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The third area was a significant change in the role of the Village Irrigation Management Groups. A detailed description of this process for the two sample irrigation districts is presented in the paper by Vermillion, Wang, Zhang and Mao (1994) and will not be repeated here.

5. Performance Impacts of the Rural Reforms

Although there is no question that the rural reforms have resulted in significant changes in the way water resources and, in particular, irrigation are managed in China, the critical question is whether these changes have resulted in improvements in performance. In this section, performance impacts of rural reforms are examined in terms of three aspects: agronomic changes, financial sustainability, and hydrologic efficiency.

5.1 Agronomic Changes

As indicated earlier, access to irrigation water significantly changed the cropping patterns in the two districts. Before construction of the irrigation districts in Bayi and Nanyao, the main crops were maize and other spring sown crops such as spiked millet, sweet potatoes, buckwheat, and beans, which are all drought tolerant crops. Very little winter wheat was grown. During the 1980s, after the irrigation systems had been established and were working well, the percentage of irrigated winter wheat and maize in the cropping system reached its highest levels. This is illustrated in Figure 4. Recently, however, farmers have shifted to growing more cash crops such as watermelon, vegetables and fruit trees in order to maximize their income.

Prior to development of Bayi and Nanyao irrigation districts, farmers living in the two regions consumed all their grain production within the household. In fact, in dry years the Government was forced to provide grain to the rural families in the area at below-market prices. After the irrigation systems were constructed, as illustrated in Figure 4, irrigated grain production increased significantly. As a result, the farmers sold 1/6th of their winter wheat and 1/10th of their maize production in Nanyao ID and 1/3rd of their winter wheat and 1/10th of their maize production in Bayi ID to the government. With the development of the agricultural production responsibility system there has been sufficient grain after providing their quota to the government for farmers to have grain for consumption and still have grain to sell on the local market.

Currently in Bayi ID about 1.5 T/ha of wheat is sold to the government, about 1.5 T/ha is left for farm family consumption and 1.0 t/ha is sold on the free market. For maize about 10 percent of the total production is sold to the government, about 65 percent is sold on the free market and the remainder is used for animal feed. In Nanyao ID, about 0.75 T/ha winter wheat is sold to the government, the remainder is left for family consumption and only a small percentage is sold on the open market. For maize, about 0.75 T/ha is sold to the Government, half of the remainder is sold on the open market and the remaining stock is used for animal feed.

As a result of increased yields, facilitated by access to irrigation water, chemical fertilizers and pesticides, and new high yielding seed varieties, net returns per hectare have increased significantly. Table 4 compares the yields, input levels and net incomes for Bayi and Nanyao IDs for the 1950s, 1960s, 1970s, and 1980s. As can be seen, development of the irrigation systems, combined with implementation of the rural reforms, resulted in impressive improvements in net income in the two districts. Bayi ID, due to its higher yields, has been able to sustain its growth in net income, while Nanyao ID has seen a drop off of net income as annual per ha production of wheat and maize has stagnated during the 1990s.

5.2 Financial Sustainability

Central to the transfer of irrigation management, development and reform has been the issue of financing. In this process it has been critical that farmers and irrigation officials alike recognize that irrigation water is not a free good, but a valuable production resource. Since the implementation of the rural reforms, education and propaganda schemes have been used to educate users and suppliers of agricultural water on the importance of financial stability to ensure long-term security of irrigation supplies.

Prior to the reforms, water fees were paid by the communes and thus "collection rates" were always 100 percent. However, as the reforms were instituted, collection rates dropped drastically as there was confusion within the irrigation systems about management responsibility. Improved management services and extensive education programs have been used as a mechanism to increase water fee levels as well as collection rates. These approaches have been successful as water fee collection increased from 436 million yuan in 1984 to 1,830 hundred million yuan in 1991 and in 1992 they doubled to 3,570 million yuan (all in current yuan). In addition to increased fee levels, collection rates

[6]Xuren Chen and Renbao Ji (1994) have a good discussion of this phenomenon in their overview paper.

increased from 30 percent in 1984 to 70 percent in 1991 (Turner and Nickum 1994). The reduction in subsidies and the obvious necessity to increase local funding to support operation and maintenance (O&M) expenses also served as catalysts to improved fee collection in many areas.

The situation has been the same in Nanayao and Bayi irrigation districts. Fee levels and collection rates have increased since the institution of the rural reforms. For example, in Nanyao ID the water fee collection rate was 100 percent until 1984 while it was paid by the commune. After 1984, when the rural reforms were first introduced, due to the confusion and an actual reduction in irrigation service, combined with an increase in the volumetric water fee, the collection rate fell to 85 percent. It fell even further from 1988 to 1991 as the district struggled with instituting a revised management system, including the WPRS. It wasn't until 1993 that the collection rate rose above 90 percent (95 percent). The case of Bayi ID is even more striking. Again the collection rate for irrigation water fees was 100 percent while paid by the commune. When the rural reforms were first introduced in 1983, the water fee collection rate fell to 5 percent. It rose to 80 percent the following year and has been fairly close to 100 percent since then.

Water rates and, therefore, actual water costs to the farmers have gone up significantly since the mid-1980s when the reforms were implemented. This is based on the principle, *He who benefits must take responsibility for management and make investments.* In both sample districts, irrigation water fees are a combination of a fixed fee based on irrigated area, and a volumetric fee based on water used. For Nanyao ID the rates are 1.5 yuan/100 m^3 and 112.5 yuan/ha, while Bayi ID presently charges 7.19 yuan/100 m^3 and 15 yuan/ha. In Nanyao, volumetric charges are only charged at the main canals as they do not have measuring devices at the sub-branch level. Therefore, at the Village Irrigation Management Group (VIMG) level farmers are charged a flat rate of yuan 225 per ha for irrigation water.

Figure 5 illustrates the historical trend of water fees for the two districts. These data are in constant 1991 Chinese yuan so the significant increases are real, not just reflections of inflation in the Chinese yuan. As can be seen, in Nanyao, the rate based on volumetric flow is less than the 225 yuan per ha. The additional funds collected are used to pay lower-level irrigation staff and provide incentives to the VIMGs to ensure they collect 100 percent of the water fees.

Even though Nanyao is known as a water surplus area and both buys and sells water, the increases in O&M costs as the rural economic reforms and the WPRS have been implemented have forced the actual per ha water costs to increase. As can be seen in Figure 6 the steadily increasing water costs have encouraged conservation in water use, thus per ha water use has declined significantly since the early 1980s.

Expenditures and revenues have both increased since the implementation of the economic reforms. As indicated earlier, one of the mechanisms encouraged to address the need for additional revenue is the development of a supplemental market-oriented enterprise. To date, Nanyao ID has not developed any such enterprise, but Bayi ID has been extraordinarily successful in this area. At present Bayi ID has 9 enterprises, of which 8 are making a profit. These include:

1. Building materials (producing limestone, cement and bricks),

2. Food and services (two restaurants and a barber shop),

3. Engineering services (design, feasibility studies, and technical consulting),

4. Machinery repairs (farm equipment and pumps),

5. Well installation (well digging and pump installation), and

6. Construction (building and renting apartments and small houses).

Within the district, the ratio of gross income from water fees to gross income from enterprises is 5:3. In terms of net income, the ratio is 2:1. Of the 67 employees in the irrigation district, 30 work in water management while 37 are involved in enterprise management. For diversified enterprise management, targets are established based on anticipated net profit. These are normally negotiated between the irrigation district and the enterprise managers. Up to the level of the target, all profits go to the irrigation district. Profits above the target are retained by the enterprise and are usually distributed as profit-sharing among the enterprise employees. In 1992, the irrigation district received 103,000 yuan in enterprise profits. This, combined with the 873,000 in water fees paid by farmers and a small amount of maintenance funds from the county, allowed Bayi to cover all of its expenditures, including paying 375,000 yuan to purchase water from the Gangnan Reservoir. Thus, Bayi ID has been able to use profits from sideline enterprises to maintain financial stability. In the past, Nanyao ID has been able to remain financially stable without requiring other

income. However, with constantly increasing expenditure levels, the district is actively exploring alternative revenue possibilities.

5.3 Hydrologic Performance

One of the most important hydrologic relationships in irrigation management is that between available water and land. In this context, one of the primary tasks facing irrigation system managers is to match area to be irrigated with the current water supply. Other things being equal, good managers will try to maximize the area served while producing acceptable yields on all of the area. Viewed another way, the manager's task is to make each available unit of gross water supply go as far as possible.

In Nanyao, irrigated area has remained almost constant for the last 20 years, suggesting that this is the maximum service area of the system (Figure 7). Water supply has shown considerable variability over this period (Figure 8), and these two facts taken together indicate that water supply is not constraining in Nanyao. Combining area and discharge information results in a set of figures portraying the duty of water supplied, which is the amount of water supplied per unit area irrigated. Figure 9 shows that for most of the past 20 years, Nanyao has had a supply of about 1,000 millimeters per year available to it. Following the canal lining program during the 1977-80 period, it can be seen that water deliveries increased sharply before beginning a steady decline from the 1982 peak of almost 60 MCM (Figure 8). Because area irrigated held steady during this period, the result is reflected in Figure 8 as a steady and dramatic decline in the duty of water supplied in Nanyao. Water use per unit area today is just one-third of the amount supplied in the early 1980s. This is said to be principally a result of increasing upstream abstractions.

In Bayi, which is located in flatter terrain, only a fraction of the potential command is irrigated, and area irrigated has fluctuated considerably from year to year (Figure 7). Figure 7 shows clearly the result of the completion of the Yingang supply channel from the Gangnan Reservoir in 1976, as irrigated area increases dramatically in the following two years, peaking at around 6,600 hectares. In subsequent years, area stabilizes at around 4,500 hectares. Figure 8 shows the main canal discharge, which also increased substantially after 1976, but then shows a continuing downward trend from 1979 to the present. Duty figures (Figure 9) show more variability than do those for Nanyao, but have declined somewhat from peak years.

Even though both systems have shown declining duties over their lifetimes as they come to use water more efficiently, duties in Nanyao are still about double those in Bayi, even though rainfall and cropping patterns are similar. Scarcity is obviously unevenly distributed and though both systems buy and sell water, markets in water are clearly not yet completely efficient.

Another interesting comparison is that illustrated in Figures 10. This figure compares the number of irrigations per year for the two systems. This provides an interesting comparison as Nanyao has clearly much more water than Bayi, yet output per irrigation in water-rich Nanyao is only about one-third that in Bayi as Bayi produces about 3 kg/m^3 of water, while Nanyao manages only around 1 kg/m^3.

Although the levels of other input use must be considered in making a valid comparison of this type, these results are suggestive of greater production efficiency in Bayi. It should be remembered that Bayi is producing almost 12 tons of grain/hectare with this water, while the annual output in Nanyao is only about 8.5 tons/hectare. A challenge which must be faced in this region is the development of institutions and pricing and marketing systems which will move water from less efficient systems to more efficient ones.

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Table 1. Crop Patterns in Nanyao and Bayi I.Ds (Average in 1990s)

Crop	Bayi I.D		Nanyao I.D	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Winter - Wheat Maize	7738.9	74.3	2473.3	74.2
Cotton	1385.3	13.3	333.3	10.0
Vegetables	364.6	3.5	93.3	2.8
Rice	-	-	66.7	2.0
Water Melon	250.0	2.4	36.7	1.1
Fruit Orchard	177.1	1.7	10	0.3
Sweet Potato	166.2	1.5	180.0	5.4
Spiked Millet	93.7	0.9	50.0	1.5
Drug Plants	-	-	16.7	0.5
Beans	83.3	0.8	40.0	1.2
Sorghum	62.5	0.6	23.3	0.7
Others	104.2	1.0	10	0.3
TOTAL	**10415.8**	**100**	**3333.3**	**100**

Table 2. Patterns of Water Requirements by Winter Wheat

	Developing Stage	Before Over-wintering	Over Wintering	Turning Green to Jointing	Jointing to Heading	Heading to Maturing	Total
	Duration	1/10-30/11 61 days	1/12-28/2 90 days	1/3-31/3 31 days	1/4-30/4 30 days	1/5-10/6 41 days	263 days
Bayi I.D	ETp[4]mm	55.4	44.1	55.2	118.8	213.8	484.9
	Average Rainfall** (mm)	47.0	13.1	10.2	20.5	56.6	147.4
	Difference	8.4	31.0	45.0	96.1	157.2	337.7
Nanyao I.D	ETp[4]mm	50.7	44.1	57.9	118.5	219.6	498.9
	Average Rainfall*** (mm)	43.3	13.5	12.2	22.7	54.2	147.5
	Difference	17.4	30.6	45.7	93.9	166.4	351.4

Table 3. Patterns of Water Requirements by Maize

	Developing Stage	Early Growing Period	Jointing Period	Heading Period	Milky Period	Total
	Duration	10/6-30/6 20 days	1/7-30/7 30 days	1/8-20/8 20 days	21/8-20/9 31 days	102 days
Bayi I.D	ETp[4]mm	44	118.7	85.6	116.6	384.9
	38.8age Rainfall** (mm)	38.82	142.2	110.1	87.89	378.9
	Difference	5.2	-23.5	-24.5	28.8	-14.0
Nanyao I.D	ETp[4]mm	43.2	118.7	81.3	116.3	359.5
	Average Rainfall*** (mm)	34.7	147.1	99.3	88.8	369.9
	Difference	8.5	-28.4	-18.0	27.5	-10.4

Table 4 Inputs and Outputs from Farming Bayi and Nanyao IDs

Item	Bayi ID					Nanyao ID				
	1950s	1960s	1970s	1980s	1990s	1950s	1960s	1970s	1980s	1990s
Chem. Fert (yuan/ha)		8	187.5	740	1535		8	187.5	645	1260
Pesticide (yuan/ha)			7.5	105	135			7.5	150	150
Manure/1 (yuan/ha)	30	30	45	55	55	30	30	45	75	75
Seed (yuan/ha)	150	180	200	210	390	150	180	200	210	390
Labor/2 (yuan/ha)	270	270	300	310	270	270	270	300	350	380
Machinery (yuan/ha)			10	157.5	322.5			10	150	202.5
Water Fee (yuan/ha)		6	8	50	240				52.5	225
Total Input (yuan/ha)	450	494	758	1628	2948	450	488	750	1633	2683
Avg Yield (T/ha)	1.05	1.6	3.6	8.8	11	0.9	1.4	3.7	7.6	7.6
Market Price/3 (yuan/ha)	0.66	0.87	0.67	0.58	0.69	0.66	0.87	0.67	0.58	0.69
Total Output (yuan/ha)	693	1392	2412	5104	7590	594	1218	2479	4408	5244
Net Income (yuan/ha)	243	898	1654	3477	4643	144	730	1729	2776	2562

/1 manure price = 1 yuan/m3 for 50s, 60s amd 70s, 2 yuan/m3 for 80s and 90s
/2 market price using 0.4 x wheat price + 0.6 x cotton price
/3 labor = 0.3 yuan/day in 50s and 60s, 0.5 yuan/day in 70s and 1 yuan/day in 80s and 90s.

