since the reforms and opening to the world economy were carried out in China, irrigation management has changed. This is illustrated in Figure 1.

Figure 1. Changes in irrigation management models in North China.



After the reforms, post-responsibility management systems were established in irrigation districts according to the standards for monitoring and evaluation of the concerned departments. In northern irrigation districts this was done in order to bring the initiatives of irrigation district management staff into play and to comprehensively evaluate the working performance of different management departments as well as each staff member. Utilizing eight economic indexes related to irrigation management efficiency as the basis for monitoring performance, suitable regulations and operational rules were established for different management departments and staff members at each position. Evaluations were made of the performance of every staff member and the achievement of each unit. At the end of a year, awards (including incremental increases in salary and bonuses) were given to individuals and units that achieved their targets. On the other hand, staff members and units that did not accomplish their targets were criticized and penalized. This irrigation management system was called the management responsibility system.

To explore these changes, IIMI and the Shijiazhuang Institute of Agricultural Modernization have been carrying out a joint research project in two irrigation districts in the Hebei Province. The two systems examined in the case study are Bayi and Nanyao Irrigation districts. Table 1 presents some basic information related to these systems.

³Everyone was willing to drink from the canteen, but no one was responsible for ensuring the system was kept filled and maintained.

Management Institutions

Institutional establishment has been an important factor in the reform. As a result, functions changed in the irrigation management system. Due to the need to comprehensively carry out an integrated management responsibility system, irrigation organization structures were adjusted in the two irrigation sample districts of Bayi and Nanyao (see Figure 2).

Figure 2. Changes of irrigation management institutions in North China.

Items	Past models	Current models
Organizing styles	Irrigation management office, Commune and Village Committee	Irrigation management office, Management section, Village management group
Organizing level	Vague	Three-level
Institutional functions	Administrative only	Services type of diversified-economies
Working pattern	Instruction	Enterprise management
Payment for salary	Government	District itself

In order to solve internal financial problems, each irrigation district was expected to: (1) develop diversified-economic activities to increase income in addition to increasing water use efficiency; (2) collect 100 percent of the water fees and (3) reduce unnecessary expenditures. As a result, for example, in the Bayi Irrigation District, revenue from many kinds of businesses are not only used for improving internal management, but also used for the maintenance of the irrigation canals in the entire district. The management model for Bayi is sketched in Figure 3.

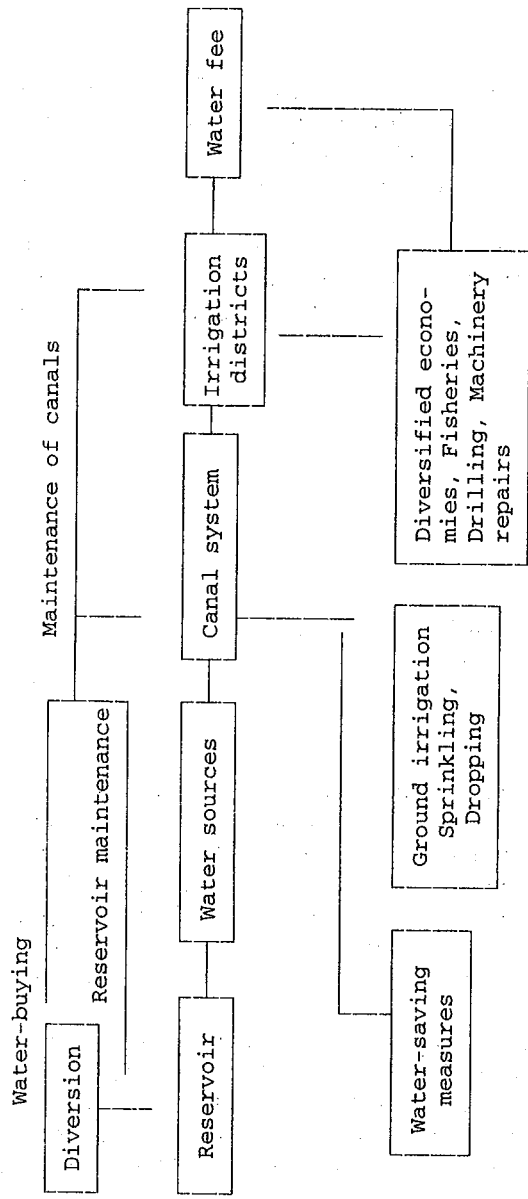
Table 1. Revenue and expenditure data for Bayi and Nanyao IDs.