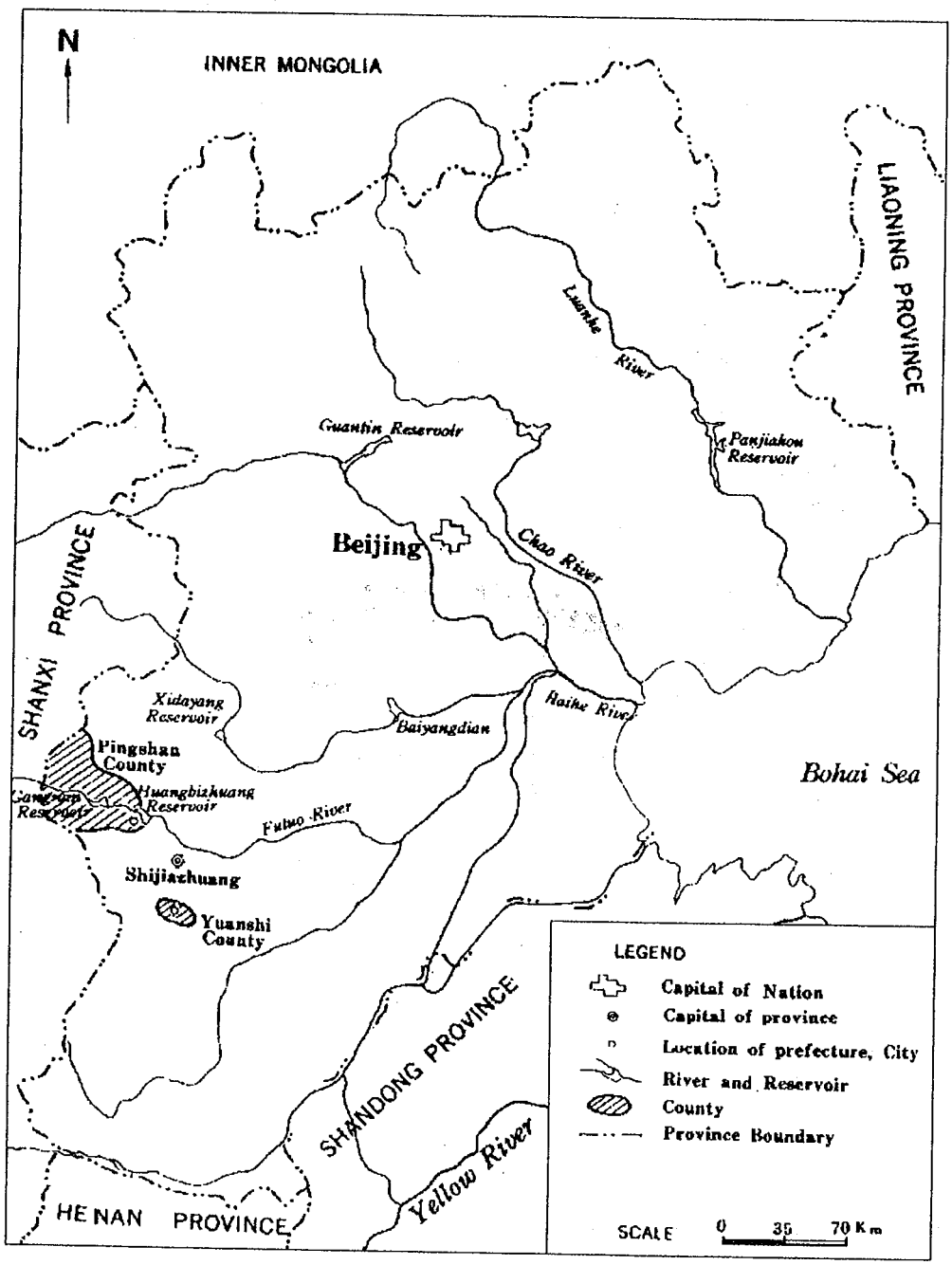


Figure 1 Hebei Province Showing Location of Pingshan and Yuanshi Counties

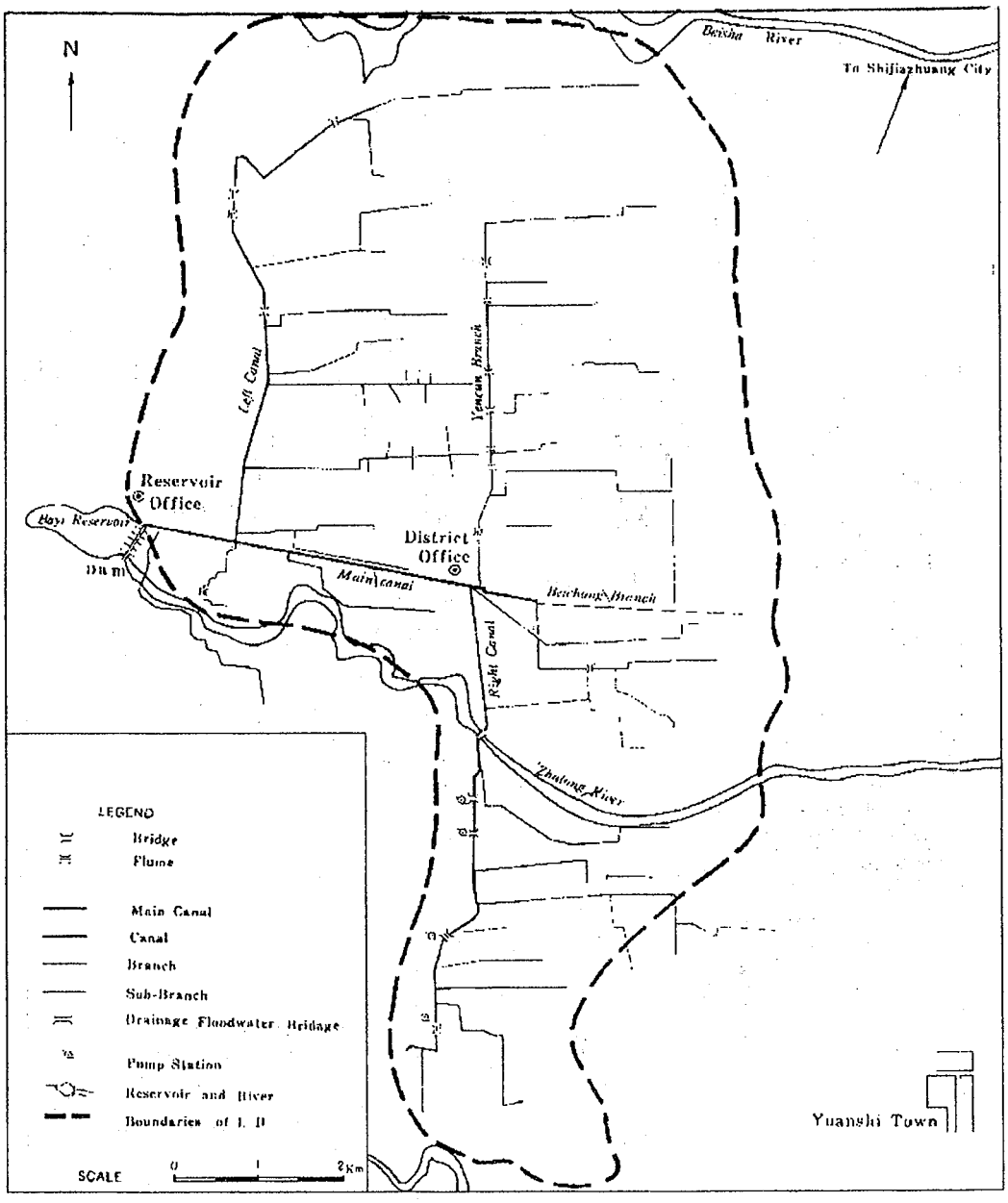


Figure 2 Canal Schematic Layout for Bayi Irrigation District

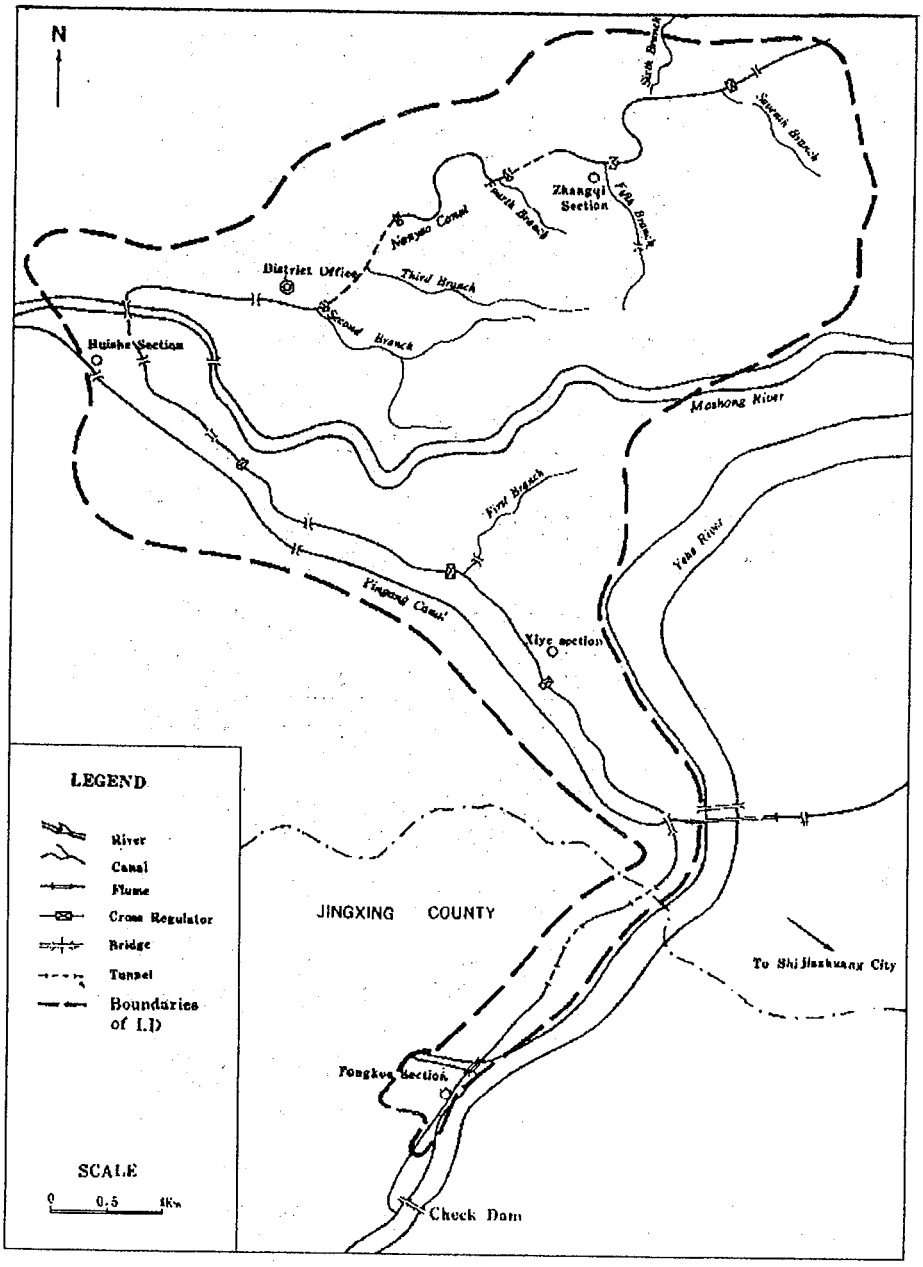
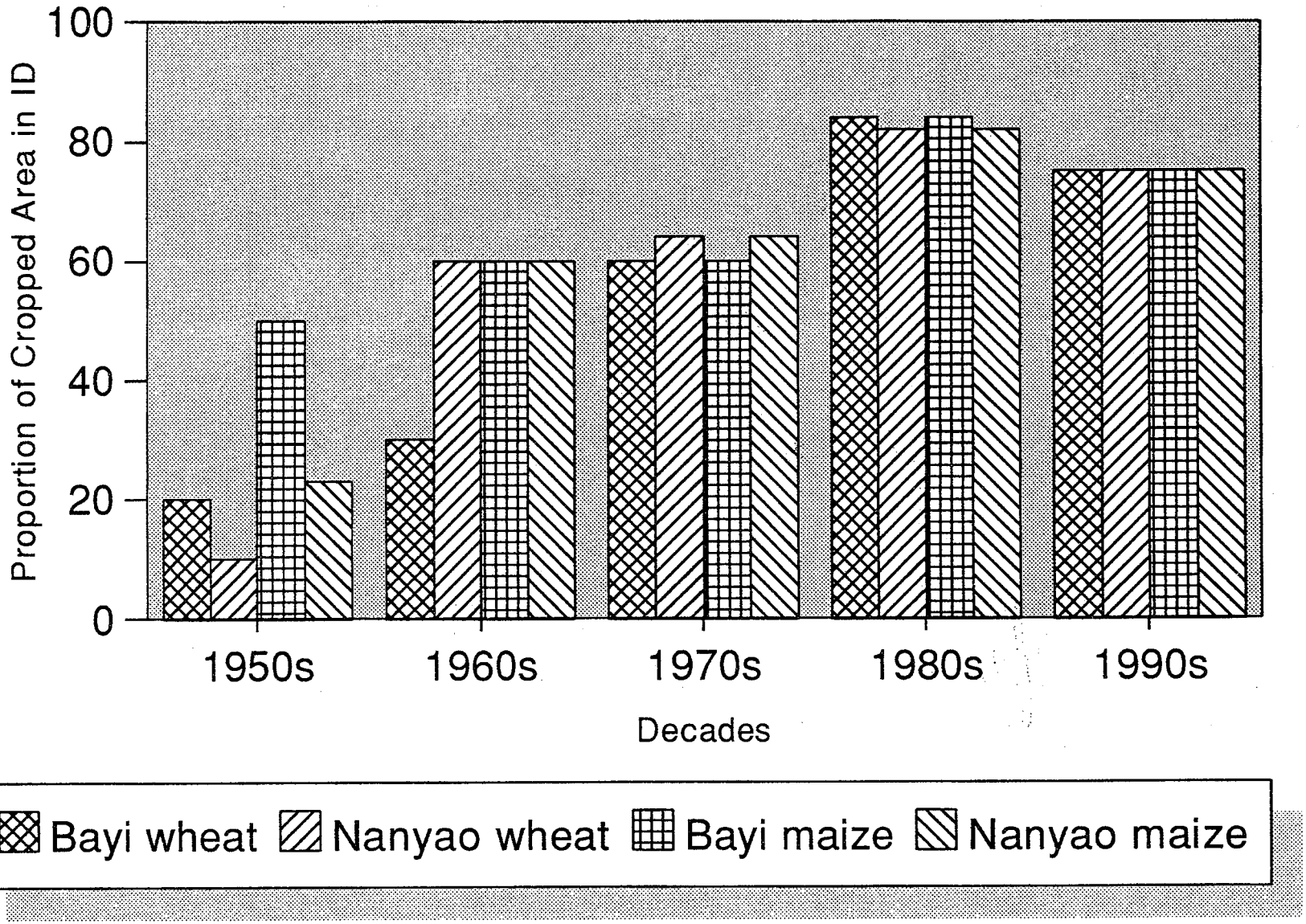


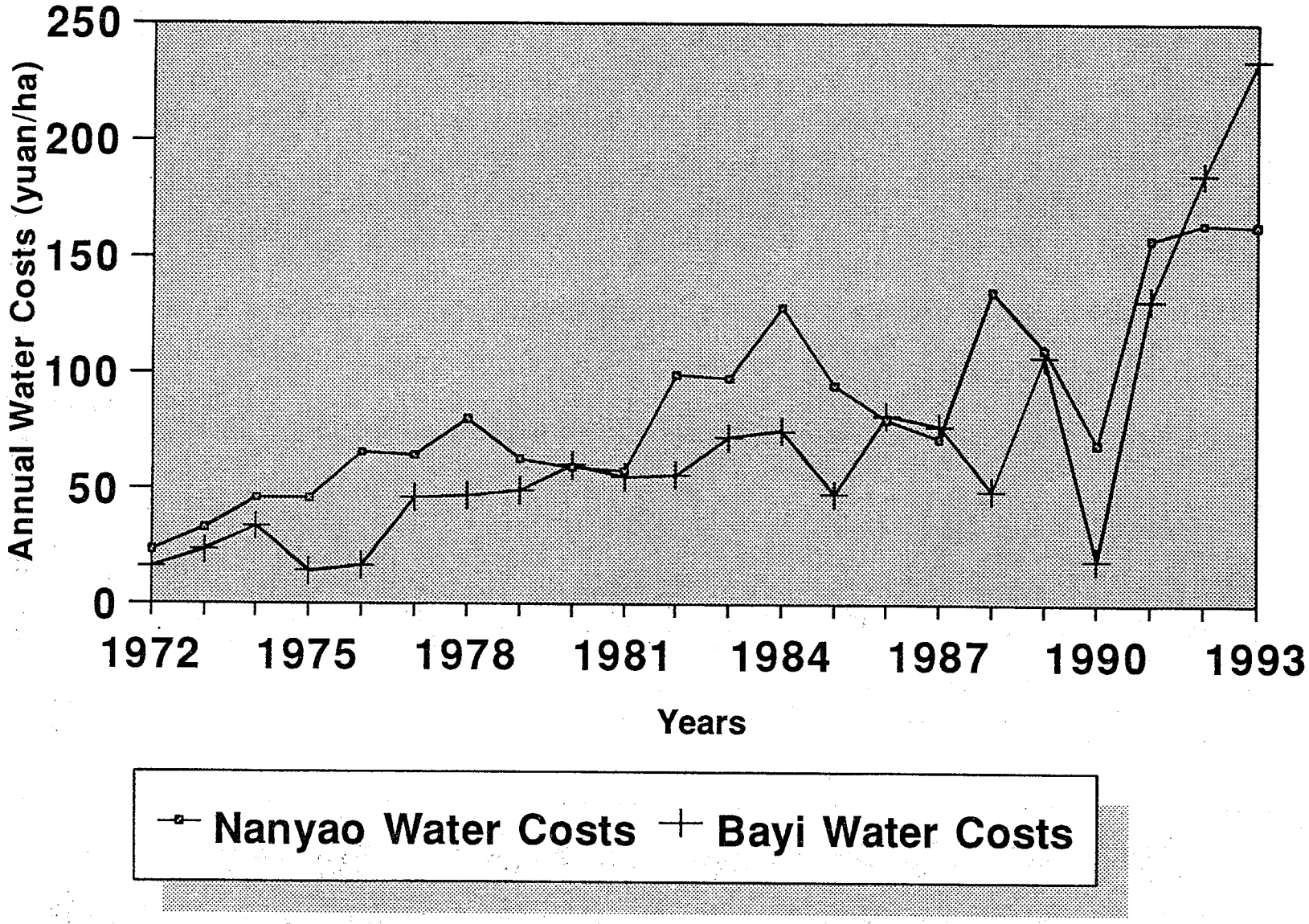
Figure 3 Schematic Canal Layout for Nanyao ID

Figure 4 Proportion of Land in Irrigated Grain Crops Bayi and Nanyao IDS -- By Decades 50s-90s



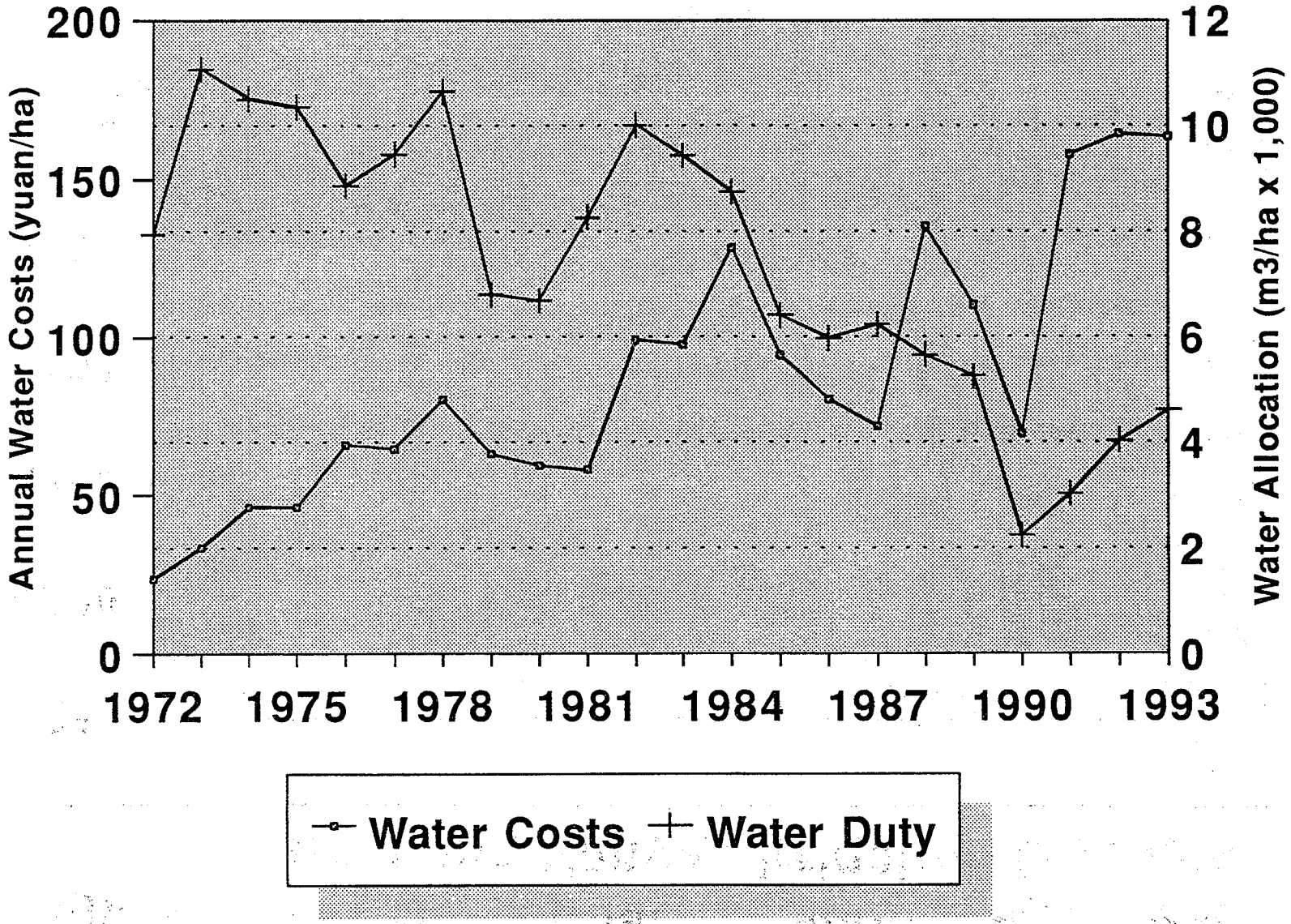
data from IIMI-SIAM collborative study, 1993-94

Figure 5 Per Ha Annual Irrigation Water Costs Bayi and Nanyao Irrigation Districts



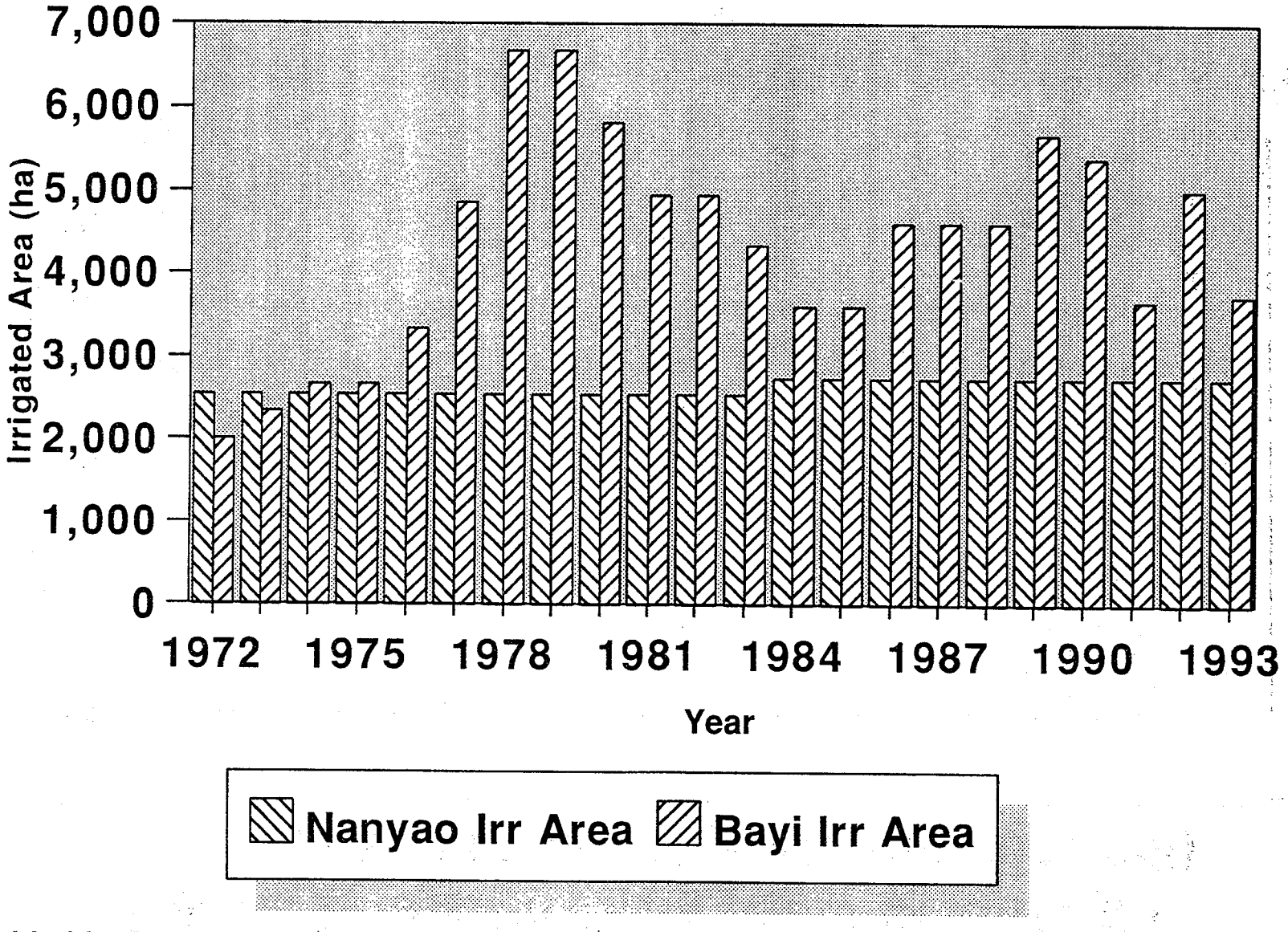
Converted to 1991 Chinese Yuan

Figure 6 Compare Annual Water Costs and Duty Per Ha Values for Nanyao ID 1972-93



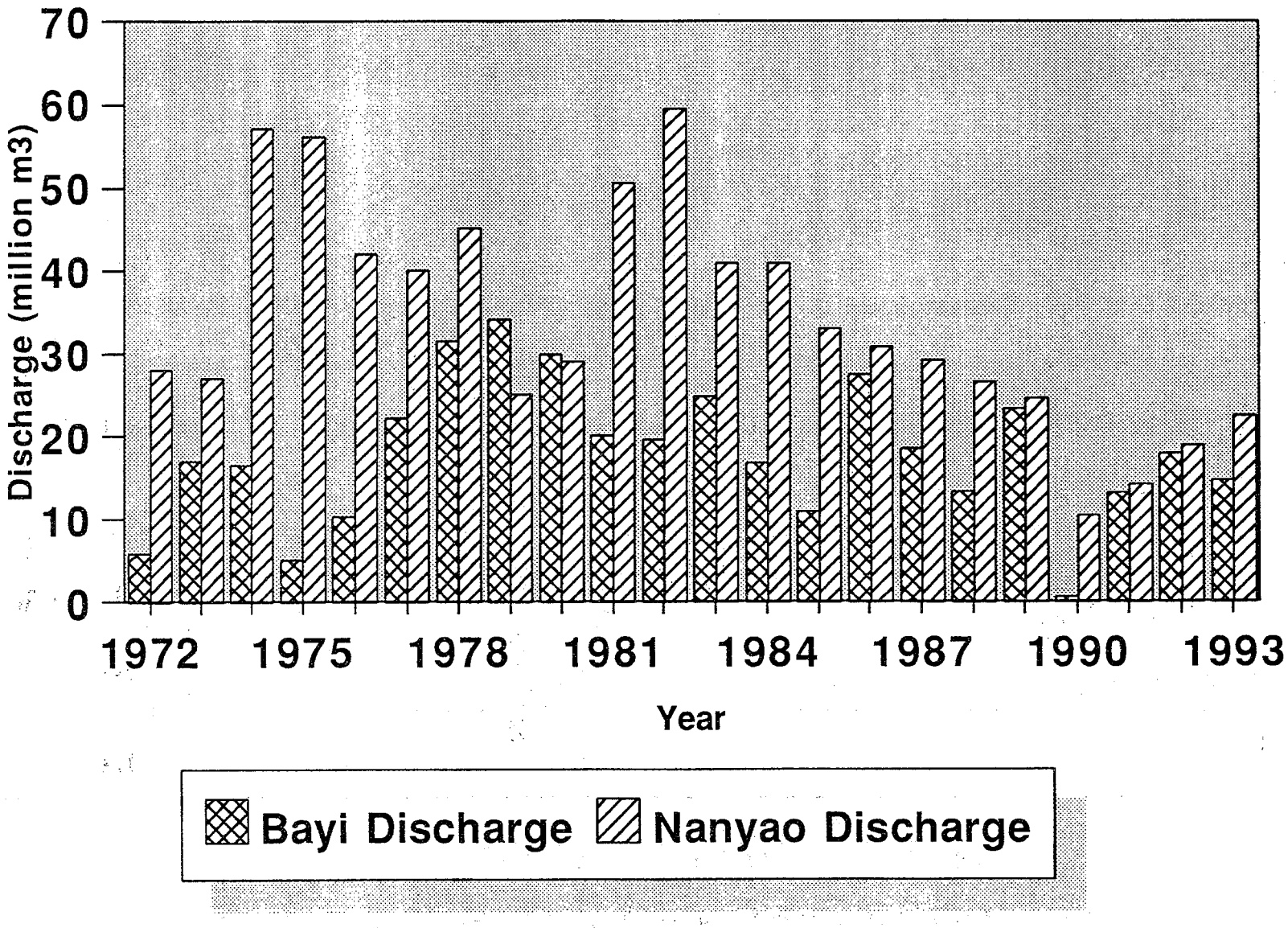
Costs converted to 1991 Chinese yuan

Figure 7 Annual Irrigated Area (ha) In Bayi and Nanyao IDs



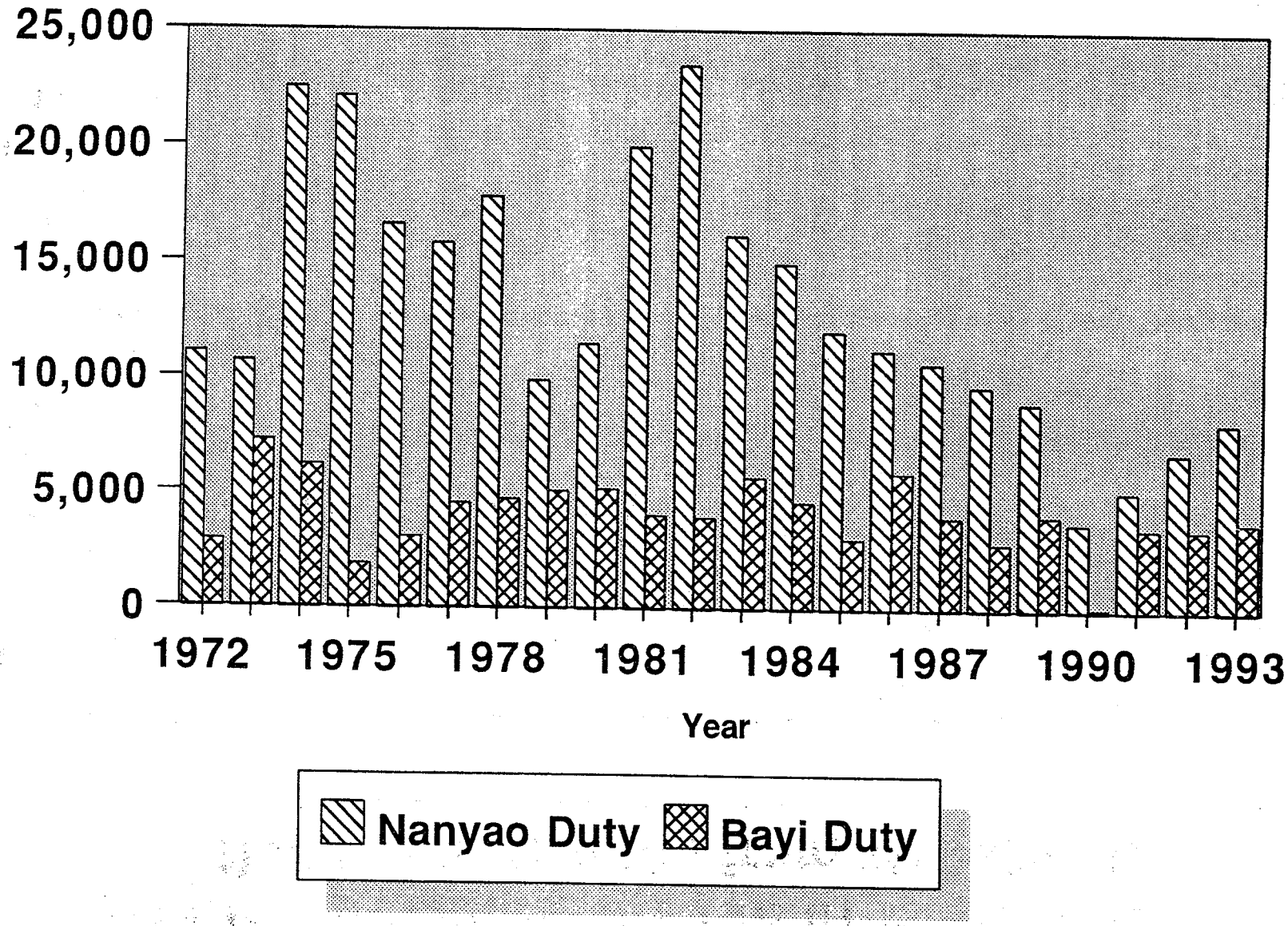
data provided by Bayi and Nanyao IDs

Figure 8 Annual Main Canal Discharge Nanyao and Bayi IDs (million m3)



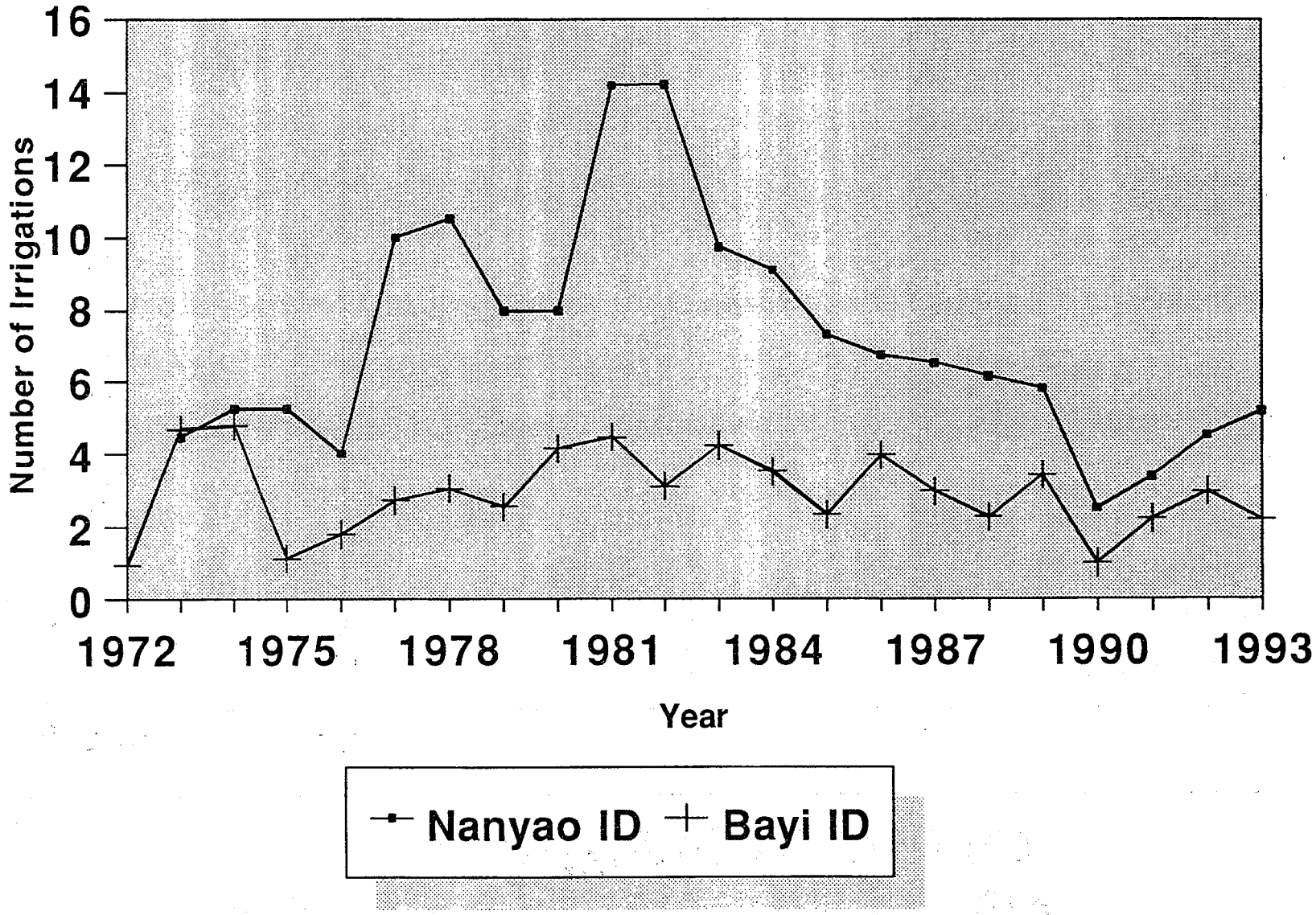
data provided by Nanyao and Bayi ID

Figure 9 Annual Irrigation Duty In Bayi and Nanyao IDs



Based on diversion into main canal

Figure 10 Annual Number of Irrigations Nanyao & Bayi IDs from 1972-1993



Data provided by Nanyao and Bayi IDs

Irrigation Management Transfer in China

Jiang Kaipeng[1]

INTRODUCTION

Irrigation has had a long tradition in China. Since the founding of the People's Republic of China, the Chinese Government has put great emphasis on irrigation. Farmers have dedicated themselves to making the maximum use of limited water and arable land. At present in China, the total irrigated farmland has reached 53 million ha of which, 50 million ha is effectively irrigated. The irrigated farmland, covering half of the total area under irrigation, produces 70 percent of the total grain output, 80 percent of the total cotton output and 90 percent of the total amount of vegetables.

Irrigation projects play an important part in the development of agriculture and rural economy. Besides the direct economic benefits from increasing agricultural products, irrigation projects have played a part in improving the eco-environment, reforestation, water supply and navigation, thereby improving rural production and living conditions, and promoting regional socioeconomic development. Therefore, both direct economic benefits and indirect social environmental benefits from irrigation development are significant.

At present, there are 5,340 irrigation districts (667 ha and above) and over 20,000 small irrigation schemes. More than 80,000 reservoirs of various sizes with a total storage capacity of 468 billion cubic meters have been completed. Some 3.35 million tubewells and 0.49 million pumping stations have been installed for irrigation and drainage, amounting to 66 million KW. Small sluices, dams and ponds are widespread throughout the country.

These irrigation projects are owned and managed by the State, collectives and individuals, respectively. The responsibility and authority for irrigation are mainly determined according to investment. Projects invested in by the State are owned and managed by the State. Projects invested by collectives (subsidized by the State and with labor contribution of farmers) are owned and managed by the collectives while projects built by farmers (subsidizes by the State) are owned and managed by themselves.

Large and medium irrigation projects are generally owned and managed by the State. An irrigation system within one administrative region is managed by a public organization under the jurisdiction of the water authority of the region. An irrigation system covers two or more administrative regions, and is managed by public organizations under the command of the higher water authority. A large irrigation district is usually managed by organizations at various levels, such as prefecture, county, township and village (see the following map).

Irrigation Management Development

The development process of China's irrigation management can be divided into two phases: highly centralized management and relatively independent management.

Highly Centralized Management

A majority of the key projects in large irrigation districts were completed in the 1950s and the 1960s. During that period the country was very poor. Based on the advantages of the socialist system, the spirit of self-reliance and hard work, and a highly centralized planning economic system, the State was able to concentrate its limited capital and material on carrying out socialized production. A great number of irrigation projects were completed. Agricultural production conditions were improved. For key projects, material and equipment were provided by the government; farmers contributed the labor. Conveyance systems were completed by communities and were subsidized by the government. Most irrigation districts were built jointly by the State, collectives and individuals.

Irrigation management organizations were generally appointed by the government through water authorities. Irrigation districts were managed according to the government's plan. Water was free. The operation and maintenance costs, as well as the salaries of the irrigation district staff were paid for through the Public Revenue. Part of the salaries of both contract and temporary workers was paid for through the Public Revenue and the other part was paid for by the collectives.

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Agriculture was organized on cooperative principles. Collective community was the popular form of agricultural settlements. In these communities, the means of production were communally owned and each member's work benefited all. After making a contribution to the State the rest of the production was allocated among members according to each member's contribution to the community.

Under the centralized economic system, irrigation districts were directly managed by the government. In spite of its shortcomings, this system played an important part in increasing productivity during that period.

[Relatively] Management

Since the 1980s, introduction of the production responsibility system in the countryside has motivated farmer's initiatives. Agriculture has developed dramatically. To be geared to the system, the irrigation management system has also changed from complete government control to contract management.

Irrigation management transfer is implemented on the principle of separating management rights from ownership. The Water Authority, which is the tender inviter, invites public bidding. The management organization, the bidder, makes a bid for irrigation management. The winner should sign a contract (for about 3 years) with the water authority. This is the first stage contract. The first stage contractor will invite public bidding and so on. The management station is the second stage contractor and the individual is the third.

Through contract management, the competition system was introduced. The management organization is optimized. The introduction of the contract management responsibility system brought about a dramatic change in the local responsibility and authority. The benefits are significant. It is necessary to improve and extend this kind of system.

APPROACHES TO INNOVATION ON PROPERTY RIGHT OF IRRIGATION DISTRICT AND IRRIGATION MANAGEMENT TRANSFER

With further reforms in the countryside, the contract management responsibility system began to show its limitations. The key factor of contract management is how to determine properly the base of the contract. The contract is based on the original property rights. The readjustment in benefits distribution is a constraint of property rights. So the contract base is often determined subjectively, not tallying with the economic law. Some contract targets such as revenue and expenditure, [intact] degree of the project, the irrigated area, production investment, water use efficiency, etc., have no clear relations with the improvement of management levels. So it is not easy to carry out these contract targets. Sometimes, a contractor competes for profit with the government but the government cannot limit the short-term action of the contractor. Some governments improperly interrupt the management of irrigation districts. Irrigation water fees cannot compensate for the cost. Irrigation management organizations are facing great difficulties in collecting irrigation water fees and raising funds to rehabilitate existing projects. They are not able to solve such problems by themselves. It is not easy to find a balance between the tender inviter and the bidder. Nobody will be responsible for the outcome of investment and management. This causes a great deal of losses of State-owned fixed assets.

With the establishment of the socialist market economic system, new irrigation management systems should be considered. It is important to determine the property right of irrigation districts and realize the separation of ownership, use and control. This could be done in the following manner:

1. Assess assets and determine property rights. The first thing to do is to assess the assets of irrigation districts and estimate the value of fixed assets. Then convert the total value into shares based on the capital and labor investment in the project. Shares consist of State shares, organization shares, collective shares and individual shares. Each entity has the nominal ownership of its shares and the right to share profits.

2. Set up a new management system according to the requirements of shareholders. To get their share of profits, shareholders have to retain the original assets and make profits. This can form a multi-property-right benefit continuum, consisting of the State, collectives and individuals. The desire for profits makes shareholders select modern management systems, e.g., shareholders' congress responsible for making important decisions, board of directors acting as legal representative and managers accountable for daily management. The manager can formulate internal regulations for irrigation management such as the target management responsibility system and the contract responsibility system.

3. Formulate an economic system for [good circle.] To retain simple reproduction and to expand production, irrigation districts must have stable incomes. These are water fees and shares in cash from beneficiaries. Shares of the State and collectives should reflect the favored policies for agriculture and water sectors.

Beneficiaries pay water fees and bear "shares" on the basis of irrigated area and water supplied. The benefits of these "shares" will not be reflected [though sharing of profits in cash but grain and side agricultural product increments.] Shareholders other than direct beneficiaries will share profits in cash.

EXPERIENCES WITH IRRIGATION MANAGEMENT TRANSFER

Numerous irrigation management transfer programs have been implemented in China. Laiyang in Shandong Province and Jiaozuo in Henan Province have been implementing irrigation management transfer programs for two years. The program is called a cooperative share system, i.e., the combination of a cooperative system and a share system. The cooperative share system has been implemented in 410 projects in 144 village in Laiyang. The total fixed assets amount to RMB 12.4 million yuan (US$1.5 million). The fund raised by 28,000 shareholders totals RMB 20 million yuan (US$2.5 million). The irrigated area has been increased by over 10,000 ha. Benefits have increased by RMB 6.5 million yuan (US$0.8 million). The basic ideas of the program are: cooperation, enterprise management, democratic management and supervision.

Approaches of the cooperative share system for medium and small schemes are:

1. Assess assets. A group consisting of experts, management staff, village leaders and farmers, and farmers should be organized. This group will assess existing irrigation projects and keep accounts based on the existing fixed assets;

2. Convert the fixed assets into shares and make property rights clear. Based on the original labor and capital investments, divide shares among organizations and farmers. Each shareholder has equal rights to own the assets and share profits; and

3. Build up the project through the share system and manage it cooperatively. Shares can be cash, materials, labor, land and techniques, etc. Shareholders can be collectives, individuals, the community and enterprises.

Cooperative styles:

* For a new project, after an economic evaluation, shares will be determined based on the principle of investor as owner. The project will be managed through the share system.

* For an existing project, after converting the existing assets into shares and dividing them among all owners, the cost of rehabilitation and production expansion will be shared by all shareholders. The profit-sharing principle of the cooperative share system is: first, accumulation and discount and then, profit-sharing based on contribution and shares.

* Formulate cooperative regulations. It is the basis of cooperative management. The regulation will reflect the right and duties of shareholders, the principle for profit-sharing, measures such setting criteria for project management and financial management systems, etc.

After the implementation of the cooperative share system, the principle of "people who invest in and manage the project will benefit by it" will be realized. The cooperative share system is the main style for irrigation management transfer.

Turnover of Public Tubewells by Gujarat Water Resources Development Corporation[1]

Shashi Kolavalli and K.V. Raju

THE GUJARAT WATER Resources Development Corporation (GWRDC), a wholly owned corporation of the Government of Gujarat (GOG) engaged in groundwater exploration, construction, and management of public tubewells, has been facing worsening financial and operational conditions ever since its inception in the mid-seventies. It has to depend on the government for large subsidies to continue its operations; constraints on what it can charge for its services and cost escalations only add to the deficit every year. It also faces difficulties in collecting water charges from the users and in operating its tubewells effectively through its field staff. In recent years, nearly 20 percent of the deep tubewells which were not being utilized adequately have been closed down. The Corporation began leasing out the tubewells to users in 1987 to reduce costs. About 350 wells have been leased out to users so far.

The objective of this paper is to examine the following: i) the initial objectives of the organization, its performance and the forces which led to the policy of leasing wells; ii) the agency's expectations from transfer; iii) the procedures adopted for leasing the wells; iv) the working of wells subsequent to transfer; and v) the impact of and implications from transfer. This will be done based on information obtained from GWRDC and information collected from a small sample of users who have leased the wells.

OBJECTIVES OF THE ORGANIZATION

The government of Gujarat has been engaged in the development of public tubewells with the belief that it is the responsibility of government to provide irrigation wherever possible (GWRDC 1991, 1). Deep tubewells were installed particularly in alluvial areas which were not served by any public surface irrigation systems. The installation of these wells and their management were initially undertaken by the Irrigation Department now renamed as the Narmada, and the Water Resources Department (WRD). After the introduction of democratic institutions at the district level, the management of these tubewells was transferred to the district *panchayats* (DPs). The latter supplied water at charges which were less than supply costs. The panchayats were in turn given operating subsidies by the irrigation department.

The government felt that its own resources were inadequate to instal a sufficient number of public tubewells. In order to facilitate mobilization of funds and to provide a more flexible and efficient administrative mechanism for developing and managing public tubewells, the government created a wholly owned GWRDC which could borrow from financial institutions (GWRDC 1991, 2). GWRDC had a broad mandate to: i) construct and maintain tubewells; ii) protect, preserve, and develop groundwater resources; and iii) manage the public tubewells using institutional finance.

In accordance with the mandate, the government transferred the Directorate of Groundwater Investigation which was part of the state geological unit to GWRDC in 1976. The irrigation department which was receiving a large number of complaints from users was also not satisfied with the way in which the government tubewells were being managed by the panchayats. In order to centralize their management, about 900 tubewells which were under the control of the panchayats were withdrawn and placed under the control of GWRDC in 1978. As in the case of district panchayats, the government directed GWRDC to supply irrigation at low charges. The government committed to reimburse the losses sustained by GWRDC as a result of the policy (GWRDC 1991, 3). The extent of subsidy, however, was to be determined on the basis of norms to be established periodically for expenses on operation and maintenance of tubewells.

PROGRESS AND PERFORMANCE

A GWRDC tubewell comprises a deep tubewell, a pump house, a tank to create the required head, and an underground distribution system with air vents and outlets to serve about 100 hectares (ha).[2] It has installed 250 to 300 new tubewells annually. GWRDC borrowed nearly Rs 700 million from NABARD to instal tubewells under 11 different projects. The number of public tubewells increased to 3,623 by March 1993.

Unfortunately, not all of the tubewells were used for 2,000 hours annually as had been expected. The performance in terms of the area irrigated or hours of use has declined over the years. The overall capacity utilization was around 67 percent in 1981 owing to poor demand, improper location of tubewells, erratic power supply, poor quality of water, and greater emphasis on construction rather than utilization (Asopa and Dholakia 1983).

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[1]We would like to acknowledge the assistance provided by various officials in GWRDC and Mr. Bhrambhat. Messrs. Rajeev Bhagwat and Prabhat Desai provided valuable research support.

[2]The area which can be actually irrigated by a well is estimated annually based on well discharge. A discharge of 1,000 gallons per hour is expected to be sufficient for 3 hectares or 8 acres. Of this 50, 30, and 20 percent of the area are planned to be irrigated in rabi, hot and kharif seasons.

The general decline in performance can be attributed to both supply and demand related factors. In addition to decline in discharge from wells caused by either changes in aquifer conditions or other technical faults with wells, repair and maintenance of wells were not prompt. These delays combined with erratic power supply have reduced the hours of operation. In addition, GWRDC has had little control over its own operators. It was not uncommon for operators to be taking bribes from users and to often cultivate leased lands in the commands of tubewells in their charge. On the other hand, the users also were not paying the charges regularly. Water allocation procedures deny irrigation to those who have not paid the charges for irrigation already received, as a result of which a significant portion of the users in the commands of several tubewells became ineligible to take water.

In 1992, GWRDC decided to close down wells operating for less than 500 hours annually or discharging less than 10,000 gallons an hour. Nearly 800 wells were shut down because of lack of demand for water, the need to redrill the wells to augment yields, inadequate discharge owing to receding water tables, decline in the quality of water, and large overdues. Out of the total 3,623 wells installed till March 1993, only 2,852 were functioning.

In 1993, the government directed the GWRDC Agency to drill new tubewells only where alternative irrigation sources were limited, where users agreed to manage the well through a cooperative society, and where the users agreed to bear a part of the capital cost. During 1993-94, only 23 new tubewells were put into operation. In the first three months of 1994-95, only 3 wells have been installed. NABARD, the main source of funds for well construction, has decided that it would no longer lend to GWRDC as it has not been recovering the full cost from the users.

FINANCIAL PERFORMANCE AND STATE SUBSIDIES

The financial condition of GWRDC has worsened over the years. The causes can be traced to a low fee for irrigation which was not revised to keep pace with increasing costs, increasing maintenance and repair costs, and to a limited extent, poor recovery of irrigation charges.

GWRDC could not raise its revenues by increasing water charges. In 1975-76, water charges were Rs 1.50 for 10,000 liters. The charges levied by the WRD for the same quantity of water from canals was about Rs 0.30 for 10,000 liters. As the charges for water from tubewells were several times that of charges from surface systems the users protested in 1977-78. GWRDC agreed to charge only Rs 0.80 for food crops. As much of the area irrigated generally grew cash crops, the agency revised the rates to Rs 1.00 for 10,000 liters. The last rate revision took place in 1981 when GWRDC fixed the rate as Rs 1.80 for 10,000 liters. Subsequent proposals to the state to increase the rates were not approved. Based on the operation and maintenance costs approved by the state in 1988-89, GWRDC estimates the cost of supplying 10,000 liters of water to be Rs 5.47. The current costs are estimated to be nearly Rs 7 for 10,000 liters.

While water rates have stayed constant or have declined in real terms, the costs have been increasing. Being assured of subsidies to cover the deficits and without clarity on the extent of subsidies, GWRDC has also lacked the incentives to economize on its costs. The operation and maintenance costs have been rising rapidly. Overhead expenses have been high (Asopa and Dholakia 1983). GWRDC has a total staff of about 6,000 of which 3,500 are operators. As the corporation is fully owned by the state government, the employees demand the benefits extended to regular state employees. It has faced difficulty in keeping up with periodic upward revisions in benefits provided to state employees. In addition, the operators have succeeded in their claim for overtime payments for operating wells at night when electricity supply is more reliable. The salaries and benefits of a tubewell operator nearly equalled the annual average recoveries of water charges from a well.

The operation and maintenance subsidy that GWRDC receives from the government is negotiated on the basis of established norms for incurring these expenses. The norms were revised in 1973, 1976, and 1979. The permissible expenses for an electric well with greater than 30 horsepower (HP) motor were increased from Rs 12,835 in 1973 to Rs 17,335 in 1976 and Rs 24,750 in 1979 (GWRDC 1991). But they have not been revised regularly since then. A committee to recommend new norms set up in 1989 submitted its report only in 1991. GWRDC had to manage with ad hoc provisions for nearly a decade. The committee in 1988-89 approved about Rs 59,000 as maintenance and repair expenses for a well. The same committee also recommended norms for staffing in 1988-89. The actual expenses have grown substantially since then. GWRDC will be claiming operating and maintenance expenses of about Rs 112,000 per well in 1994-95.