EXPENDITURE (10 ⁴ yuan)							REVENUE (10 ⁴ yuan)			
	Total expenditure	Operation	Maintenance	Salary	Others	Total	Water fee	Subsidy	Sideline	Others
Nanyao Irrigation Dept.	31.50	14.50	10.00	6.50	0.50	36.50	35.00	0.00	1.50	1.50
Bayi Irrigation Dept.	71.80	49.99	4.85	11.50	5.73	97.60	87.30	10.30	0.00	0.00

Table 2. Income and expenses of water fee of two irrigation districts of Yuanshi and Pingshan in North China Plain.

	Base water fee in 1992 yuan/mu	Volumetric water fee yuan/100 m ³	Base water fee (yuan/mu)			Volumetric water fee (yuan/100m ³)	
			5 years ago	10 yrs ago	5 years ago	10 yrs. ago	
Nanyao Irrigation Dept.	7.5	1.50	2.5	3.5	1.00	0.3	
Bayi Irrigation Dept.	1.00	7.19	0.50	0.30	1.40	0.75	

Figure 3. Management model in the Bayi Irrigation District.



Village irrigation management groups were called irrigation teams before 1984. They were primarily composed of the members of the village committee, while the farmers rarely participated in them. The main task of an irrigation team was to organize farmers to implement the irrigation plan from the irrigation management office; it was never involved in the planning process. Before the implementation of the family production responsibility system, the land was owned by the collective, the water fee for irrigation was collected only on the irrigated area instead of the irrigation water actually used, so the villagers in their irrigation rotation, irrigated only during the daytime. As a result, a large amount of water was lost during the night. Furthermore, farmers' low level of personal initiative, unlevel land and the poor state of repair of sub-sub-branch canals also contributed to the severe water losses.

Radical changes have occurred since the family production responsibility system was instituted. First, the village irrigation management group now is composed entirely of farmers; it is relatively independent of the village committee and is more or less directly under the supervision of the irrigation management section. Every year, farmer representatives from each village irrigation management group attend a working conference for the entire district where they participate in making the annual plan for irrigation and canal maintenance, as well as examine and approve the budget for any improvement projects to be implemented within the year. Second, since the farmers now have their own land, during the irrigation rotation severe water losses during night are avoided. In addition, because the water fee collection now is not only based on the irrigated area but mainly on actual water use, farmers pay much more attention to water-saving practices in irrigation. At present, a four-level irrigation responsibility system has been formed in the two irrigation districts of Baiyi and Nanyao.

Irrigation Management Laws and Regulations

During the transformation from the planned economy to a market-oriented economy, the irrigation management system in some irrigation districts has still not become perfect. In many systems, water measuring standards are not scientific and rational. For example, some districts do not use water measuring devices within the systems and, therefore, they collect water fee according to the area irrigated. As a result, water users cannot see the advantages of water-saving and the disadvantages of water loss.

In order to promote agricultural development, water conservancy facilities should be protected, water saved, the management for agricultural irrigation enforced, and the water fee collection system standardized. The national and provincial governments have issued several laws and regulations related to irrigation. These include:

- * Water Law of the People's Republic of China.
- * Regulations for Protection and Maintenance of Water Conservancy Facilities in the Hebei Province.
- * Regulations on Water Fee Collection.
- * Eight Economic Norms.

All these laws or regulations provide a sound basis to be followed for implementing reforms related to the agricultural irrigation management system.

Income and Expenses of Water Fee

For many years, water fee collected in most irrigation districts in China has been a kind of welfare water fee. Most agricultural production inputs such as fertilizers, pesticides, and tractor-plowing services have been sold at a market price. As a consequence, prices for these inputs have increased significantly. However, it was felt that water fee could not be lifted out of a concern for the welfare of farmers. Yet, according to an estimation from the people's irrigation district in the Jingxing County of the Hebei Province, the production cost for winter wheat in 1993 was about 90 yuan. While the water fee only accounts for one third of the production costs, the benefits are several times higher than the total production costs. Hence, the cost of irrigation water is incompatible with the market price charged for other production inputs.