GWRDC can claim the difference between its income from levying irrigation charges and the estimated total operation and maintenance costs based on the norms as subsidy from the government. Subsidies are provided on the assumption that wells are operated for 2,000 hours. The agency, in addition, can claim compensation for operational losses from under-utilization owing to reasons beyond its control.[3] The committee set up in 1989 also suggested that subsidies should be correspondingly reduced for under-utilization (GWRDC 1991). The gap between income and expenses of the corporation has grown rapidly. During 1992-93, the corporation earned an income of Rs 63.3 million and its expenses were Rs 390.3 million (GOG 1994).

[3]Accepted reasons are: inadequate power supply, decreased availability of water in the aquifer, decreased demand resulting from canal supplies and rainfall and topography and agricultural conditions, breakdowns during critical periods, and inadequate resources resulting from ad hoc subsidies (GWRDC 1991, 28-29).

Though the government is committed to meet the deficits of the organization, subsidies have not been coming forth regularly. As the norms for operation and maintenance costs have not been revised regularly, subsidies have often been ad hoc, delayed and subject to prolonged negotiations. The two major sources of difference between GWRDC and the government have been charges not recovered from users and increase in unit cost arising from use of wells for less than 2,000 hours annually. The government holds the Corporation responsible of collecting at least 90 percent of the water charges. Collection has improved
over the years and stands at about 80 percent of the billed amount.[4] Tougher measures instituted by GWRDC to improve recovery have resulted in user pressures on the government and a directive from the government that irrigation should not be denied even to defaulters during scarcity.

The difference between estimated maintenance and repair costs (including overheads) assuming utilization at 2,000 hours and actual was Rs 0.28 per 10,000 liters in 1981 (Asopa and Dholakia 1983). The difference, therefore, between what was permissible and what was claimed would have been nearly Rs 5 million for the 184,650 million liters of water extracted in 1981. Although the subsidy provided by the state grew from Rs 500,000 in 1975-76 to Rs 127,100,000 in 1993-94, the disparity between what the GWRDC claims and what the state actually gave also has increased over time. The process for claiming subsidies has became cumbersome. In recent years, the subsidy given ranges from 50 to 70 percent of the amount claimed by the organization.

MOTIVE FOR TURNING OVER

Involving the users in the management of wells has been in the air for a long time. A government order was issued as early as 1972 when GWRDC was being established suggesting that the management of public wells be handed over to groups of four or more users, panchayats, water user associations (WUAs) or *gram vikas mandals* (GVMs). But firm steps in this direction were taken only in 1987 with the discussion in the Legislative Assembly to lease out GWRDC wells. In 1990, the government decided to shut down any tubewell operating for less than 500 hours annually or discharging less than 10,000 gallons an hour unless users came forward to manage it. The 1994 finance committee has gone a step further and has suggested that GWRDC itself should be wound up (GOG 1994).

The objective behind the government step in transferring tubewells to users is to reduce the burden on the exchequer. Several governments have not had the courage to hike irrigation charges for fear of losing support of the farmer lobby. The growing demand for subsidies is also not backed by a lobby of engineers and contractors as in the case of medium and large irrigation systems. Threatening the closure of wells unless the users themselves take them over appears to be a convenient way out for the government. While reducing the burden on itself, the government, however, does not intend to increase costs to the users. There is an implicit belief that operation and maintenance costs will be substantially lower when the wells are managed by the users themselves with the result that they need not pay any more than what they are paying now. The second objective is to improve utilization of wells. Again, wells are expected to be managed better by the users through timely maintenance, more effective collection of dues and reliable supply of irrigation.

While the government and GWRDC are keen to transfer as many wells as possible to reduce costs, they have tried to retain some control over how the wells are operated at least in the initial stages, to ensure that well utilization subsequent to transfer does not conflict significantly with the objective with which the government operated the wells.

NATURE OF TRANSFER

In the initial stages, any tubewell that a group of users was interested in managing was leased out. In 1992, the rules were revised to permit the transfer of only those wells which had been shut down or those which were going to be shut down for reasons stated earlier. In 1993 the rules were revised again to permit leasing of any well. The process of transfer has been quickened somewhat by authorizing the executive engineer in sub-divisional offices to lease out tubewells which have been shut down or which are about to be closed.

Initially, the wells were transferred only to cooperative societies of users or gram vikas manadals. As many groups faced difficulties with registration, they were given six months from the initiation of the agreement to register themselves as a cooperative society. Later on, the requirement was removed altogether. GWRDC can transfer wells to even groups of users. Nearly 80 wells have been leased out to groups primarily in Mehsana District.

Under the existing rules, the right to use the tubewell is transferred to the lessee for a nominal fee of Rs 11 a year for an initial period of one year at the end of which lease can be extended to five years. The lessees are required to operate the well without causing any damage and undertake any repair only according to the plans approved by GWRDC. The lessees have to deposit Rs 5,000 with GWRDC to ensure compliance with several other conditions.

Two important conditions of the lease relate to collection of dues and access to services of the well. The lessees are required to collect outstanding dues from the members and cannot supply water to those who have overdues. The agreement stipulates that any lessee who supplies water to such farmers will have to pay the outstanding amount on

[4]The total outstanding was Rs 101,367,603 from 101,489 users at the end of 1990. This works out to about Rs 30,000 per operating well. More than 60 percent of these dues were owed by a third of the farmers. Nearly 20,000 farmers owed between Rs 1,000 and Rs 2,000. Another 11,000 farmers owed more than Rs 2,000. The users can accumulate arrears as they need to deposit only Rs 250 per hectare before the season to become eligible for water. The delay in billing permits them to take water for another season without paying the charges for the first season.

behalf of them or that the amount will be deducted from the deposit. GWRDC retains the right to terminate the agreement with lessees who supply water to defaulters.

There are two important clauses in the agreement relating to access. One stipulates that the lessees should charge for water on a "no-loss no-profit basis." In the initial stages, this was taken to mean that the lessees could not charge a fee higher than what GWRDC was charging. This was modified in February 1993 to permit the lessees to charge higher rates. The other clause relates to spreading of benefits. The agreement stipulates that all farmers in the command should be given water on a first-come first-served or *warabandi* basis. Only after meeting the needs of those in the command can water be supplied to others. To ensure that the lessees provide such wide access, they were required to obtain the consent of farmers in the command that they are agreeable to the transfer and that they would be willing to take water from the lessees. This requirement has now been removed and was widely ignored when it was in force.

The government decided in 1991 that the GWRDC wells could be sold to cooperatives of users. The managing director of the corporation constituted a committee to suggest the criteria for determining the sale value of wells. The committee suggested that the sale value should include the value of civil works, tubewell, pumping machinery, and, only under limited condition, land measuring about 425 square meters.[5] The committee recommended a procedure for estimating the sale value which incorporates both depreciation and cost escalation since construction. The sale value thus estimated falls between fully depreciated value and the cost of construction of a new system or replacement costs. As an example, a well constructed in 1974-75 at a cost of Rs 152,500 would have an estimated sale value of Rs 266,400 compared to the current GWRDC cost of Rs 680,000. The cost of a unit built privately with similar capability may be nearly one half of this.

Whether the sale value thus estimated would be close to the market price would depend on factors such as availability of alternative irrigation sources, the condition of the well, and the nature of agriculture being practiced in the command of a particular well. Recognizing that in most cases the estimated value may exceed the market value, GWRDC has sought approval of the government to sell the tubewells at depreciated values and include individuals and other interested organizations outside the command among the parties to which it can sell a well. GWRDC has recommended that the priority should be in the order of cooperatives of users, panchayat or other cooperatives, NGOs, groups of users, and individuals or other organizations not in the command. GWRDC has also proposed that the wells should be sold to the first three at 50 percent of the depreciated value and to the last two at 25 percent of the depreciated values. GWRDC is yet to receive approval from the government.

PROGRESS IN TURNING OVER AND STUDY SAMPLE

About 385 tubewells have been leased out so far in 13 districts. The step seems to have been successful in Mehsana and Kheda districts. GWRDC believes that the primary reasons for success in the two districts are fairly high well discharge in Kheda and the management of tubewells by companies in Mehsana District (GWRDC 1993). Lessees have returned 96 tubewells to GWRDC. Of the lessees who returned the wells, 60 percent did so within two years from taking over. We decided to limit our study of the performance of leased wells to Kheda District which has a third of the leased out tubewells and has wells which have been leased out for the longest period. In this district, 103 wells were leased out, of which 32 have been returned by the lessees.

A sample of 20 wells (20 percent of the population) was drawn from two groups of lessees: those which continue to operate the wells and those which have handed the wells back to GWRDC. All the lessees in this district are cooperative societies. These were further stratified on the basis of the number of years they have been managed by the lessees or were managed by the lessees before handing back. A majority of the wells which are still under the control of the lessees have been in operation for 3 to 4 years. The majority of wells which were handed back were managed by the lessees for less than a year.

PERFORMANCE OF SAMPLE WELLS

The lessees of tubewells in Kheda are predominantly cooperative societies of users.[6] But membership in these cooperatives is not as broad based as the work cooperative would suggest. Most of them have 11 members, the minimum required to register a cooperative society. The members are often relatives, friends or farmers belonging to the same caste. Some of the members are not even aware that they are members of the cooperative society. There were two cases in which relatives of GWRDC staff took over the tubewells without the knowledge of the villagers. The villagers protested when they came to know of this. A society was formed later with broader representation.

All the wells which were leased out were in operation before being leased out. Four of them were operating for an average of more than 2,000 hours in the four years before the transfer. Two others were operating between 1,000 and

[5]The committee suggested that the land cost should be included only if the land was acquired by GWRDC by compensating the original owner. In cases where the owner has not been compensated, the cost of the land should not be included if the owner belongs to the group interested in buying the well. Otherwise, original owners should be compensated if they demand and the cost should be included in the sale value.

[6]The cooperatives pay lower electrical charges. They pay only Rs 192 per HP annually against Rs 360 for others.

2,000 hours and the remaining operated for less than 1,000 hours. The wells that were returned by the lessees operated for an average of nearly 600 hours compared to nearly 1,200 for those which are still being operated by the lessees. The dues outstanding from these wells were also fairly high--nearly Rs 70,000 for wells that are still on lease compared to Rs 41,000 for those which have been returned. The average outstanding from the users per well was nearly equal to the amount billed in about 3 years. When four cases in which the outstanding amount was equivalent to the amount billed in more than 10 years are not considered, the average outstanding amount is equal to amount billed in one year.

Our data suggest that utilization of wells has not improved significantly after they were leased out. The average number of hours for which they were operated was about 950. The average was slightly higher for wells that are still in use (1,063 compared to 966) compared to those returned. Five of the wells out of 14 still operating registered a decline in use. The reasons for poor utilization cannot be easily determined. In some cases, the groups did not have resources to take care of the repairs. Some were affected by erratic power supply and others by frequent breakdowns. Usage ranged from as little as 300 hours to 2,000 hours annually. The value of total sales per well was Rs 18,911. Water charges ranged from Rs 10 to Rs 26 per hour. The average charges were Rs 21 in the case of wells which were still functioning compared to Rs 15 in the case of wells which had been returned. Therefore the average value of services provided by the wells which were returned was one half of the value in the case of functioning wells (Rs 11,000 compared to Rs 22,000). As data on operation before transfer suggest, returned wells were performing poorly to begin with.

The average annual total cost was around Rs 20,000. It ranged from Rs 8,000 to about Rs 40,000. The average cost was higher by about Rs 2,000 for operating wells. The average total cost consisted of about Rs 9,000 for electricity, Rs 4,000 for staff and Rs 7,000 for repair. Most of the groups hired an operator for at least a part of the year. A few societies had hired paid secretaries to maintain their accounts and collect the charges from members. These costs are nearly a third of the costs incurred by GWRDC (see Appendix A for comparison).

The societies on the average incurred a loss of Rs 1,100. Those that were operating showed an average profit of around Rs 1,000 while those which have been shut down incurred a loss of Rs 6,000. All but one of the societies which returned the wells showed losses while one half of societies which still managed the wells showed losses. Many villagers indicated that they were making profits but did not indicate so in books to avoid being subjected to strict rules about what the cooperatives can do with profits. The reasons for failure were not necessarily financial. In two cases, two or more individuals essentially took over the wells without broadbased participation. In one of them, a school teacher and a GWRDC operator took over; the well was wound up because of differences between them. In another, a labor contractor took over with only 2 other active members. In another, only 4 farmers were able to irrigate their fields because of low discharge. Some of the members were not even aware that they were members. In yet another case of well returned after four years, a single family was operating the well to irrigate its own and relatives' lands. It returned the well because it did not want to bother with meeting reporting and audit requirements. Only in one case of a returned well was well usage high but there were problems in collecting dues.

Three societies which had reported relatively high profits ranging from Rs 8,000 to Rs 18,000 annually had broadbased representation and appeared to be genuine cooperatives. One of them was managed by a GVM. Two societies which declared the highest losses (in the range of Rs 8,000-10,000 a year) also indicated that they did not show profits on the books. There was another case in which the secretary and the chairman of a society supplied water to nearly 40 ha during rabi for a share of the crop. Between the two, they had purchased a tractor from the profits which the other members were unaware of.

EXPECTATIONS AND OUTCOMES

The government has two explicitly stated objectives for turning over the public tubewells. They are to reduce the financial burden on the state and to improve the utilization of wells. Some of the other implicit objectives are to collect outstanding dues, continue to supply water to everyone in the command of the tubewell, and to supply water at low prices.

To the extent that the leased out wells were already closed, there will not be any reduction in operation and maintenance costs. The transfer of operating wells would result in the reduction of electricity and repair costs which were estimated to be around Rs 28,000 per well at 1991 prices. A transfer of nearly 350 wells is likely to have resulted in a reduction of nearly Rs 1,000,000 in operation and maintenance costs. Although GWRDC claims that there is a reduction of nearly Rs 20 million in its costs, all of this could not have resulted from transfer of wells. GWRDC has not succeeded in reducing the cost of the field staff which makes up for nearly 50 percent of the operation and maintenance costs per tubewell.

The corporation sought permission of the Department of Labor to retrench 300 operators who have no work as a result of transfer. The Department turned down the request on the grounds that the retrenchments were arbitrary as they were not based on any seniority list, the corporation did not make sufficient efforts to improve its financial conditions before deciding to lease the wells, and the retrenchments were not fair as they did not apply to staff at all levels. GWRDC has appealed to the higher courts while staff without any work remain on the payroll. The staff at higher levels expect to be absorbed in the regular departments of the state.

Our information suggests that well utilization has not improved a great deal at least in the short run. A survey by Shah and Bhattacharya (1992) indicates that the wells have been put to far better use subsequent to transfer.

Conceptually, the utilization ought to improve significantly when the control rests with the users themselves. But this is subject to the limitations that some wells are technically not sound, power supply in some regions are very erratic, and some groups, particularly those comprising of small farmers, lack the resources required for timely repair and maintenance of wells.

Several aspects of transfer are designed to achieve equity in terms of wide access to irrigation at reasonable prices, particularly for small and marginal farmers. A cooperative form of organization was initially imposed on the lessees expecting certain core values to drive their operations (Shah and Bhattacharya 1992). This was to ensure widespread participation, democratic decision making, and the use of whatever surpluses created for the general good. The lessees were required initially to operate on a no-loss no-profit basis again to achieve the state policy of providing irrigation at low costs. Strangely, the proposed terms for even outright sales require that the buyers continue to sell water to everyone in the command.

Whatever the intention of GWRDC or the government, what happens in practice is likely to be quite different from the intended policy. The corporation has limited ability to influence the lessees because it can neither get the information it requires to do so at reasonable costs nor does it have effective mechanisms to enforce its will. The government cannot differentiate between true cooperatives and fronts put up by a few individuals. It cannot get full information on whether the lessees are supplying water as they have agreed to. Nor can it establish the veracity of the financial reports filed by the cooperatives to the Registrar of Cooperative Societies. If the corporation could collect such information at reasonable costs, it could effectively operate the wells through its own staff.

Policies which provide opportunities for individual benefit create strong incentive among individuals to subvert the intentions of the state. In fact, the development of state policies may be driven by such interests. It is not too difficult to establish a cooperative society. Nor to meet the reporting and audit requirements of GWRDC or of the Registrar of Cooperative Societies. Some lessees were paying the staff of these two agencies themselves to prepare the reports for them. This was not delegation of a task they were incapable of doing but an attempt to bribe those who monitor them. As potential benefits would suggest, individuals or groups of individuals have connived to use the public tubewells purely for their benefit in violation of the spirit of the lease agreements.

Gujarat offers interesting models which show how a well owner who provides irrigation services is likely to behave. Markets for irrigation services are prevalent in Gujarat. Most well owners in alluvial areas sell water to their neighbors in addition to meeting their own needs. Most well owners have an incentive to provide services to their neighbors particularly because they pay a fixed fee for electricity (see Shah 1992). Even in times of scarcity well owners try to meet the needs of the buyers as much as their own. They do so because they face competition from other well owners.

A lessee of GWRDC who is likely to treat the asset as his own is also likely to behave as any other seller in the market. The only difference is that having obtained the asset at no cost, he would be under less pressure than a private investor to earn returns from the investment. Our survey indicates that whenever there was power shortage or where well discharge was inadequate, buyers who were not part of the management were not treated fairly. The outcome of the current policy of transfer is, in a disturbing number of cases, free provision of valuable public assets to individuals or groups of individuals for their private use.

Groundwater irrigation systems are amenable to greater control by a few than parts of a surface irrigation system. It is not always feasible to avoid such control by imposing certain forms of organization. Imposing a cooperative form of organization also may impose severe limitations on the ability of the groups to improve performance. Shah and Bhattacharya (1992) in their comparison of the cooperatives and water companies argue that the rules which the cooperatives have to abide by affect the incentives of the management, pricing decisions, and the ability to muster resources. They find that the performance of irrigation companies was far superior.

Whatever the outcome, the government is keen on divesting itself of the public tubewells. As the response of the users has not been too enthusiastic GWRDC has modified the terms of transfer. Outright sales of tubewells has also been recommended by the finance commission which may be more desirable as those who are likely to benefit from the assets would have compensated the government for the value of these assets. Whether there will be enough buyers and whether the value can be captured through public auctions remain to be seen.

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Appendix A

Comparison of Expenditure of GWRDC and Cooperative Wells in Kheda District, 1991-92

Items		GWRDC norms (Rs)	Cooperative (Rs)
1	Electricity charges	10,800	7,000
2	Repair charges		
	a) civil	3,000	2,800
	b) mechanical/electrical	9,000	6,700
	c) electrical control panels	3,000	
	d) transportation charges	1,500	
	e) cleaning and fishing	500	
	Total	17,000	9,500
3	Field establishment		
	a) tubewell operator (one per well)	25,370	7,000
	b) mechanic (one per 60 wells)	527	
	c) electrician (one per 120 wells)	304	
	d) wireman (one per 30 wells)	865	
	e) beat karkoon (one per 15 wells)	1,525	
	f) helper (one per 15 wells)	1,125	
	Total	29,716	7,000
4	Other committed expenditure towards field establishment such as travel, medical, leave, concessions, bonus, gratuity, stationery, registers and other facilities	10,602	1,630
	Total (1+2+3)	68,118	25,130
5	Supervision and overhead charges for regular establishment sub-division to head office level charged on M&R of tubewells at 15% of items covered under 1 to 4	10,217	
	Grand total	78,335	25,130

Source: GWRDC 1993.

The Financial Sources for the Development of Small and Medium-Sized Irrigation Works

Li Lishan[1] and Chen Xieqin[2]

ABSTRACT

THE CHINESE GOVERNMENT has paid great attention to the development of small and medium-sized irrigation projects by raising funds at different administrative levels and in different ways. In 1991, the total amount invested in irrigation works was US$1,092 million.[3] When this amount is distributed amongst the different regions of China, the amount allocated to each region is inadequate to meet financial requirements for farm irrigation development. The present policy of the Chinese Government is based on the principle of self-reliance with a subsidy from the State.

This paper presents the financial support for irrigation development from the central government and the local administrative departments at different levels. The different ways of raising funds and the corresponding policies are discussed. The paper demonstrates that with the reform of the rural economic system and the rapid development of rural enterprises, raising funds in rural areas by different ways is an effective means to promote the development of small-sized irrigation and drainage works.

INTRODUCTION

The Chinese Government considers the water sector as the lifeblood in the development of agriculture and attaches great importance to the development of hydraulic projects. High priority is attached to the expansion of irrigation and drainage works.

The total irrigated area in China as at 1990 was 48 million hectares (ha). This covers about 50 percent of the cultivated land in the whole country. At present, there are 146 large-sized irrigation projects each covering an area of over 20,000 ha, 5,156 medium-sized projects with command areas ranging from 1,000 to 20,000 ha. There are over six million small-sized irrigation works of less than 1,000 ha.

In Hubei Province, the area under irrigation amounts to 2,610,000 ha which amount to about 73.6 percent of the cultivated land of the province. There are 27 large-sized irrigation projects, 223 medium-sized and over 6,000 small-sized irrigation projects.

China is a vast country with a substantial diversity in terrain, water resources, arable farming systems and economic conditions. The priority in irrigation development is given to small-sized irrigation works. At the same time, joint development work is carried out on large and medium-sized irrigation projects. As the small-scale irrigation projects are located near the fields, they are more flexible in terms of meeting crop water demands. Generally, small-sized irrigation projects can withstand short-term droughts which occur periodically. However, the large-sized irrigation projects have the potential to withstand much severe droughts. In China's experience, the adverse effects of drought and waterlogging could be minimized by the creation and the unified operation of large, medium and small-sized irrigation works by increasing farm production substantially.

In order to develop medium and small-sized irrigation projects, the Chinese Government has adopted a strategy to raise funds at the different administrative levels and through different ways. Institutions ranging from the central government to local administrative departments are expected to allocate funds to develop irrigation projects. Collecting funds by different ways means that the State, the collectives, as well as individuals can raise money to run water conservancy works in the light of practical circumstances.

Investments by the Chinese Government in water conservancy works cover capital construction, operating expenses, and financial allocations for special projects. The principle of investment is that free investment is put in the first place and the investment with payment in the second. Projects such as flood and waterlogging control and irrigation works rely mainly on free investment, while small-sized hydropower stations and the water supply projects with sound benefits are making investment with payment. For the rural small-sized irrigation projects, the State provides financial assistance and farmers invest labor in earthwork.

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[3]All monetary values are expressed in United States dollars. In March 1994, the exchange rate was approximately 8.7 Chinese yuan to one dollar.