The cost of water for irrigation water is supposed to include a depreciation charge for the irrigation projects, canal maintenance expenses and operation and management expenses. According to estimates from the Hebei Province, on some large, middle-sized reservoirs and irrigation districts, after accounting for the value of the input of voluntary labor by farmers, the total water cost at the head of a sub-sub-branch is about 5-11 yuan per 100 m³. Considering farmers' ability to pay, the present water price is only about 3 yuan per 100 m³ which is less than 50 percent of the minimum water cost.

The water fee in the two irrigation districts of Bayi and Nanyao usually includes two parts: the base water fee and a water volume fee (Table 2). Annual income and expenses of the water fee and procedures of irrigation management at the irrigation management office level are shown in Figure 4.

In the Bayi Irrigation District, in order to bring the initiative of the farmer members of village irrigation management groups into play, to participate in irrigation management, the irrigation management office allows them to collect 5 percent more than the total water fee as their salary and bonus to compensate for their time and efforts. In the Nanyao Irrigation District, if the village irrigation management group can submit 100 percent of water fees to the office in time (before the first irrigation of the year), the members of the group receive a bonus of 5 percent of the total water fees. The two irrigation districts stipulate that severe penalties will be given to any farmer who steals irrigation water. Therefore, there have not been any cases of water-stealing for the last several years.

Maintenance of Irrigation Structures

Most of the existing irrigation projects were constructed in the 1950s or the 1960s under the system of the planned economy. Some of these projects, especially the sub-sub-branch canals, urgently need to be rehabilitated because of lack of maintenance in the past. However, since the farmers could not afford to rehabilitate the canals, canals or even entire sections of the projects cannot be used any more. This has caused water losses and a consequent reduction of the irrigated area.

In addition, some farmers tend to overirrigate because of their unlevel land and too large area of each crop plot. In the Huquan Village, Bayi Irrigation District, the average crop plot area is about 0.4 ha. In this village, it has been determined that the average water volume used for each irrigation is 237 cubic meters per mu. This is three times more than the normal irrigation. An experiment from the Tanghe Irrigation District showed that when the length of a crop plot increases by 50 meters, the water volume used per mu for irrigation will increase by 30-40 cubic meters.

Since the implementation of the irrigation management responsibility system, there has been a new emphasis on maintenance of irrigation engineering structures. At present, the two irrigation districts of Bayi and Nanyao have routine maintenance on canals at all levels twice every year. These come before the first irrigation and after the last one. Routine maintenance mainly includes desilting, weeding, plugging holes and reinforcing the dikes. Labor required for maintenance is shared by the villages within the irrigation district by providing voluntary labor. Usually, the amount of labor volunteered from each village depends on the irrigated area in the village.

In most cases, the village irrigation management group divides the voluntary labor requirements from its village into a quantity of labor to be provided by each household. If, for some reason, a household cannot contribute the required [voluntary] labor for canal maintenance, these households are requested to pay the wages for hiring other farmers to work. For special maintenance works, different organizations will take responsibility according to the maintenance work done on different levels of the canals. Generally speaking, for important maintenance such as lining of canals or building a new structure along the main canal, the irrigation management office will make the plan and take responsibility of organization; building materials will be provided by the office as well. However, one village or more that directly benefit will be asked to provide the required [voluntary] labor. All maintenance on sub-sub-branch and field canals is organized and conducted by the village irrigation groups through whose villages the canals pass.

Because the central government did not invest in rehabilitation since the completion of the two irrigation districts, in order to prevent the canals from deterioration, the two irrigation districts require a large amount of [voluntary] labor to protect the canals, and at the same time, to try to raise funds to conduct the necessary maintenance within the system. As a result, water conveyance efficiency on the canal is kept at a normal level. In order to tap the potential of the whole irrigation system, an evaluation index--the percentage of the irrigation structures in good condition--is developed to evaluate the maintenance works on canals of irrigation management organizations at all levels within the system. Table 3 illustrates the contributions by Village Irrigation Management Groups (VIMGs) in the two systems.

CONCLUSIONS

Results of the two case study locations show that the management responsibility system is suitable for the development of irrigation in the transformation from a planned economy to a market-oriented economy. As an incentive mechanism, the responsibility system is helpful to improve the maintenance works for the whole irrigation system, to increase the management efficiency, and, most importantly, to recruit farmers to participate in irrigation management. At present, not only is the water conveyance efficiency of canals in the Bayi Irrigation District kept at the normal level, but also the irrigated area is above the actual design level of the system. In Nanyao, water conveyance efficiency has increased slightly. Goals for the two irrigation districts to achieve in the near future are to realize management modernization, service socialization, irrigation professionalization, enterprise diversification and develop transparency in water fee collection.