THE GOVERNMENT'S FINANCIAL SUPPORT

1. Financial Support from the Central Government

i. Investment in capital construction of water conservancy

Water conservancy projects which cover flood control, irrigation and waterlogging are built without payment while small-sized hydropower stations for agriculture development are set up with payment which is an interest-free bank loan. The payback period is 7 to 10 years. The annual investment in the Hubei Province amounts to US$4.6 million without payment and 1,459,000 with payment.

ii. Subsidy to mitigate severe drought

The State allocates funds to the special projects to mitigate the adverse effects of severe drought. The State allocates a sum of US$11.5 million, annually, primarily as a subsidy for mechanical equipment. The annual sum allocated to the Hubei Province amounts to about US$230,000.

iii. The fund for special projects for grain production

This is an important measure adopted by the State to increase grain production. Since 1986, a sum of US$115 million dollars has been allocated annually to special projects about half of which is used for the development of small-sized farm irrigation projects, mainly for the building and repairing irrigation facilities, such as reservoirs, pumping stations, river dams, and reclamation of low-yielding fields. The allocation to the Hubei Province amounts to US$552,000 of which US$276 is spent on irrigation works.

iv. Special fund for comprehensive development of agriculture

The purpose of this fund is to promote agriculture, irrigation and drainage, animal husbandry, fishery, forestry and rural traffic network, etc. Investment in irrigation and drainage works takes up about 50 percent. From 1986 to 1990, the total investment for irrigation and drainage works amounted to US$1.2 billion in the whole country. In the Hubei Province about US$9.3 million was allocated annually for construction of small-sized irrigation and drainage projects. However, 50 percent of the fund should be paid back in 5 years.

v. Free investment to provide work as a form of relief

The free investment, which provides work as a form of relief, is a kind of special fund allocated by the State for the development of water conservancy work , traffic, and capital construction of farmland. Providing work as a form of relief means that the State provides means of production and consumer goods to impoverished rural areas in an effort to build irrigation works, highways and to improve the conditions of farms. The farmers can get a certain amount of relief food and goods according to the workdays provided by them. The annual amount allocated to the Hubei Province, amounts to US$ 6.8 million to 8.0 million.

vi. Subsidized credit for water saving irrigation technology

The State allocate a sum of US$6.9 million annually to encourage the adoption of water saving irrigation technology. This is provided as a low-interest loan for the development of sprinkler and drip irrigation or other water-saving irrigation projects. The interest of the loan is subsidized by the State.

2. Financial Support from Provincial Administrative Departments

The Chinese Government is keen that the initiatives of the administrative departments from provinces, prefectures and counties should be brought into full play in an effort to develop small-sized farm irrigation works. In addition to a certain amount of fund provided by the central government every year, provincial administrative departments should also appropriate a portion of the fund from its financial budget for the construction of irrigation works.

The investments in water conservancy works by the Hubei Province are as follows:

i. The investment in capital construction of water conservancy is mainly used for the establishment of irrigation works and of a part of its conveyance system. Annually there is a free investment of US$172,000 which irrigation and drainage projects take up 55 percent; water supply projects 10 percent; flood control projects 30 percent and capital facility projects 5 percent.

ii. Subsidy for small-sized irrigation and drainage projects. The financial departments of the Hubei Province allocate a sum of US$9.7 million to subsidize small-sized irrigation and drainage works. These include:

   a. About US$4.0 million is spent in small-sized reservoirs, irrigation channels, pumping stations, low-yield land transformation, etc., Farmers contribute the labor while the State provides subsides mainly for purchasing steel, cement and other facilities.

   b. About US$0.69 million is allocated as subsidies to pumping stations mainly for the repairing of pumps, energy and management expenses.

   c. About US$0.9 million is allocated to subsidize projects such as the water and soil conservation, the transformation of slope land into terraced fields and the improvement of farm irrigation conditions. The average subsidy for a hectare of land is US$172.

   d. A sum of US$862/ha is allocated as a subsidy for sprinkler and drip irrigation facilities.

   e. A subsidy of US$2.76 million is provided for the construction of small-sized rural hydropower stations. Of this amount, 50 percent is subsidized without payback; the balance 50 percent is with payment and it will be collected 7 to 10 years later.

iii. Providing subsidized loans for rural water supply projects. The financial departments of the Hubei Province allocate US$230,000 as a loan at a subsidized interest rate for rural water supply schemes. The loans are channeled through the banks. The State subsidizes the interest for about 3 to 5 years.

iv. Awards. Every year, the financial department of the Hubei Province allocates 115,000 US dollars to be awarded to the advanced counties and cities that have achieved positive results in capital construction of farm irrigation works.

3. Financial Support from the Local Administration

A precondition of the central and provincial financial departments for investment in irrigation projects is that local administrative departments from prefectures, cities, and counties must provide a certain amount of finance for water conservancy works in accordance with the policy of sharing investment.

The investments made by the local administration at different levels of prefectures and counties of the Hubei Province totaled over US$2.9 million. This sum was mainly used for the works of renovating and repairing irrigation facilities, and of drought control, etc. The beneficiaries are responsible for the earthwork.

FARMERS' COLLECTING FUND

China's irrigation sector covers a vast area. The financial allocations made by the central government to local administrative departments for the development of irrigation works are quite substantial. For example, in 1991, the total allocation amounted to US$1,092 million. Yet, this amount is inadequate to meet the demand of farm irrigation development in the different parts of the country. Recently, the Chinese Government has encouraged the regions to be self-reliant and central government assistance is limited to subsidies. The regions are expected to mobilize labor and financial resources at different levels for irrigation development. Since the Third Session of the IIth Congress of the Communist Party of China, when far-reaching economic reforms were introduced, there has been great achievements with regard to the aspect of collecting funds for the construction of water conservancy. The main adopted reforms are as follows:

i. Labor accumulation system

As stipulated by the State each farmer contributes a force of 10 to 20 workdays every year for capital construction. The labor is mainly for building of irrigation and drainage works. State funds are used mainly for purchasing of materials, facilities and for the payment of wages of technical workers.

ii. Encouraging farmers to collect funds for the construction of water conservancy

There are many ways of collecting funds. For example, funds can be collected by villages, production groups and individuals. All irrigation projects built by the farmers' collective fund are owned and managed by the farmers themselves. State support is confined to the provision of technical and construction materials.

iii. Setting up of a fund for water conservancy

In some places funds, are collected from the beneficiary farmers and self-employed laborers in villages and towns who are engaged in industry and business. The funds are used for improving and building water conservancy works.

iv. Running a sharing system in an effort to build water conservancy works

In some regions the sharing system works on the basis of cooperative system, which draws on the experience of the farm sharing system. The rule stipulates that one is [voluntary] to buy a share and the property rights are shared by members of cooperative group. Shareholders draw extra profits according to stock, and taking risks is their responsibility.

v. Foreign capital investments

The Hubei Province obtained a loan of US$80 million from the World Bank. A substantial amount of this was spent in irrigation development. From the winter of 1992 to March 1993, the Guangdong Province invested foreign capital to the value of US$46 million.

CONCLUSION

1. China's guiding principle in the development of irrigation and drainage lays emphasis on the development of small-sized irrigation works.

2. As small-sized farm irrigation projects cover a vast area, funds should be collected through different administrative levels and in different ways. It is necessary to adhere to the guiding principle of self-reliant irrigation projects with some State assistance in the form subsidies.

3. The government departments formulate policies to encourage farmers to collect funds for the development of water conservancy works. With the implementation of economic reforms, the village and township enterprises have developed rapidly and have become the mainstay of the rural economy. It is justifiable to allocate a certain portion of funds from the profits generated by the village and township enterprises for the development of farm irrigation works.

4. The State has responsibility to support rural water conservancy projects by providing technical know-how and construction materials.

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

Changming Liu, Haisheng Mou, Quijun Ma[1], and Sam H. Johnson III[2]

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 rein-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.

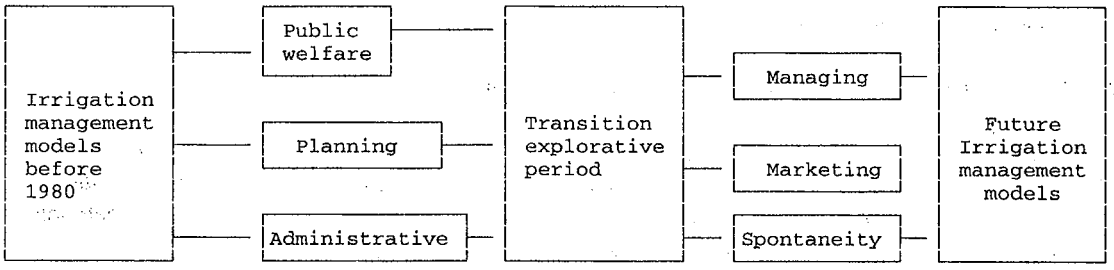
Agricultural water consumption accounts for more than 85 percent of total water consumption in North China. Though the water supply has decreased in recent years and some water-saving measures have been adopted everywhere, the situation of water wasting is still serious due to deterioration and disrepair 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 m^3 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.

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

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.

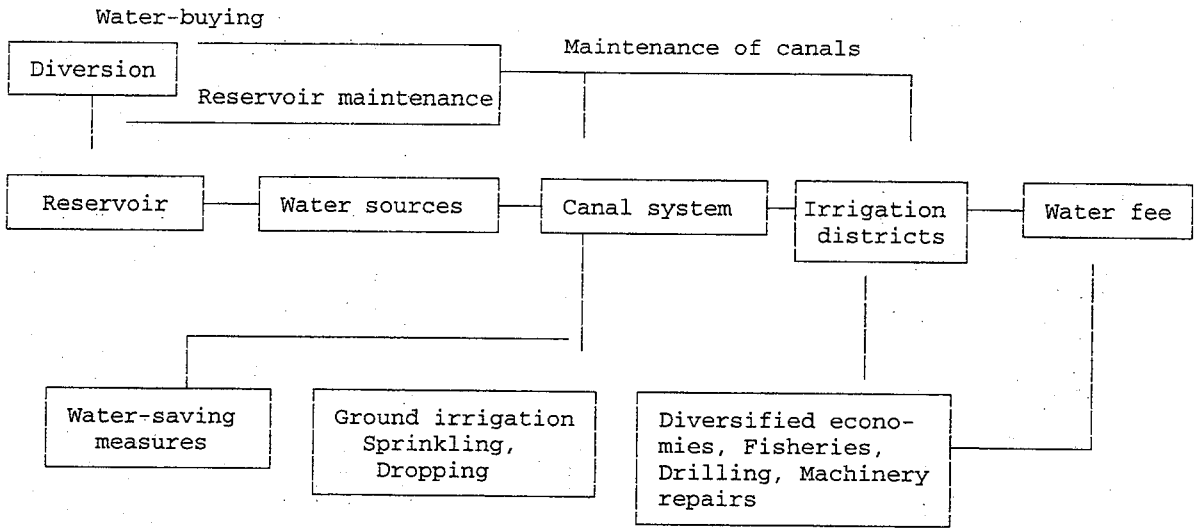
Table 1. Revenue and expenditure data for Bayi and Nanyao IDs.

	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 Bayi 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 m^3. Considering farmers' ability to pay, the present water price is only about 3 yuan per 100 m^3 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.

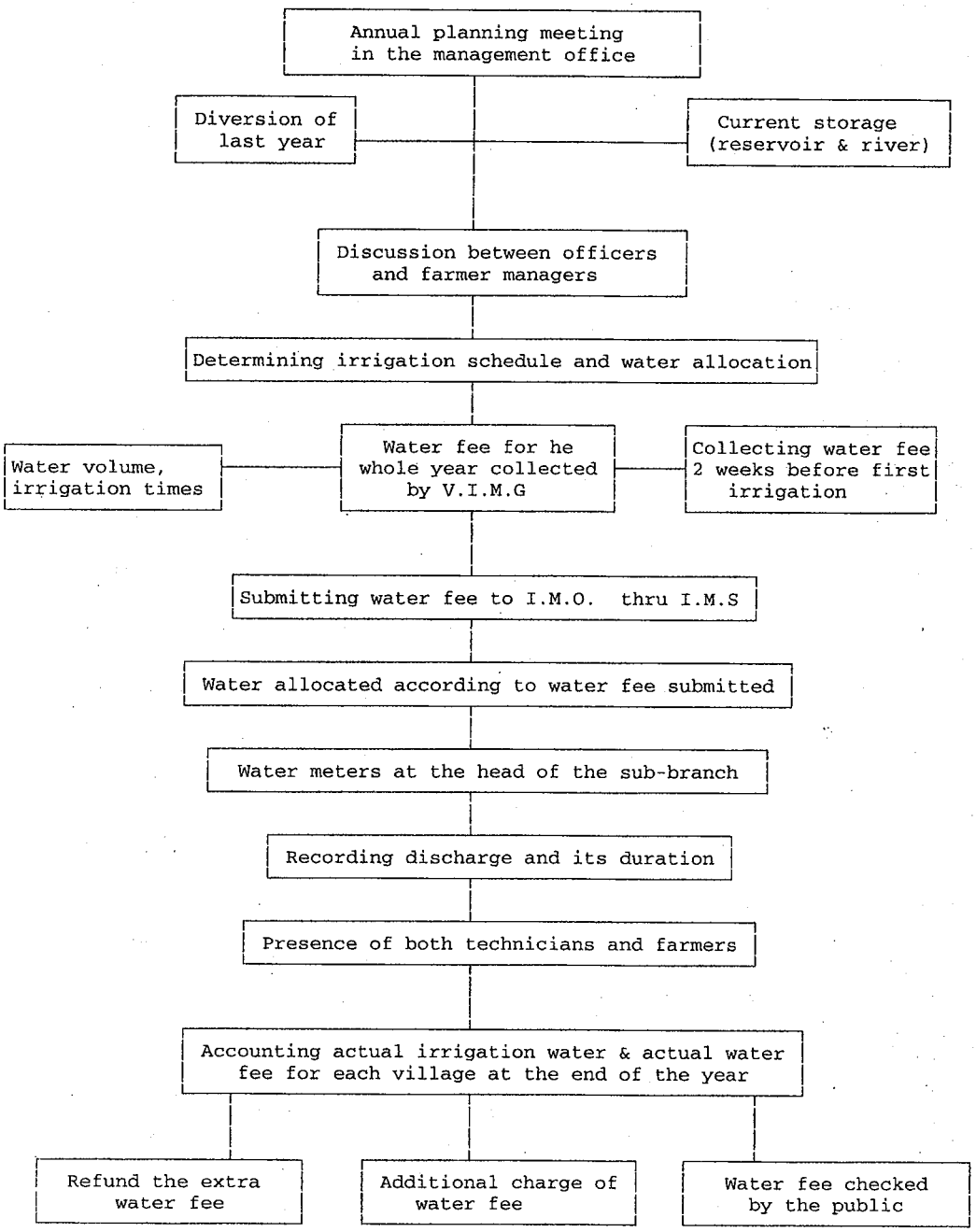


Table 3. Labor input and funds invested by VIMGs.

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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Irrigation Management Transfer (IMT) in Vietnam

Nguyen Manh Ta[1]

PART I: BRIEF INTRODUCTION TO RELATED AGRO-CLIMATIC CONDITIONS AND IRRIGATED AGRICULTURE

Natural Conditions

VIETNAM LIES IN the tropical monsoon region. Its territory is narrow but stretches over from 12° to 23° latitude N, thus, being affected by diverse climatic regimes. There are 2 distinct seasons: the dry season is from November to April and the wet season from May to October. Annual temperature is 23° C. Rainfall is abundant, ranging from 1,800 to 200 mm/year, but uneven in distribution. The rainy season rainfall accounts for 70-80 percent of the total amount, and it is concentrated in July, August and September in the North and August, September and October in the Central and Southern parts.

Typhoons occur from July to October, frequently bringing heavy rain causing river floods and waterlogging.

The country has a dense river and stream network with 25 rivers systems. Total run-off is approximately 300 km^3 (excluding runoff from outside) of which 70-80 percent is concentrated on 6 months of the rainy season. In the dry season, rivers runoff is little and water level low causing difficulties in irrigation.

Generally speaking, the agro-climatic condition in our country is good for agricultural development.

South Vietnam with a moderate climatic regime, high temperature, abundant sunshine and a small disparity in temperature, is suitable for cultivating crops year round; North Vietnam has a climatic regime which is relatively severe, as the country is affected by cold wind and low temperature in the dry season and high floods and typhoons in the rainy season; also, cultivation is possible year round but needs a more serious farming.

Development of Irrigated Agriculture

Agricultural Development

* Vietnam is an agricultural country with approximately 70 percent of its population still engaged agricultural production. Rice is a traditional cropping and the staple food. In addition, there are subsidiary food crops such as maize, potato, sweet potato, beans, vegetables, cassava, etc.

  Arable land area is 11 M ha, while the present cultivated area is 7 M ha, of which rice crop land is approximately 4.0 M ha.

* Great efforts have been given to agricultural development, especially to irrigated agriculture with emphasis placed on both horizontal and vertical expansion, i.e., extending the newly cultivated area on the one hand, promoting intensive farming and multi-cropping in irrigated areas on the other.

  In the last five years, owing to the reforms in government policy and institutions for agricultural development, such as the introduction of the responsibility system in cultivation, the allocation of land, allowing farmers a choice in input supplies and enabling some improvement in security of land tenure, etc. Agriculture has had a marked progress. Annual cropped area has increased from 5.6 M ha in 1986 to 6.02 M ha in 1990 and 6.4 M ha in 1993; average rice yield increased from 2.81 T/ha in 1986 to 3.19 T/ha in 1990 and to nearly 3.49 T/ha in 1993.

  Total food production in rice of 18.0 M tons in 1986 has increased to 21.4 M tons in 1990 and to 24.1 M tons in 1993.

  Generally, the cropping pattern is: rice, rice, dry crop.

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* Agricultural cooperatives have been established with various forms and levels.

Size of a Cooperative is about 300-400 ha depending on specific circumstances. Landholding size averages 0.4-0.5 ha/household, in South Vietnam it is as large as or more than in North Vietnam.

Recently, the introduction of the responsibility system and in particular, the long-term land-use right promulgated by the government has encouraged farmers to invest their inputs for production. According to the figures collected from 4 typical provinces,[1] farmers' additional inputs, including seed, fertilizer, pesticide and labor, approximate 26 percent of the production value [input provided by Cooperative in responsibility system, that had been used is 15.7 percent].

Nowadays, the household actually becomes a production unit. The Cooperative undertakes inputs services and controls only the crop grown.

Irrigation Development

Vietnam has a traditional saying on the role of agricultural inputs : "First water, second fertilizer, third care, fourth seed." Nowadays, with progress in biological technology of agriculture, the role of inputs changes but water remains in the first place. Up to 1990, nearly 300 irrigation systems, including 700 electric pumping stations with more than 10,000 pump units (excluding about 8,000 small electric pumps managed by farmers) and a dense canal network (70-120 m/ha) were completed, creating an irrigation potential of 2.49 M. ha. The total asset is valued at more than 20,000 billion VN$; approximately, US$1,000 ha.[2] In addition, farmers' contribution in labor is about 30 percent of the total asset value.

Table 1. The growth of rice and annually irrigated area in '000 ha.

Year	Irrigated area	of which		
		Spring crops	Autumn crops	Summer crops
1955	1,043 (*)	488		555
1976	3,251	1,203	317	1,731
1980	3,736	1,582	437	1,717
1985	4,472	1,689	791	1,992
1990	5,045	2,011	1,127	1,907
1993	5,400	2,320	1,340	1,740

Source: M.W.R. * Northern provinces

In order to manage irrigation systems, 300 irrigation management institutions staffing 16,000 people were established. In average, a person is responsible for 180 ha; where there is proper management, the responsibility is for 100-120 ha per person.

Irrigation management institution at system level is a production and service-oriented enterprise, named the Irrigation Corporation (IC). Its activities are based on the decree enacted by the government in June 1963. Water service fee is the main source of income of the IC. Presently, water service fee collection has reached 180 kg/ha per crop, and even 300 kg/ha per crop in some provinces. However, fee collection efficiency is only 70-80 percent. The amount of money collected covers 30 percent of the costs for O&M of pump irrigation system and 50-60 percent of the gravity irrigation system. The IC still depends on subsidy from the government to cover its shortages. The problem the Irrigation Management at system level is facing is the degradation of physical facilities because of the deficiency in finance. Thus, an improved policy of water service fee collection is being prepared by the Ministry of Water Resources for Government approval so as to promote farmers' and other beneficiaries' further involvement in irrigation management.

In this context, Vietnam has a saying: "The Nation takes people as its base" or "Things ten time easy without people we cannot do; thing ten times difficult, with people it is O.K." Starting from this view, and facing the demand for irrigated agricultural development while the country economy has been in difficulties, irrigation transfer at farm level has been soon considered by the Government as a policy and has been legislated in the decree, titled "Decree on irrigation system management, exploitation and protection." The managerial sector, institutions as well as the responsibility of the Government and the farmers in irrigation development and management have been defined in the Decree, such as:

"The local authority has to rapidly involve farmers/Cooperatives to construct field canal networks and ancillary facilities based on system irrigation planning in order to make local irrigation profitable" (No.5).

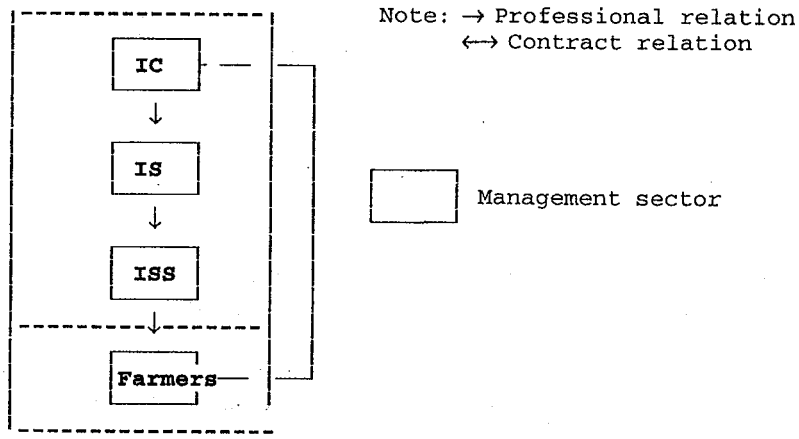
"Costs for O&M small-medium and small-scale structures serving irrigation for one Cooperative or more are paid by the Cooperative and the individual farmers themselves. On-farm irrigation management is organized by the Cooperative and the individual farmers" (No.6, 16).

As such, two managerial sectors have been formed in an irrigation system:

* The government sector, including headworks, the conveyance canal system and ancillary structures, is managed by the government IC.

* Grassroot, i.e., the farmer sector, including field distribution canal system and ancillary structures, is managed by the Irrigation Team organized by the farmers themselves under assistance of the System IC.

The form of irrigation system management organization can be generalized as follows:



ON-FARM LEVEL IRRIGATION TRANSFER

Transfer Contents

The transfer is to be carried out right after the formation of the irrigation system. It includes transferring of responsibility and authority to collective farmers to construct and manage on-farm irrigation facilities, including the following:

* to construct field canal network and ancillary structures,

* to maintain and repair field canals and structures, and

* to distribute water to field plots and manage water application.

As such, within the farmers' sector, i.e., the Cooperative sector, farmers by themselves contribute capital investment for field physical facilities construction and pay for O&M costs as well as organizing their own water management institution—the Cooperative Irrigation Team (CIT).

The Cooperative Irrigation Team

The establishment of CIT has been legislated by a regulation promulgated by the Inter-ministries Agriculture and Water Resources in 1977.

CIT is an organization of Cooperative farmers. It is established and paid for by farmers themselves. Its tasks are:

* To formulate a seasonal irrigation schedule prior to start of the crop season and water delivery calendar for each irrigation; to receive water released from the main system and distribute water to field plots.

* To maintain and operate on-farm irrigation facilities, including:

  Removing obstructions in canal,

  Undertaking structures' small repairs,

  Protecting and preventing structures from damages made by people, and

  Maintaining and operating diesel pumps.

The responsibility system introduced is based on the following:

* Area to be irrigated and water supply quality

* Canals and structures to be maintained according to length of canal and amount of field intake, offtake. For success of on-farm irrigation management each member of CIT should be responsible for 18-20 ha with high-level farming and for 30-40 ha with low-level faring and poor physical conditions.

Support from the Government for On-Farm Irrigation Transfer

In line with instructions and the organization of on-farm irrigation management, the following activities of the government have been undertaken:

* Partly provide funding for construction of on-farm irrigation physical facilities. The support has been carried out annually with the State budget, depending on the economic status of the specific location.

* Provide cement, iron and construction materials at a low price for construction of field structures. In recent years there has been no provision of construction materials, and farmers can buy them at the market.

* Such assistance in training to improve farmers' knowledge of irrigation management and agriculture and improving their skills in irrigated agricultural practices as:

  - The IC has organized and provided part funding for training courses.

  - The Irrigation Department (ID) has organized training courses for IC-selected staff as source trainers for local farmers' training. There have been skilled farmers attending the courses.

  - Assigned staff to interact with farmers to provide them with technical assistance in irrigation planning and management. Salaries of staff assigned by the IC or the ID have been paid by the IC or the ID.

Programs such as completion of irrigation systems, land reclamation and upgradation of irrigation systems, etc., have been initiated and directed by the Government and the Ministry of Water Resources in the 1970s. Later, programs on land consolidation and land reclamation have been initiated and conducted by many provinces.

Funding for implementation of the programs has been provided mainly by Cooperative farmers and partly by the local budget.

Support mentioned above and benefits from irrigation development have encouraged farmers to get involved in irrigation development at farm level.

Results Obtained from On-Farm Irrigation Transfer

The involvement of farmers in irrigation development and management has been maintained.

According to the figures collected from some selected Cooperatives, the amount the farmers have paid for on-farm irrigation physical facilities, with earth canal density 100-120 m/ha, has been US$10-120 ha; for O&M, US$ 5-7 ha per crop in cash at current prices, i.e., 2.5 percent of the actual production collected. Of this US$1 ha per crop has been paid for CIT, the rest for maintenance of structures and repair and pumping of power consumption. In the last 2 years, incentives given by the land allocation policy and market economy have prompted farmers in many irrigation systems to give their own money for canal lining to save land and irrigation water. The cost for canal lining has been US$8-10 per km at current prices [land saving 34 percent of land used for earth canal; water saving 40 percent].[4]

The IMT combined with irrigation technology transfer (ITT) at farm/cooperative level has given encouraging results.

* The figures collected in the medium-sized pumping station studied in the Red River Delta in the early years of IMT [5] have revealed that:

* Irrigated area has increased from 934 ha to 1,600 ha after 4 years, i.e., irrigated efficiency has increased from 50 percent to 81 percent due to proper management of irrigation.

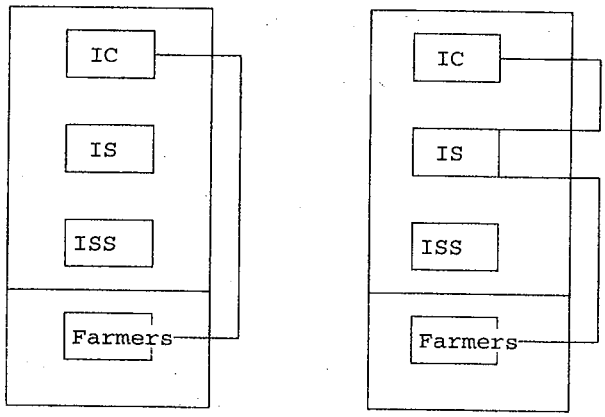
* Water consumption has been reduced from 8,000 m^3/ha down to 5,120 m^3/ha, saving 36 percent.

* Costs for producing 1.0 ton of paddy reduced to 50 percent.

* Cropping intensity has increased from 1.7 to 2.5. Besides, there have been viable sources of finance to sustain on-farm/Cooperative irrigation facilities; reduction of structures' damages and disputations in irrigation among farmers.

LOCAL MANAGEMENT TRANSFER

In response to the need for strengthening "district level" irrigation systems, local management transfer has been carried out since the late 1970s. A partial or complete management including responsibility and authority have been transferred to the district level, that means to an institution whose irrigation performance is placed under district authorization. System assets and institutions remain in the hands of the government ownership, management organization is also still in the hands of the governmental but is separated from the IC organization structures. For instance, in the Red River Delta of Vietnam, of the 14 interprovinces and interdistrict systems there were 5 which, prior to transfer, have been managed by 6 ICs; at present, the 6 ICs have been separated into 28 ICs of which 6 are managing head works and the main canal, and 24 district ICs (DIC) are managing lateral and sub-lateral canals and ancillary structures. The situation can be generalized by a chart as follows:



Before transfer After transfer

Note: → Professional relation
⟷ Economic contract relation

Management sector

This has been really the transfer from this government institution to that government one but not turning over from the government to the water users. Facts have revealed that DIC have proved to be dynamic and that they have full capability to do well in O&M. Furthermore in case of difficulties, it makes full use of supports from the district authority in collecting irrigation service fees; mobilizing farmer labor forces for rescuing the structure from the damaged one when it is in danger and for dredging canals to ensure timeliness of farming.

However there also have been the following constraints:

* In large irrigation systems many an IC is autonomous in finance and activities will be easy to bring about:

  - Disunity in system management and performance
  - Disputation in irrigation benefits between regions
  - Disorderliness in system planning due to local development
  - Gaps in system performance, resulting in low system efficiency and to a certain extent in uneconomic management
  - Disputes in water distribution between regions.

LESSONS DRAWN FROM IRRIGATION MANAGEMENT TRANSFER FROM THE GOVERNMENT TO THE FARMER AND THE LOCAL MANAGEMENT

1. In most cases, for on-farm, even independent small irrigation structures, the irrigation transfer from the government to the beneficiaries/farmers is essential so as to involve farmers in self-developing and management of irrigation at farm/cooperative level and at the same time to release the government's burden of investment in construction and management of on-farm physical facilities.

2. Farmers have proved to be entirely capable of doing well in O&M of on-farm irrigation facilities even in small-medium size projects once they receive education, training and support from the government.

3. Rehabilitation and improvement of physical facilities to be transferred and the promotion of community-based organization/CIT as well as farmers' understanding and willingness are prerequisite conditions to ensure success of irrigation management after transfer.

4. The transfer of responsibility and authority for irrigation management without transfer of irrigation and agriculture technology have not enabled the transfer to yield desirable success. The results obtained from the case study as mentioned above revealed that transfer of technology should be promoted just during and after transfer.

   The extent and level of transfer should depend on the farmers' capability of shouldering the responsibility and on the economic status of the locality/the farmers.

5. For large irrigation systems, interprovinces and interdistricts, in the partial transfer, the IC retains management control of the water source and the main canal, and the DIC manages secondary canals and ancillary structures within its own sector; this will easily bring about loss of system unification in irrigation planning and in management and performance, and also making system operation less efficient. Therefore, the problem should be explored further.

6. The establishment of irrigation institutions as well as the irrigation transfer should be based on hydrologic locality and there must be a professional organization responsible for O&M activities.

7. The transfer of irrigation management in existing irrigation systems should be implemented step by step; first is to transfer responsibility in finance for O&M in the spirit of self-supporting; the transfer of authority and assets should be implemented later.

8. For large irrigation systems, the moving toward a full transfer of irrigation management, including transfer of responsibility and authority and assets in the spirit of "self-manage, self-support" to the farmers' community in order to replace the role of the government management organization, is considered by many scientists concerned as an orientation strategy to reduce the subsidy of the government and what is more important is to reach the sustainability of the irrigation systems. Naturally, the IC still exists as an essential body for irrigation system O&M in the market economy.

Data Sources:

[1] Case study finding on "Strategy for creating Capital Investment" - Dr Tran Nhon, Vice Minister of M.W.R-1991.

[2] Department of Irrigation Review 1990.

[3] Case study finding (Dr Tran Nhon, Manh Ta - M.W.R).

[4] Dan Hoai, Tu Liem, Song Chu ICs - 1993.

[5] Case study finding on "Improvement of irrigation at farm-level" Manh Ta, Xuan Dao - Senior irrigation engineers - 1975-1980.

Planning Perspective of Farmers' Participation in Irrigation Management in India

B.N. Navalawala[1]

ABSTRACT

INDIA'S PROSPERITY WILL depend for a few decades to come on the growth and development of agriculture. The Indian agriculture sector is as diverse as in any continent. Out of 4 farmers in the world, one is in India. The success of Indian agriculture is inextricably linked with the development of irrigation which has helped the food grain production to increase from 54.92 million tonnes in 1949-50 to 180 million tonnes in 1992-93. Despite such achievements in the production of food grains and other agricultural items, the growth rate on the farm sector has, nevertheless, not kept pace with the rising population. The country's total food grain production will need to be boosted to a level of 210 million tonnes by the year 1997 and 285 million tonnes by the year 2007. Against such a back-drop, irrigation will occupy the center stage in the planning strategy but at the same time there are significant and difficult issues facing irrigation performance, particularly related to institutional aspects. Farmers' participation in irrigation management is now a key factor in importing water use efficiency as well as productivity to irrigated lands as a pre-requisite to sustain the country's self-reliance in food grain. On the basis of experience gained over the past 4 decades, this paper analyzes the need for and future of farmers' participation in Indian irrigation management from the point of view of the planning strategy.

NEED FOR FARMERS' PARTICIPATION AS A PLANNING STRATEGY

For India, farmers' participation in irrigation management is more a need as the planning strategy for optimal utilization of basic resources--land, water and human--than maximizing agricultural production. Indian agriculture has made major strides in the decades following independence. This was facilitated by promotional efforts of the State, that is Central and State Governments, in introducing and spreading new technologies of crop production, putting in place a fairly wide network of a delivery system of inputs in which irrigation is a critical one, supporting services, establishment of institutions to assist the farmers in adoption of improved technologies, etc. The success of agriculture is inextricably linked with the development of irrigation. Even though there has been considerable improvement in the production of food grains and other agricultural items, the growth rate of the farm sector has not kept pace with the rising population. The overall growth rate of agriculture in the same period has been 2.5 percent compared to the 2.1 percent increase in population. The share of agriculture in total GDP has gone down from 56 percent in 1950-51 to 32 percent in 1992-93. Also, the population living in villages and dependent on agriculture has shown a marginal decline from 80 percent to about 70 percent over the same period.

The production of food grain crops has increased from 54.92 million tonnes in 1949-50 with a gross cropped area of 99.28 million ha to 180 million tonnes in 1992-93 with a gross cropped area of 124 million ha. The present (1990-91) cropping intensity is about 130 percent. As per the Eighth Plan projections, the Indian population will grow from 844 million in 1991 to 925 million in 1996, 1,006 million in the year 2001 and 1,102 million in 2007, and it is further estimated that the population will be 1,394 million by the year 2,025. Accordingly, the food grain requirement will also go up from 172.5 million tonnes in 1991-92 to 210 million tonnes in 1996-97, to 245 million tonnes in 2001-2002 and to 285 million tonnes in 2006-2007. Unless there is an increase in the agriculture growth rate, it is doubtful whether enough will be produced to feed the population of one billion at the turn of the century. For this, it will obviously be needed either to expand the land area for cultivation or to increase the cropping intensity (and thereby gross cropped area) through expansion of irrigation facility or both. However, there are severe constraints in expanding the land area for cultivation, as discussed hereinafter.

There is yet one more dimension, namely poverty alleviation. In India, nearly two thirds of the work force (which is 314.9 million as per the 1991 census) is still dependent on agriculture for livelihood. At the beginning of the Eighth Five-Year Plan (1992-97), the total number of unemployed was 23 million with 17 million completely unemployed and 6 million severely underemployed. The Eighth Plan has set the target of providing additional employment opportunities to 43 million people out of which 40 percent is in the farm sector for which irrigation is a key factor. However, during the Eighth Plan period, it is estimated that 35 million will be new entrants in the unemployed labor forces. Thus, at the

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end of the Eighth Plan and after fulfilling the target of employment generation, still there will be 15 million people unemployed. With the constraint on the availability of more land area for cultivation, the planning strategy demands to go for increasing gross cropped area with expansion of irrigation so as to generate more employment opportunities and for that, the present cropping intensity level needs to be increased to 140 percent by the turn of century and 145 percent by the year 2006-2007. An acceleration in the growth of agricultural output in the lagging and poorer regions would have to come obviously from an increase in yield levels of individual crops, increase in cropping intensity and changes in the cropping pattern in favor of high-value crops. The most important factor contributing to such changes would be the availability of assured irrigation, followed by the provision of modern input and appropriate price policies. Employment implications of irrigation, through various effects like the increase in cropping intensity, yield levels and cropping pattern are found to be quite significant. On the basis of a cross-section analysis among different States, it is observed that a one percent increase in irrigated area leads to a 0.38 percent increase in employment. But field-level studies in Andhra Pradesh, Orissa and Karnataka show that an irrigated hectare of sown area uses from 50 to 150 percent more labor than an unirrigated hectare. Thus, it is obvious that for accelerating the growth of agricultural output and employment in the slow-growing regions, a major thrust on provision or irrigation would be necessary. It may also be pointed out that due to low yield and consequently low farm-income level, a good proportion of the persons already engaged in the farm sector is under the threat of becoming openly unemployed and, as such, they are the candidates for employment outside the farm sector. Therefore, besides generating new employment opportunities, it is also equally important that employment already in the farm sector should be more effective and remunerative through better performance of irrigation.

CONSTRAINTS ON LAND WATER USE

With India's net sown area (NSA) being stagnant at about 141 million ha (accounting to about 43 percent of its geographical area) during the last two decades, the area under food grain crops has been about 118-121 million ha (about 85 percent of the total NSA), since 1970-71. Against this, the NSA is likely to decrease to about 138 million ha at the turn of the century due to the growing pressure on land use as a result of fast occurring urbanization, industrialization and developmental activities. On the other hand, the per capita water availability per year in India will dwindle from its 1990 level of 2,464 cubic meters (m^3) to about 1,496 m^3 in the year 2025 which will be less than 1,700 m^3 per capita per year, a threshold value below which a country will begin to experience periodic or regular water stress. At the same time, the share of agriculture in total water use in India will come down from its present level of 83 percent in 1990 to 73 percent in 2,025 due to competitive demands on water use from other sectors, particularly energy, domestic and industrial use. In view of such compulsions, caused by the growing population on the good grain production, land and water use, the agricultural growth strategy will have to move in two directions, namely expanding the irrigation cover and optimizing agricultural productivity from irrigated area through the improvement of performance efficiency for which the most important step is to integrate farmers' participation with effective institutional development, better maintenance and optimum utilization.

IMPROVEMENT IN IRRIGATION PERFORMANCE

Faced with the above discussed constraints on land water use, the national planners in India increasingly agree that the most effective long-term strategies for having the required agricultural growth rate, to fully meet not only the growing demands for food grains in the country but striving to achieve a greater share of exports of both agricultural commodities and processed products in the international markets, include conservation and more efficient land-water use. Before a strategy for improving irrigation performance is considered, one has to take a quick look at its present status from the angle of (i) water use efficiency and productivity, (ii) reliability, and (iii) finance.

WATER USE EFFICIENCY AND PRODUCTIVITY

On an average, water use efficiency in the existing irrigation projects is put at 40 percent which means the bulk of the water diverted to agriculture never benefits a crop. The overall productivity (as in 1992) in case of cereals in India is as low as about 1,996 kg per ha as compared to the global average of 2,791 kg per ha and Asian countries' average of 2,898 kg per ha with China's 4,397 kg per ha, Japan's 5,847 kg per ha, South Korea's 6,568 kg per ha, Saudi Arabia's 4,741 kg per ha, European countries' average of 4,006 kg per ha and North America's 4,369 kg per ha. Major crop-wise yields in India vis-a-vis some selected countries in the world over the period (1965-89) are given in Annexure I. Several studies conducted have established that productivity from irrigated lands in India can be achieved to a level of 3 to 4 tonnes per ha. For improving agricultural productivity, irrigation and fertilizers are the main actors amongst various inputs for agriculture. The total consumption of fertilizers in kg per ha per year in India has increased from a

mere of 3.68 in 1963-64 (the year after which India started using High Yield Varieties) to 65.30 in the year 1988-89 which is very low as compared to 114.7 for the Asian average, with averages of 262 in China, 415.10 in Japan and 229.30 in Europe. More details of fertilizer consumption, yearwise and countrywise, are given in Annexure II. For improving the present level of fertilizer consumption, the assured irrigation is a prerequisite.

It would be interesting to cite an example of farmers' participation in the Lower Bhavani Project in the southern State of Tamil Nadu in India. Commendable work has been done for the formation of a water users' association for managing the command under this project. The highest yield of the main crop of rice as recorded as well as awarded in the competition held in 1990-91 was of the order of 11.3 and 9.6 tonnes per ha. Also the results of crop cutting experiments done during 1988-89 showed a 146 percent rate of productivity growth in the tail end, a 142 percent rate of productivity growth in the head reach and a 118 percent in the middle reach for the rice crop. Similarly, in another irrigation project, i.e., Periyar Vaigai Command water users' associations have been fairly established and the crop yield estimation studies carried out during 1990-91 showed an increase of 48.14 percent of productivity of rice crops. Thus, all over the country, there is nevertheless considerable scope for improvement of agricultural productivity through the improvement of infrastructure for the farm sector so as to fully harness the basic resources in India, in a sustainable manner. It is estimated that management improvements including increasing water use efficiency to 60 percent alone could allow an additional 8 million ha to receive irrigation waters from existing irrigation facilities. In other words, the present yield from this newly irrigated land could be doubled without developing any new water sources. The investment as required for such management improvements could be in the range of Rs 64 billion (US$2.1 billion) to Rs 320-350 billion (US$10.4-11.6 billion), at the current price level, to create new irrigation potential for this area of 8 million ha. The presumptive annual loss comes to Rs 33 billion only on account of incremental agricultural production.

RELIABILITY

This is rather a true reflection of the level/quality of service that user farmers are provided with. If the arrival of water in the canal is unreliable and unpredictable or if farmers have not had any for a long time, not only would the productivity of crops grown on the ground get severely affected but would also dampen the enthusiasm of farmers in getting themselves associated with the irrigation management. The prevailing engineering-oriented approach or, at best, managerial approach of irrigation management has to be changed over to a productivity-management approach which is to be based on the simple understanding that agriculture is an economic activity and, to that extent, that the farmer is an economic animal who would be guided only by economic considerations. The present irrigation management owned by the government departments has the following negative aspects:

(i) Does not provide freedom to the user farmer for selecting a crop which is otherwise a major economic decision on his part.

(ii) Does not give freedom or incentive to use groundwater in the irrigated command which, at times, constrains the farmers in going for more remunerative crops; on the other hand, the conjunctive use of groundwater and surface water, although much espoused, seldom gets practiced on the ground, leading over the time, to various problems like waterlogging, salinity, etc., in the command.

(iii) Does not give freedom/flexibility in deciding as to when irrigation water is to be released in view of the rainfall and climatic conditions. This aspect is very important from the viewpoint of economic returns from irrigated lands which are subjected to the vagaries of the monsoon.

(iv) Instead of assuming the role of a facilitator, government irrigation management agencies are deciding on behalf of the user farmers who, in fact, should be in the position of a decision maker for irrigation-related matters. The farmer, in the decision maker's position, will have irrigation for his best economic benefit. But, in the present government-managed irrigation systems, the farmers' participation is remote, more dilute and not systematic.

Since the element of commercialization has now entered agriculture in a big way, farmers are obviously concerned with a high level of irrigation service. In a country like India where rainfall pattern is often erratic, affixed (predetermined) water delivery system cannot always be conducive to the farmers' needs (and the productivity) linked mainly with climatic factors. This kind of flexibility of irrigation water scheduling, responding fully to the farmers' needs, is difficult when it is to be operated by the government and, consequently, the productivity of crops gets affected. Similarly, the use of groundwater within the command is again controlled by the government in case of State-managed irrigation systems. The fundamental philosophy for irrigation is to benefit the user farmer but unfortunately the same

user farmer is not a decision maker in the present setup of irrigation management. In fact, today's decision makers, on behalf of the farmers, should assume the role of a facilitator and this calls for an attitudinal change in State Government departments managing irrigation systems. A farmer may be illiterate but he is the shrewdest judge as far as economics of his agriculture are concerned, be it in the selection of a crop or time interval of irrigation or volume of irrigation needed by crops on the ground. Therefore, distribution or delivery of irrigation water has to be decided by the user farmers. All these aspects can be met with only if there is farmers' participation in irrigation management.

FINANCIAL PERFORMANCE

Many of the water shortages cropping up around the world, in general, and in India in particular, stem from the widespread failure to value water at anything close to its true worth. Water charges in India, on an average, are very low--typically amounting to 2-3 percent of the harvest's value in most States--that they have no influence on the farmers' management decision. The cost of irrigation water on the basis of investment, on an average, works out to 91 paise per thousand liters against which at prevailing water charges, the highest water rates for rice and sugarcane are 1.2 paise (100 paise = one Indian rupee) and 11.6 paise per 1,000 liters, respectively. As against average water charges for irrigation at 3 percent of the production cost, China is charging 20 percent and South Korea 42 percent. Most of the States have not revised their irrigation water rates for the last 15-20 years. The direct fallout of such low irrigation water rates with the added problem of low recovery is that today the water charges allocated do not cover even working expenses, not to speak of depreciation charges and even a moderate return on the investment. On an average, gross revenue collection per hectare of irrigated command is found to be about Rs 68.00 against which the estimated working expenses are Rs 216.00 per ha and thereby resulting in a financial loss of Rs 149.00 per ha per year. It is estimated that the financial loss (difference between working expenses and revenue collected) as incurred by the irrigation sector during the Seventh Plan period (1985-90) was Rs 36 billion (without considering interest) and Rs 89 billion (with interest on investment). Upward revision of irrigation water rates is not only overdue but has cast its evil shadow on the performance of existing irrigation works. Understandably, such required upward revision has to be in a phased manner along with upgrading of the level of service from the irrigation works to the farmer beneficiaries.

Another aspect involved here is the revenue recovery from irrigation systems which has substantially declined since 1974-75. From Annexure III, it can be seen that the all-India average of revenue recovery as a percentage of working expenses declined from 64.2 percent in 1974-75 to a mere 7.8 percent in 1988-89. This has been further aggravated due to rising expenditure of staff involved in working expenses on irrigation projects which can been seen from Annexure IV. In some States, the cost of collection of fees is more than the revenue. The combined effect of these two aspects is reflected in the deteriorating level of maintenance and repairs of irrigation works which is evident from Annexure V which shows that, on an average, of 14 States, a little more than one third of the working expenses required for the upkeep of major (having a culturable command area [CCA] of more than 10,000 ha each) and medium (having a CCA of 2,000-10,000 ha each) irrigation projects was provided as maintenance funds in 1986-87. A classic example of such neglect of maintenance and repairs can be found in irrigation tanks, (i.e., catchment or stream reservoirs; the term "tank" is Indian English usage derived from Portuguese). While in 1962-63, the total area irrigated by 0.51 million tanks in India reached an all-time high of 4.78 million ha. It came down to 3.07 million ha in 1985-86 (in spite of thousands of new tanks added during that period) due to the neglect of upkeep of the tanks, resulting in the reduction in their capacity because of siltation, several tanks becoming completely dried up and fore-shore area being encroached by urbanization, etc. In financial terms, the loss of irrigated area was of the order of 1.7 million ha which could be a capital loss of about Rs 51 billion, i.e., US$3 billion.