Figure 4. Water fee collection and irrigation management procedures.

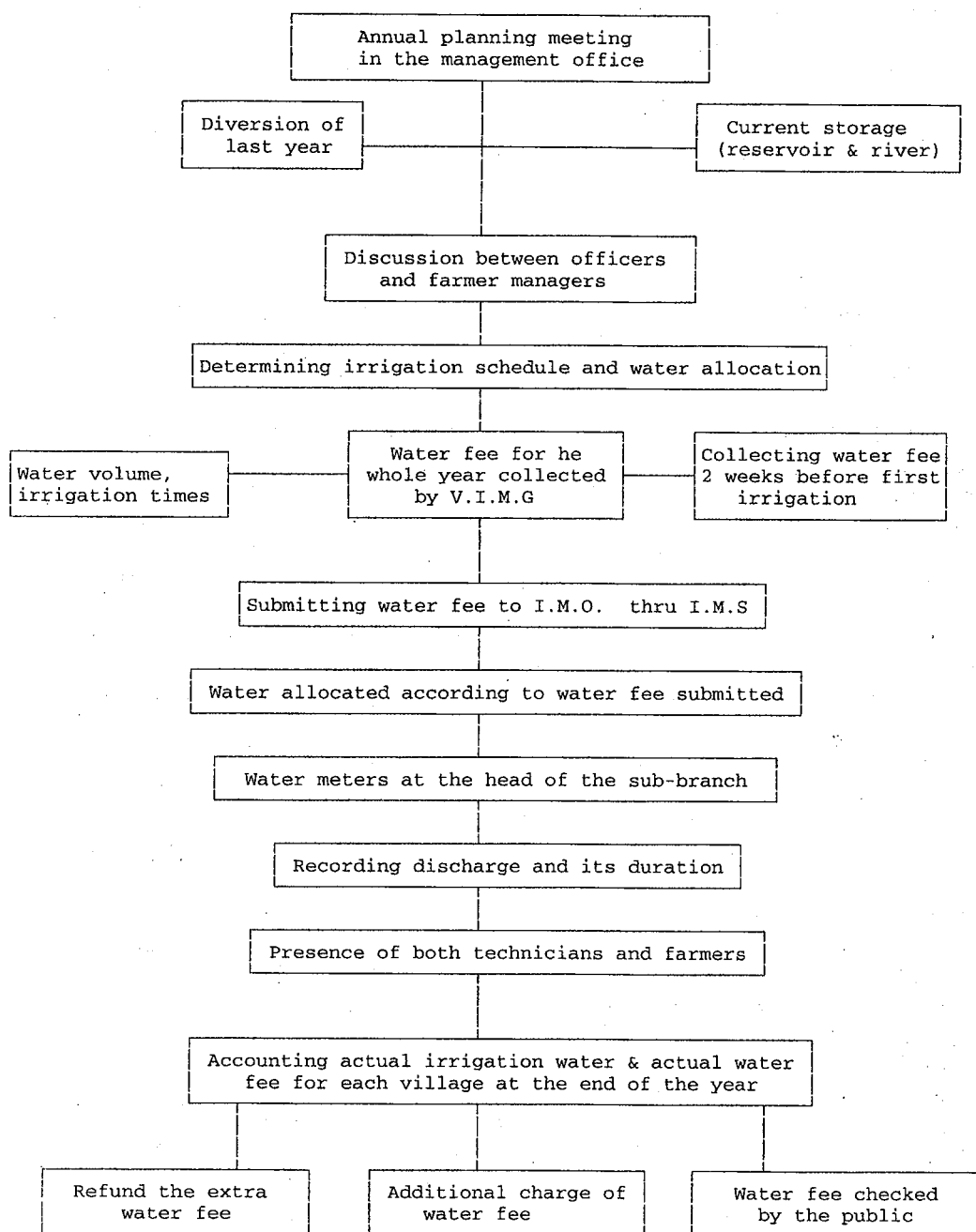


Table 3. Labor input and funds invested by VIMGs.

I.D.	Total labor input (Man-days)			Funds invested by VIMG (10 ⁴ yuan)		
	1990	1991	1992	1990	1991	1992
Nanyao	17410	17426	17444	0	0	0
Bayi	1510583	771338	116040	28.19	13	2.39

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