Inadequacy in the design of the systems increases O&M cost. Funds for O&M depend on the collection from farmers; [a vicious circle of dissatisfaction, declining collection and declining performance starts]. Thus the irrigation agencies have to depend on budgetary provision for O&M expenditure which is not linked with the actual performance or higher agricultural production but is made according to resource availability. Besides, when funds for O&M are collected from the general revenue, the irrigation agencies do not feel themselves accountable to the users to provide optimal services. In this regard, a success story of water users' associations formed for irrigation management under Baldeva Medium Irrigation Project and Pigut Medium Irrigation Project located in the Bharuch District of Gujarat State in India needs special mention. Both these associations have been authorized to decide on the crop pattern, internal distribution of water, scheduling of irrigation water, fixation of water rates and collection of water rates/revenue over and above operation and maintenance of this system. In the case of Baldeva, the revenue collection as realized was 100 percent with Rs 60,000 (about US$2,000) in 1992-93 which increased to Rs 94,400 (about US$3,150) in the subsequent year, i.e., 1993-94, thereby mustering, 57 percent increase in revenue in just one year. Similarly, for the Pigut scheme, the recovery increased from 89 percent in the first year, 1989, to almost 100 percent in 1992-93. The revenue realization increased from Rs 30,500, i.e., about US$1,015 in 1989-90 to Rs 91,400 (about US$3,045) in 1992-93. Also, in case of the Pigut scheme, it is reported that the availability of "delta" (it is an expression used in India to mean the

depth of water that would result over a given area from a given discharge for a certain length of time. Alternatively, it may be defined as the total volume of water delivered divided by the area over which it has been spread) decreased from 43 cm in 1989 to 27 cm in 1993-94 as a result of improved water use efficiency achieved under irrigation management by the farmers' association.

MAJOR INFLUENCING FACTORS

Among the factors responsible for making a WUA a success or a failure, the following factors have emerged, from the Indian experience, to be major ones.

Mutual Accountability

The relationship between an irrigation department and a Water Users' Association (WUA) should be a businesslike relationship in the sense that the irrigation department stands committed as well as accountable to ensure that a predetermined quantity of water is made available at a predetermined time and place to a WUA on a payment basis. On the part of a WUA, it stands committed and accountable to pay for the water delivered by the department. This aspect of accountability needs to be reflected in the structure of irrigation water pricing, with due provision for allowing rebate (more as compensation) on the prescribed water rates in case of delay (but within a tolerable time period from the plant growth point of view) in supplying water as per the irrigation water calendar (to be decided jointly by the department and the WUA) as well as allowing overall reduction in the water rate if no water is supplied or is supplied beyond the tolerable time period. Also detailed service standards should be set out for each irrigation scheme or a group of similar irrigation schemes in terms understandable by the users and measurable at various points in the system. It is a proven principle that where comprehensive service standards are set out and enforced, service quality is high and the beneficiaries are more able and willing to pay the service charges. Where such service standards are not met by the operating entity, beneficiaries refuse charges even to meet O&M costs. Therefore, this bears heavily in any effort to transfer system responsibilities from the government to the user beneficiaries.

Legal Support

Considering water, a prime natural resource and precious national asset, India has adopted the National Water Policy in 1987 which, inter alia, states that "efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in deficient water use and water management" (para 12). Also, under the Government of India's centrally sponsored command area development program, financial support in the form of a management subsidy of Rs 100 per hectare per year for the first two years and Rs 75 per ha per year for the third year is available for the formation of WUAs under selected major and medium irrigation schemes. A model Bill was circulated in 1976 by Government of India providing, inter alia, for water committees at irrigation-outlet level. However, as per the Constitution of India, irrigation and canals are among the State List subjects and thereby the concerned States are primarily responsible for the development and management of irrigation works. As such, the States' Irrigation Acts have to provide legal support for WUAs.

The survey of relevant legal provision in the existing States' Irrigation Acts shows that not all Irrigation Acts provide, explicitly and comprehensively, for people's participation in irrigation management. Even State legislation with the provisions for people's participation, provides for the same only in small community irrigation systems and such WUAs are required to function under the active control of the State irrigation departments. Thus, a serious legislative backing should be provided through suitably amended States' Irrigation Acts with built-in financial incentives, giving more flexibility to the working of WUAs more as a "village-level resources management," and to that effect legislation will have to provide for devolution of authority to WUAs. It would be worthwhile to mention here that a draft revision of the Irrigation Act was prepared by the State Government of Gujarat and was promulgated as the "Draft Gujarat Irrigation & Drainage Ordinance" with effect from 1.8.1989, but, unfortunately, it lapsed in the absence of the enactment of the said Act within [*] months by the Gujarat Legislative Assembly. The draft Act envisages delivery of water only to WUAs (formed at outlet level) or federations of WUAs and not to individuals as is the prevalent practice. Further, a landmark development for devolution of authority to the elected representatives of people has taken place in the form of the Constitutions (Seventy Third) Amendment Act passed recently by the Indian Parliament for the revitalization of Panchayats (elected body of people's representatives at village and district level).

Attitudinal Change

The role of irrigation departments should be that of a facilitator supportive of WUAs. The bureaucracy should undergo attitudinal change so that they are considered and accepted by the user farmers as their friends, philosophers and guides rather than as water lords. This will need intensive training of government staff/officials through short- and long-term training courses as well as by deputing them to the NGOs of good standing for a period of at least two years with the total expenditure towards their salaries to be borne entirely by the government. Similarly, the farmers should also be imparted with training to enable them to understand and sympathize with the daily problems of the irrigation agency in providing adequate and timely water and working within bureaucratic constraints. Also, annual agricultural fairs, discussions/debates, seminars, workshops, exhibitions, film shows, prize incentives for best performing farmers, etc., are among the essential initiatives to be taken by the statutory bodies to have better interaction with the farmers, besides helping in the creation of healthy competition among farmers for agricultural production and educating them in scientific irrigation agriculture.

Level of Participation

Experience shows that if the size of the WUAs is too small, say less than about 200 ha, the proposition may not be viable. If the size is too large say more than 500 ha, it may become non-homogenous and difficult to manage. Hence, WUAs on minors covering an area of about 300-500 ha may be most appropriate as they will cover only about one or two villages. In the case of minor irrigation projects, the size of project is usually about 500 ha and, hence, one WUA for the entire minor irrigation scheme may be sufficient.

Registration of WUAs

Another important issue is the registration of a WUA. Although it is not always necessary to register a WUA, especially at first, such registration becomes necessary for a WUA to acquire legal status enabling it to make contracts and Memorandum of Understandings, get bank loans, acquire fixed assets and, most important, to assure the members of financial responsibility in the legal sense. However, due to the tardy and comparatively complicated procedure of registration under the relevant Act, the farmers many a time get frustrated and disgusted with the whole procedure. To avert such a situation and at the same time to facilitate the purpose, "a Two Phase Registration" would be a practical remedy. Under this, the first stage is for a WUA or any sort of farmer water management grouping to be recognized by the authorized government department and on being certified to be made viable for the purpose by the appropriate field officer. The certification should take into account the purpose of such grouping/association, list of members, provision for annual meetings and the support of its farmer members. The second stage is the legal registration by the authorized government departments after a WUA is found to be viable and ready for legal registration.

Autonomy in Working of WUAs

The WUAs should have authority to fix their own water rates, collect revenues, decide on internal distribution including deciding scheduling of water, selecting a crop pattern to be adopted by all member farmers and using groundwater in the command under a legal instrument. Under the Memorandum of Understanding to be signed between the government department(s) and WUAs, the water rights should be granted to the WUAs for each crop season with in-built incentive that if during a crop season the WUA saves water by better water management, such saved water is available in addition to the sanctions for the next crop season or in hot weather seasons.

Role of Women in Farmers' Participation

Of the total agricultural labor force (which is estimated to be about 210 million on the basis of the 1991 census), women constitute nearly 50 percent of whom 37 percent are cultivators. The majority (nearly 75%) of women work force belongs to families of small (having landholdings of 1-2 ha) and marginal (having landholdings less than 1 ha) farmers. An evaluation, under the Indo-Dutch Cooperation Program on "Women in Irrigation Projects" in the States of West Bengal and Uttar Pradesh has revealed that women's contribution to agriculture is estimated to be 54-60 percent depending upon the cropping pattern and the technology involved and that taskwise women participate almost in all activities except in ploughing. The women are quite knowledgeable about various agricultural inputs and operational details. However, such a productive role of women in agriculture is unfortunately not taken into account in a systematic manner in models of farmers' participation in irrigation management in India.

Multifunctional Nature of WUAs

WUAs that have a formal structure need to have a reliable income to manage and maintain the water distribution system. If they do not raise their own income, they can hardly be sustainable. Some WUAs handle very modest sums of money, particularly in informal organizations where all maintenance except that of field channels is undertaken by the ID and the farmers just contribute labor. The objective in the turnover process is that WUAs will manage distributaries or at least minor canals, get enough additional profit from the improved management, and raise their own resources. If a WUA does not result in perhaps 20 percent additional income to the farmer, it is probably not worth his time and trouble to participate in such organization, considering the social, emotional, time and monetary costs and the WUA will not be sustainable. By definition, a successful WUA is one that the farmers find profitable above what it costs them in time and money to maintain the society. There is no exception to this. To achieve this objective, WUAs functioning after an initial stabilization period should not remain restricted only to water distribution and water rates collection but must diversify its role to become a broad based "Farmers' Organization." They can undertake commercial activities like the sale of certified seeds, fertilizers, pesticides, etc., as well as other agricultural implements, marketing, taking contracts for maintenance or repair, extending a loan facility on interest to its members, and so on and so forth, relating to village/area development and thereby accomplishing the ultimate aim of becoming an effective vehicle of "village-level resource mobilization."

Model of WUA

There is a large variety of possible ways farmers can organize themselves. These differ by States, administrative areas, irrigation projects, cultural regions, settlement patterns, crop regions, and ecological regions and according to water source and water quality. The farmers themselves have to decide locally what kind of organization they feel they can support. In each region, the most effective ways may have to be worked out in action research (where the principle should be the testing of alternatives) through existing WALMIs (Water and Land Management Institutes), as well as by building on existing social institutions in the States. Some private agencies, especially in Maharashtra and Gujarat, have done well in working through alternative models. In each case, once the farmers decide to organize, they will have to make decisions on a wide range of alternatives by which their society can function.

CONCLUSION

On the one hand, faced with constraints on the use of both land and water resources by 2025 AD and, on the other, with serious deterioration in irrigation performance during last four decades, water use planning has acquired a significant place in the Indian economic planning for sustaining the growth rate of agriculture against the rising population. Experience over the years from the world's largest irrigated area that India possesses has conclusively shown that farmers' participation should be in the center stage of the planning strategy not only to pull back from sliding down but also to place the irrigation performance at the level required to sustain the growth rate of agriculture, particularly to meet the growing demand of food grains which will be 285 million tonnes by 2007 AD against the present level of food grain production of 182.40 million tonnes. Bureaucratic attitudes of state-owned irrigation management, inherited from 190 years of British colonial rule, have not changed enough with changing needs of farmers for irrigation over the years and particularly in the wake of the present commercialization of agriculture. There are about 4,420 WUAs in various forms in the States of Andhra Pradesh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, Himachal Pradesh, Karnataka, Uttar Pradesh and Assam in India and the total area as presently managed by these WUAs is reported to be about 0.234 million ha which account for just 0.33 percent of the total area being presently irrigated in India. The growth of WUAs has not only been sluggish but also scattered and mainly site-specific in the sense that even in the case of successful WUAs, it has, curiously enough, not spread further to other areas or even to the adjoining blocks of the same command. Several evaluation studies, conducted to understand the working of, as well as problems faced by WUAs in India, show that major factors, if not deterrents, influencing the future of WUAs in India are comprehensive changes in laws and policies, rending legal support, mutual accountability, particularly of irrigation departments, towards WUAs as well as attitudinal changes in bureaucratic functioning, and autonomy in the working of WUAs so as to place the user-farmer in the decision maker's position for irrigation water use.

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Annex I

Yields of important crops in different countries of the world vis-a-vis of India (in kg/ha).

Country	1965			1970			1975			1980			1985			1989		
	Paddy	Wheat	Maize	Paddy	Wheat	Maize	Paddy	Wheat	Maize	Paddy	Wheat	Maize	Paddy	Wheat	Maize	Paddy	Wheat	Maize
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
India	1300	910	1000	1660	1210	1120	1858	1338	1203	2010	1436	1137	2329	1870	1146	2590	2241	1345
Pakistan	1650	860	990	1830	1180	1000	2290	1320	1296	2418	1563	1271	2350	1612	1256	2269	1865	1287
Bangladesh							1853	926		2020	1899		2170	2075		2502	1632	
Indonesia	1850		900	2040		930	2629		1187	3301		1448	3942		1774	4228		2130
Thailand	1540			1870			1825			1899			2061					
China	NA	NA	2200	NA	NA	2900	3507	1367	2990	4200	1878	4038	5263	2937	3607	5537	3054	3720
Japan	4950			5640			6187			5128	-		6225					
Philippines	1310		660	1780		980	1721		863	2338		950	2663		1100	2705		1296
UK		4070			4130			4334			5878						6600	
Italy	4020	2280	3230	4730	2230	4350	5806	2711	5938	5385	2687	6836	6052	2789	6889	5577	2510	7749
USSR	4770	850	2530	5100	1440	2830	5826	1068	2763	4946	1597	3176	3833	1553	3214	3861	1900	3552
USA	2640	1790	4630	3640	2090	4500	4019	2057	5420	4191	2249	5711	6068	2519	7407	6444	2203	7023
Canada		1540	5010		1790	5290		1800	5740		1725	5671		1766	6204		1788	6309
Mexico			1120			1200			1264			1780			1861			1678
Brazil	1640		1380	1640		1470	1428		1562	1570			1898			2106		
Argentina		1320	1680		1250	2330		1626	2508		1549	2570		2627	3563		1847	2803
Egypt	5033	2640	4070	5430	2770	3730	5480	3472	3617	5755	3225	4038	5948	3759	4601	6490	4997	5816
Syria		860			470			916			1536			1355			1171	

Annex II

Fertilizer Consumption in India and Global Comparison (in kg/ha).

Country	1963-64				1969-70				1974-75			
	N	P	K	Total	N	P	K	Total	N	P	K	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
India	2.62	0.75	0.31	3.68	6.15	1.45	0.92	8.52	10.70	2.90	2.10	15.70
Pakistan	4.31	0.42	0.23	4.96	11.28	1.76	0.88	13.92	18.50	2.10	0.10	20.70
Bangladesh									9.10	3.90	1.20	14.20
China									30.20	10.10	4.30	44.60
Japan	119.60	81.63	96.45	297.68	160.09	123.04	123.15	406.28	123.00	123.30	128.50	374.80
Philippines	4.29	2.23	2.86	9.38	8.29	7.49	4.41	20.19	17.20	4.60	5.80	27.60
Asia Average	5.77	2.86	2.34	10.97	10.96	4.97	3.68	19.61	19.60	8.00	4.70	32.30
U.K.	82.16	62.03	61.33	205.52	89.46	63.41	63.56	216.43	128.40	62.30	66.30	257.00
Italy	24.33	23.71	8.49	56.53	36.69	32.41	12.97	82.07	54.70	30.00	18.80	103.50
Germany	88.52	89.62	133.47	311.61	132.68	104.80	137.03	374.51	148.60	108.50	144.90	402.00
Sweden	39.67	32.70	27.74	100.11	67.14	45.55	42.16	154.85	77.80	43.70	38.60	160.10
Netherlands	293.22	122.26	148.38	563.86	431.85	120.71	138.06	690.62	516.10	108.50	131.90	756.50
Poland	19.79	15.58	22.13	57.50	51.52	39.13	68.48	159.13	76.00	58.90	95.70	230.60
Europe Average	35.07	34.47	34.93	104.47	61.30	49.30	47.74	158.34	78.40	55.60	57.20	191.20
USSR	5.91	4.21	3.92	14.04	16.29	8.22	9.94	34.45	29.00	13.90	15.90	58.80
USA	21.75	16.11	13.73	51.59	38.35	23.49	20.75	82.59	37.70	19.70	19.40	76.80
Canada	2.95	5.38	2.70	11.03	5.64	7.37	4.38	17.39	11.80	11.20	5.30	28.30
Mexico									23.90	8.10	1.60	33.60
North America Average	17.66	13.28	10.78	41.72	30.65	18.84	16.39	65.88	32.40	17.20	15.60	65.20
Chile	6.22	9.65	2.28	18.15	19.37	4.43	32.89	9.10	17.40	17.40	2.60	29.10
Peru	39.55	18.38	63.00	25.29	3.82	1.37	30.48	30.48	39.50	4.50	4.30	48.30
Latin America Average	3.47	2.93	1.73	8.13	4.75	5.38	3.58	13.71	8.50	11.10	6.80	26.40
Egypt									126.10	22.80	1.90	150.80
South Africa	5.86	12.47	3.23	21.56	12.44	21.68	7.40	41.52	30.30	6.30	16.00	52.60
Africa Average	1.65	1.18	0.51	3.34	3.45	2.56	1.17	7.18	5.10	3.30	1.30	9.70

Country	1979-80				1986-87				1988-89			
	N	P	K	Total	N	P	K	Total	N	P	K	Total
1	14	15	16	17	18	19	20	21	22	23	24	25
India	20.40	6.00	3.20	29.60	38.70	13.20	5.10	57.00	42.80	16.20	6.30	65.30
Pakistan	40.00	11.40	0.50	51.90	66.40	19.80	2.10	86.30	63.40	18.70	1.20	83.30
Bangladesh	28.40	13.00	3.20	44.60	46.20	16.80	4.40	67.40	59.50	20.60	6.10	86.30
China	106.20	19.70	3.00	128.90	137.80	31.10	7.30	176.20	191.60	53.40	17.00	262.00
Japan	158.30	169.30	150.00	477.60	145.20	156.40	125.50	427.10	136.70	155.10	123.30	415.10
Philippines	22.90	5.20	6.40	34.50	30.90	5.80	5.80	42.50	46.70	9.70	6.90	63.30
Asia Average	43.00	13.20	5.30	61.50	62.90	20.50	7.50	90.90	77.30	27.00	10.40	114.70
U.K.	190.20	66.20	66.70	323.10	238.00	63.50	78.20	379.70	209.20	62.00	74.60	345.80
Italy	88.90	66.80	33.50	189.20	82.90	54.80	31.50	169.20	76.10	58.90	37.20	172.20
Germany	196.60	121.50	169.50	487.60	211.50	91.60	124.80	427.90	206.30	86.20	118.80	411.30
Sweden	85.60	43.20	40.60	169.40	81.10	26.60	28.90	136.60	77.60	24.70	25.10	127.40
Netherlands	564.00	97.50	143.50	805.00	556.90	96.80	115.90	769.60	467.20	81.60	101.00	649.80
Poland	88.40	63.60	66.30	218.30	23.00	52.10	79.60	224.10	102.90	63.90	78.50	245.30
Europe Average	193.10	65.70	59.00	318.70	18.67	56.90	61.30	230.80	11.70	55.80	60.80	229.30
USSR	32.20	23.60	19.00	74.80	49.40	36.00	28.70	114.10	49.90	36.80	30.30	117.00
USA	54.90	26.00	29.70	110.60	49.40	19.20	23.20	91.80	50.80	19.70	23.10	93.60
Canada	18.20	14.10	8.70	41.00	25.00	14.00	8.50	47.50	25.80	13.40	7.80	47.00
Mexico	35.60	11.00	2.60	49.20	53.50	16.60	3.70	73.80	51.40	16.00	3.80	71.20
North America Average	46.50	22.10	23.40	92.00	45.80	17.80	19.10	82.70	46.70	18.10	18.90	83.70
Chile	9.70	12.60	2.30	24.60	19.80	17.50	2.70	40.00	36.70	31.90	5.70	74.30
Peru	25.10	4.30	2.70	32.10	23.10	5.00	3.20	31.30	41.30	10.60	5.90	57.80
Latin America Average	10.60	16.60	10.20	37.40	13.00	15.60	11.10	39.70	13.10	15.20	12.80	41.10
Egypt	175.60	34.20	2.40	212.20	259.30	48.10	11.90	319.30	309.40	78.90	11.90	400.20
South Africa	27.50	28.20	8.70	64.40	27.50	25.50	9.10	62.10	28.90	23.40	10.40	62.70
Africa Average	8.30	5.30	2.00	15.60								

Annex III

Statewise and yearwise percentage recovery of working expenses through gross receipts in Irrigation and Multipurpose river projects.

Sl. No.	Name of the States	1974-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Andhra Pradesh	15.5	16.9	7.5	7.7	8.7	7.6	7.0	6.6	6.8	120.2	21.8	26.9	10.0	7.7	1.1
2	Bihar	72.5	94.4	61.2	74.0	39.5	47.4	63.2	39.8	49.3	58.4	29.8	29.3	15.1	19.6	12.1
3	Gujarat	71.1	94.3	84.1	90.6	71.3	70.6	34.4	16.0	30.8	35.7	35.4	25.8	44.6	6.5	5.7
4	Haryana	55.3	77.9	86.6	69.4	66.2	55.2	64.4	57.5	43.5	42.9	37.7	46.8	57.0	9.1	16.6
5	Jammu & Kashmir	6.0	2.0	3.2	4.1	3.1	2.2	1.8	1.5	1.9	0.6	5.8	8.0	13.7	4.9	7.1
6	Karnataka	97.6	129.2	20.8	76.4	95.5	85.9	7.6	77.3	33.2	50.9	29.7	6.8	38.7	10.1	10.3
7	Kerala	51.2	69.6	50.8	135.9	58.7	139.2	49.5	24.4	32.0	82.9	37.8	24.9	16.5	6.3	11.8
8	Madhya Pradesh	129.3	539.9	*	*	1401.8	*	45.5	30.7	39.8	44.8	30.2	41.8	33.3	31.8	35.1
9	Maharashtra	166.0	134.4	98.8	97.2	79.8	93.5	93.8	94.1	78.7	61.1	47.3	48.9	43.3	5.9	5.2
10	Orissa	30.7	86.4	71.9	75.7	60.9	46.3	46.8	69.8	79.3	95.0	64.3	134.9	209.0	45.8	46.2
11	Punjab	63.2	113.4	106.7	106.5	92.3	81.8	73.8	69.3	26.6	50.0	81.5	48.3	51.5	21.0	25.5
12	Rajasthan	49.6	104.9	105.7	57.0	65.5	66.0	55.9	46.5	51.2	43.7	43.6	19.3	16.1	11.3	9.7
13	Tamil Nadu	22.5	9.9	8.6	6.9	5.3	6.4	15.6	2.5	11.0	6.4	7.7	6.8	4.3	1.9	2.0
14	Uttar Pradesh	123.3	184.9	286.4	201.7	218.2	187.7	134.4	152.7	111.7	186.9	48.4	169.8	48.8	6.8	10.0
15	West Bengal	38.2	46.8	35.0	31.5	11.2	20.8	11.0	8.1	16.5	13.1	8.8	7.3	4.6	3.8	3.6
	ALL INDIA	64.2	91.1	92.9	76.2	69.6	71.7	45.8	45.3	49.3	60.3	38.8	46.0	34.1	9.9	7.8

Source: Combined Finance and Revenue Accounts of the Union and State Governments in India.

Remarks 1. Due to more credits in irrigation projects (Non-Commercial) which resulted in negative working expenses, such figures are not given.

2. Working expenses for the years 1987-88 and 1988-89 are inclusive of interest on capital at the end of the year.

Direction and administration as percentage of working expenses of major and medium projects (1974-75 to 1986-87).

S. No.	State	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Andhra Pradesh	21	20	5	18	22	18	59	62	46	42	33	52	59
2	Bihar	52	44	53	49	56	59	55	64	64	67	69	68	70
3	Gujarat	24	28	29	29	27	29	25	7	26	39	40	47	45
4	Haryana	22	23	24	24	21	19	24	20	26	37	20	35	27
5	Jammu & Kashmir	36	25	20	27	19	18	14	13	19	13	16	9	5
6	Karnataka	8	23	15	14	13	12	2	20	18	28	11	7	36
7	Kerala	23		56	29	7	32	26	39	61	58	68	84	73
8	Madhya Pradesh				100	100	100	100	100	100	100	100	100	100
9	Maharashtra	49	50	46	42	50	49	54	52	54	50	54	54	55
10	Orissa	10	9	11	11	7	6	6	14	9	11	33	8	8
11	Punjab	67	70	60	59	62	61	67	56	65	60	64	63	68
12	Rajasthan	42	36	19	21	12	21	36	33	30	29	24	8	15
13	Tamil Nadu	13	14	23	11	13	28	27	10	38	8	37	35	19
14	Uttar Pradesh	46	42	38	42	33	28	28	33	38	27	15	43	47
15	West Bengal	11	5	83	1	75	91	11	8	88	86	73	78	86
	ALL INDIA	34	32	30	30	30	31	26	28	41	37	32	33	43

Source: Central Water Commission (Statistics Directorate).

Annex V

Maintenance and repairs as percentage of working expenses as major and medium irrigation projects during 1974-75 to 1986-87.

S. No.	State	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Andhra Pradesh	66	73	84	68	73	76	71	72	49	55	62	64	63
2	Bihar	40	52	47	48	40	38	41	45	35	32	31	32	30
3	Gujarat	53	52	59	41	54	61	48	11	40	47	44	39	38
4	Haryana			76	75		81	76	80	74	63	79	64	72
5	Jammu & Kashmir	36	46	50	55	47	60	55	55	59	62	34	38	40
6	Karnataka	91	73	84	84	85	86	14	80	81	70	87		
7	Kerala	53	69	21	41	42	34	34	28	19	17	17	15	12
8	Madhya Pradesh	No expenditure reported for maintenance and repairs												
9	Maharashtra	43	49	48	46	36	36	40	36	34	38	43	38	37
10	Orissa	52	51	56	60	67	73	78	84	85	87	54	90	84
11	Punjab	28	36	39	32	47	43	47	38	50	42	37	44	34
12	Rajasthan	46	52	61	58	71	38	41	42	44	40	45	19	14
13	Tamil Nadu	81	78	71	51	37	50	58	17	76	19	60	45	37
14	Uttar Pradesh	43	60	64	55	59	58	66	62	54	71	24	14	44
15	West Bengal	No expenditure reported for maintenance and repairs												
	ALL INDIA	46	51	63	57	51	58	43	41	52	46	46	22	36

Source: Central Water Commission (Statistics Directors).

State Expectations and Local Interests: The Context for Irrigation Management Transfer in Nepal

Ujjwal Pradhan[1]

INTRODUCTION

IN MANY COUNTRIES in the developing world, the responsibility for managing irrigation systems which were previously controlled and managed by the state through its irrigation and agricultural support bureaucracies is slowly being transferred from the Central Government Authority to local communities. Such a process has been variously characterized as privatization, turnover, local institutional strengthening, democratization, decentralization, and so on.

Regardless of the nomenclature used, this trend has been driven by several varying forces at different places: fiscal crises faced by the developing countries, dwindling international assistance for irrigation infrastructural development, and pressures from international donors and lending agencies to make government bureaucracies more efficient. Yet at other places, the recommendation for management transfer comes from the assumption and the advocacy at times that the irrigation sector can perform better when controlled by the farmers themselves and that such management and governance transfer is in fact for their benefit.

In the study of this process whereby the governance of irrigation systems is slowly being transferred to local institutions from government authority, it is important to assess this trend in terms of salient features that are indicative of the relationships between the state and locality and the local communities themselves with one another. In the process of management transfer, the relationship between the agency and the farmers will first have to intensify, the locus of interaction increases leading in some cases to greater transaction costs, before the actual transfer has taken place. This relationship will have to be based on a different set of attitudes and orientations on the part of both the state apparatus as well as farmer groups.

This trend of management and in some cases ownership transfer in an agrarian society and economy of Nepal has also occurred because of the confidence that the planners and policymakers have had in the institutional capacity of the farmers and local irrigators in managing their own systems through their own customary practices and laws. Research on irrigation management in Nepal carried out in the early and late eighties has been instrumental in acquiring a recognized status for farmer controlled and managed irrigation systems. Such research on collective action portrayed by self-governing farmer irrigation organizations was able to put farmer-managed irrigation systems (FMIS) on the map of Nepal.

It was only in 1981 in Nepal that the government acknowledged their importance and began to consider ways to enhance and expand FMIS. The Irrigation Sector Policy for the Fulfillment of Basic Needs spelled out the direction that FMIS will be managed by the farmers themselves and that appropriate assistance will be provided by the government. In the first Five-Year Plan, the total area irrigated in Nepal was considered to be around 14,000 hectares (ha) for some 8.5 million population. Official irrigation statistics often ignored the area coverage and role of FMIS. In less than two decades since then in Nepal we see a noticeable change whereby there is a concerted effort in making even agency-managed irrigation systems FMIS.

Research and findings on the performance of FMIS have encouraged agencies to tap indigenous knowledge and skills of the local irrigators for government and agency assistance to them. Such farmer expertise and knowledge have also been utilized for bringing about participatory management in the form of joint management in several agency-managed irrigation systems of Nepal in the plains called the terai (IIMI 1992).

This paper provides a brief institutional and policy background of irrigation development in Nepal from a historical perspective and explores several scenarios of agency and farmer group relations in a variety of settings and contexts. The paper deals with the concept of local resource mobilization, an element that is going to be very important for the financial and institutional viability or sustainability once the systems are FMISs or are "turned over."

There are other aspects that are crucial elements of the turnover process and outcomes such as the performance of irrigation systems after the management transfer, equity of access to irrigation water between farmers, budget allocation for irrigation development and sustenance, organizational structure and changed roles of irrigation bureaucracies and farmer groups. However, this paper will highlight the resource mobilization aspect and the need to manage support services for attaining financial viability to some extent despite the dwindling agricultural economy of

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developing countries. The specific facilitating roles of the state may in fact lie beyond the irrigation system itself and more towards the sphere of macro financing and pricing policies.

HISTORICAL ANTECEDENTS

Readings on economic and social history of Agrarian Nepal (Regmi 19771, 1984) have pointed out the various and varying roles of both the state and the local irrigators in shaping irrigation management and the control of natural resources. The state and locality nexus, negotiations, bargaining, and shifting power balances have created the types of management styles that we currently find in the existing irrigation systems. Many direct and indirect relations exist between the farmers and the state. Such relations have been expressed through access to water, conflict adjudications, investment patterns, support service delivery, pricing policies, and development assistance patterns.

Even the so called agency-managed systems have a great deal of informal institutional arrangements for irrigation management. Similarly, in FMIS, certain formal parameters for institutional and legal arrangements are prescribed and proscribed by the state. The very necessity of registering one's organization, chalking up a constitution and by-laws to satisfy government or donor requirements, are examples of the "formal sphere."

If irrigation development at the macro level as well as at the system level is a product of this unfolding relationship between the state and local groups and between the local groups themselves, then it would be important to understand the nature and scope of these evolving relationships.

A variety of institutional arrangements exists and existed for the management of irrigation systems in Nepal. These have evolved as other changes in social and economic relations have occurred. The nature of the management style to an extent is a derivative of a combination of factors: the nature and impetus of the creation of the irrigation system, state-peasant relations and the nature of state appropriation of resources, cultural composition of the irrigators, the human settlement pattern, and others.

Legacies of the Past: Nepal's Agrarian Economy

Irrigation has been practiced in Nepal for centuries and a historical analysis of state measures and local responses can help us better understand the dynamics of irrigation. Much of what exists today is the legacy of the past. It is also within this understanding that future strategies can be formulated.

Four distinct periods (and of late five) can be demarcated in the history of Nepal to examine state-locality interaction in irrigation development. The logic for such periodization is the extent of the incorporation of the State of Nepal in the global economic system and the nature of the State especially in terms of governance (Pradhan 1990). The latest fifth period is characteristic of the recent multi-party system in governance and a thrust towards economic liberalization and privatization, but at the same time with an increase in borrowing of international capital especially as loans.

The five distinct periodizations are: i) pre-unification where small kingdoms functioned with relative autonomy, ii) post-unification where Nepal follows an expansionist policy in search of more land and confronts British Imperialism, iii) a century of Rana autocracy where Nepal's only outside contact southward is through the British (and the Nepali rulers needed British blessings to be in power), iv) post-rana period with the rise of the bureaucracy, partyless-governance and a dominant role of international capital, and v) multi-party system, economic liberalization, and increasing international borrowing,

Pre-Unification

Several irrigation systems date back to the pre-unification times and are still functioning. Historically, irrigation development falls under several domains: i) religious trust, ii) individual initiatives (primarily of the local elites), iii) community efforts, and iv) royal directives.

Each kingdom had its own way of dealing with irrigation development and functioning. Some had explicit policies regarding state intervention, others were left to function under customary norms. Naturally, the many irrigation systems dating back to the pre-unified Nepal have had different histories of resource mobilization for their initial and continued development (Regmi 1971; Poudel 1965)

Post-Unification (1779-1845)

This era witnessed a continued policy of using forced labor for infrastructural development in the economy. Local resources were mobilized through such state enforced corvee labor by state functionaries. Though the state did directly finance and construct irrigation facilities, the maintenance of such state created facilities was left in the hands of the tenants and revenue collectors. The accountability or liability lay in the burden of paying rents on registered irrigated

land. Though a sizable and capable administrative machinery existed for purposes of the army and revenue collection, day-to-day maintenance and operation of all of the state-created irrigation systems were beyond the capability of the administration. Apart from direct financing or irrigation system construction by the state, policies of financial incentives to irrigation entrepreneurs were formulated by the state.

Rana Autocracy (1846-1951)

In this era, a very significant event was the formulation of the penal code *Muluki Ain* that laid down the legal recognition of property rights in irrigation canals. Several types of customary norms, rules and practices were endorsed by the state. Both tenants and villagers from nearby were mobilized by the state through state functionaries to repair and maintain canals that were under the jurisdiction of state functionaries. A unique symbiotic relationship between the British and the Ranas ruling Nepal shared intercountry watersharing and conflicts over irrigation. It was also in this era that expatriates with western "scientific" knowledge were invited into Nepal for infrastructural development in irrigation technology.

The Rise of the Bureaucracy

Various measures for the alleviation of poverty and basic needs, not to mention the structural adjustment stringencies undertaken by the government, seem to have had impetus and coercion from the donor community whose ability to influence official policy is closely related to their substantial financial contribution to Nepal's economy. Since the 1960s, efforts have been made to rationalize and improve the quality and capacity of the state bureaucracy for devising and implementing effective development projects and programs. This expansion of the bureaucracy helped fulfill the role of the state as the key employer.

Several government agencies provided technical and financial inputs for irrigation development. Furthermore, agencies were either amalgamated, separated, or fragmented within and between ministries. The scenario regarding irrigation development by the government was that there are several agencies drawing from different types and sources of funding and multiplicity of approaches regarding the implementation of projects. Project financing was in the form of outright grants, or partial loans with a substantial grant component, or a combination with grantees' contribution, usually in the form of labor. Varying input levels—financial or otherwise—were required from the beneficiaries. The degree of beneficiary involvement during the projects differed from one agency to another and even from one project to another within the same agency. Different agencies approached the issue o maintenance and operation of the systems after completion differently. Some handed the irrigation systems over to the users, while other continued to control with minimal farmer input.

In spite of the irrigation bureaucracy being relatively new, there has been a steady increase in government involvement and assistance in irrigation system construction or rehabilitation The trend during the past three and a half decades has been towards greater state mobilization of resources to finance irrigation administration and projects. Legislative acts and regulations (e.g., Irrigation, Electricity, and Related Water Resources Act 1967, Decentralization Act, etc.,) were formulated by the state in recognition of the changing times as well as for laying down procedures for government interaction with the irrigators. The government can operate under the umbrella of these acts that grants unquestioned authority within eminent domain.

This era consisted of increasing state intervention in irrigation development, fiscal constraints to achieving national development plans, and a need for planning and mobilizing resources at the local level. This epoch also witnessed a multitude of irrigation financing strategies, both direct and indirect, implementation of irrigation projects, and the formulation of certain macro policies like decentralized and basic needs/poverty alleviation that impinged upon irrigation development.

Multi-Party System and Privatization

The present era is characteristic of a multi-party political system of governance which allows opposition and conflict within the regime rather than over the regime. Party ideologies and politics are crucial for governance. With the advent of the freedom to express and oppose, the general public holds high expectations of the government being able to deliver the goods that it promised, which generally is outlined in the preamble of the new constitution.

This era of change and anticipation however has to be juxtaposed with the realities that Nepal faces in terms of tenacity of bureaucracies for survival, attitudes, existing power relations, and the status quo. Several reforms have been undertaken to make the transition to an environment supportive of representational governance, local governance and participation, and enhanced role of the private and nongovernmental sectors.

INSTITUTIONAL AND LEGAL FRAMEWORK

In the institutional and legal framework for irrigation development, two important pieces of policy/legislation merit mention. The recent irrigation policy that became effective in 1992 makes references to legal recognition of water users as autonomous entities, rights and duties of the water users and the agency- user-managed systems to be under collective ownership of the users, the full ownership of turnover systems and the related structures to be with the water users association registered by the government.

A new Water Resources Act was passed by the parliament last year replacing the 1967 Act. A separate Electricity Act was also passed. This Act has addressed the issues of prioritization or hierarchy of water uses, privatization, incentives, licensing, etc.

A fundamental characteristic of the new Act is that the ownership of all water resources within the kingdom of Nepal is vested in the state and as the state deems fit allows corporations, communities, or individuals to use the resources. The people obtain the right to use the water either through licenses or is "granted" free access to water for certain uses. In case of facilities regulated by public agencies or private developers, the individual's rights become subservient to the terms and conditions imposed by the state through the concerned agencies. The Act also provides provisions for the principle of beneficial use of water, through the establishment of priority over various kinds of uses presumably based on a hierarchy of needs.[2]

With the government programs on turnover and joint management, several objectives are hoped to be fulfilled. These programs will translate to some extent the visions of user control and management laid down in the irrigation policy and the new Water Resources Act, reduce the transaction costs of irrigation bureaucracy to deal with many small irrigation systems, to promote local governance and decentralization to some extent, and primarily to ameliorate the fiscal burden and crises of the state. The scenario of irrigation development in terms of financing pretty much follows the previous epoch's route with increasing role of both local resources and international funds.

DIFFERENT SCENARIOS OF IRRIGATION DEVELOPMENT IN NEPAL

If in fact after management transfer, the systems are going to be locally managed then the current experiences of FMIS and the local resource mobilization issue in sustaining them become important. There are several implications that can be drawn from experiences of irrigation organizations and relations between agency and farmer groups for the management transfer process and outcomes.

Implications from the Study of FMIS

Yoder (1994) states that local control is the dominant influence in the success of the key activities of the locally managed irrigation systems. The success in continuing to mobilize labor and other resources for maintenance is the perception that responsibility for the contributions is divided equitably among all who share the benefits of the system. If system members have full authority to make decisions then it would be possible for the organization to modify its rules and adapt its rules and procedures to changing conditions. Another common characteristic of almost all successful FMIS is that virtually all irrigators have a voice in making decisions. Monitoring of adherence to rules, resource contributions, and fines is also undertaken by successful FMIS. They have the ability to contribute labor and other essential resources to keep systems maintained and operating; maintain an open atmosphere for sharing information and have developed a communication mechanism. Accountability and transparency in records, accounts, and work performance are maintained and provisions for sanctions and conflict mediation/resolution mechanisms are provided (Yoder 1994).

The understanding of the above mentioned characteristics of successful FMIS (which are many in Nepal and have been written about) would be important in outlining what systems that are being turned over to local management will need to look like (Yoder 1994). The forms and contents of the characteristics may vary depending on the history of the relations between the agency and farmer groups within that system that is being or will be turned over.

Implications from Assistance to FMIS Program

In an action research on assistance to FMIS (those that were not successfully managed and could be improved upon), the following lessons were found to be of primary importance in the formulation of assistance procedures (WECS/IIMI 1990):

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[2]The priority order is as follows: a) drinking water and domestic use, b) irrigation, c) agricultural uses such as animal husbandry and fisheries, d) hydroelectricity, e) cottage industry, industrial enterprises and mining uses, f) navigation, g) recreational uses, and h) other uses.

1. If a system already exists, then farmer initiative has taken place, land and water resources have been identified, and some level of institutions, experience, and knowledge is available to be tapped.

2. The intention of "assistance" is to stimulate the irrigation users to be involved in making their own improvements (a little assistance is better than too much).

3. Poor maintenance of physical facilities and the inability of farmers to make simple improvements on their own are symptoms of a need to improve management, without which assistance will not be used effectively and the system will not likely operate to its potential.

4. Helping farmers manage the assistance inputs for physical improvements is an effective management training method that strengthens the water users organization.

Implications from Current Joint Management Program

In joint and participatory management systems, intense activities are being undertaken for facilitating the formation of smaller units of water users associations. Though at the initial stages of planning for irrigation development, joint management and turnover programs were considered to be separate activities, it is now perceived that joint management is a process leading to turnover. Even in the context of joint management, the issues of the relative power balance between the agency and water user groups in taking key decisions, facilitating water users associations, water rights and entitlement to farmers, mutual accountability on the part of both agency and farmer groups have been raised as concerns faced in many of the irrigation systems where joint management or participatory management are being introduced in Nepal (IIMI 1992).

Implications from Farmers' Initiative to Control Management in Agency Systems

There are many examples of irrigation systems that were built or rehabilitated by the government agencies but after a while the government could not continue providing any operation and maintenance costs and the farmers de facto have taken over the systems. Even if the government did provide some assistance, it was done on an ad hoc manner and not continued from year to year for the operation and maintenance of the system.

One such example of de facto "takeover" is the Pithuwa Irrigation System in the Chitwan area which was constructed in 1967 under the minor irrigation program. After this, a couple of additional construction works were carried out in 1971 when the main canal was enlarged up to the Pithuwa market, outlets were constructed in the branches and some modifications to the old canal network were undertaken. Further rehabilitation activities were carried out in 1974 when a permanent head regulator and more outlets were constructed (Shivakoti et al. 1987; Prachan 1994).

In this system, water is diverted into the main canal through an earthen approach canal from the river to the head regulator. Thus, after every flood, the approach canal is damaged requiring a few days of frequent repair. The government has provided a bulldozer to repair and maintain the approach canal and the weir during the monsoon. After the completion of the canal network, no water distribution policy was formulated by the government and conflicts over water distribution occurred. The more powerful were able to capture the water for themselves.

A certain social worker who had some experience in water distribution in a larger FMIS further west of Nepal from where he had migrated, took a leading role by motivating other farmers of Pithuwa to come up with a proposal to distribute the canal water on a time basis that was proportional to one's share of water. This was tried out in one of the branches at the tail end. A committee was formed in that branch and rules, regulations, and sanctions were formulated for water distribution in that particular branch. The water distribution in that branch was successful and it curbed many conflicts regarding water shares and distribution. The demonstration effect was successful and that within a year, a main committee consisting of fifteen members, a chairperson, and a secretary was formed and the water distribution practice set in that tail-end branch was emulated by other branches. The specific mandates of the committee were to make resources available for diverting water into the canal and also maintain and equitable distribution of water in the system.

As a first step of actions undertaken by the main committee, several alterations on the main canal were made such as the relevelling of the branch head pipes, alterations and exchanges of pipes at the branch canals, extension of branch canals and field ditches to take into account the changes made to sub-command areas due to alterations in the pipes. These alterations were being negotiated amongst the farmers themselves to smoothen the agreed process to undertake equitable water distribution and resources for such alterations were mobilized from the government and the local irrigators. Though the government had set aside nearly Rs 100,000 for annual maintenance (to include intake work) since 1983, very little money (around 31,000) was available for 1986 and this money was handed over to the

main committee. Though the committee at first was reluctant to undertake main canal repair and maintenance, they gained confidence in their organizational capacity when they could do the desilting canal work in a couple of days' time.

The irrigation organization is currently being provided with a bulldozer for major desilting work and all operation and maintenance activities are carried out by the farmers. The farmers would like to possess their own bulldozer (to be used for non-irrigation activities too to raise cash for operation and maintenance of the system). The farmers do not want total turnover of the system to them for they fear that this will not guarantee them the chance of receiving a bulldozer from the government or the fact that a more permanent intake may be built by the government later on.

The farmers' intervention in the operation and maintenance of the system has improved the reliability of the water supply in the system. Alterations to outlets and their sizes were brought about to match a distribution of water and sub-command areas as agreed by the farmers.

LOCAL RESOURCE MOBILIZATION: IMPLICATIONS FOR TURNOVER

Local resource mobilization (LRM) will be crucial to maintain the institutional and financial viability of systems that have been turned over and are to be self-governing. To a great extent in the context of Nepal, labor constitute the greater bulk of local resources to be contributed. It is therefore important to understand the incentives and disincentives at work from local interests in the context of local resource mobilization. Given the fact that local labor contributions may bear little direct relationship to water received, we would expect that not all incentives and disincentives for labor contribution will be water related (Lynch and Pradhan 1988). Figure 1 maps a number of factors that may act as incentives and disincentives for local labor mobilization.

The term "incentive" can refer to things that agencies or other governing authorities do to stimulate local resource mobilization. They may grant power, rights, or privileges in return for participation; they may provide wages or food supplements for participants; or they may use their police powers to apply sanctions against those who fail to perform. The four factors at the top of the figure are institutional rewards and sanctions that irrigation agencies and governing bodies provide or guarantee to stimulate local resource mobilization. They constitute the incentive structure, but they are not necessarily the factors that influence farmers' decisions to participate.

Potential workers may base their decision to participate on their calculation of the benefits that they can expect as an outcome of their participation and the costs and benefits of non-participation. They will weigh these benefits against the opportunity costs of participation. These resultant benefits may be social or economic, water related or not, direct or indirect.

Increased agricultural production is a primary goal for irrigation agencies, but for farmers it is a rather problematic outcome of the labor contribution. First, even where there is a direct relationship between the irrigator's labor contribution and improved water deliveries to his or her parcel, this may only have a substantial effect upon yields under certain conditions. Yields will vary with water supply if it is adequate and reliable but not overabundant and where the other inputs required are present. Where irrigation makes it possible to bring a crop to maturity, farmers will exert considerable effort to keep the system functioning. But regular maintenance does not always mean the difference between a reliable, adequate water supply and none at all. More often the difference is incremental.

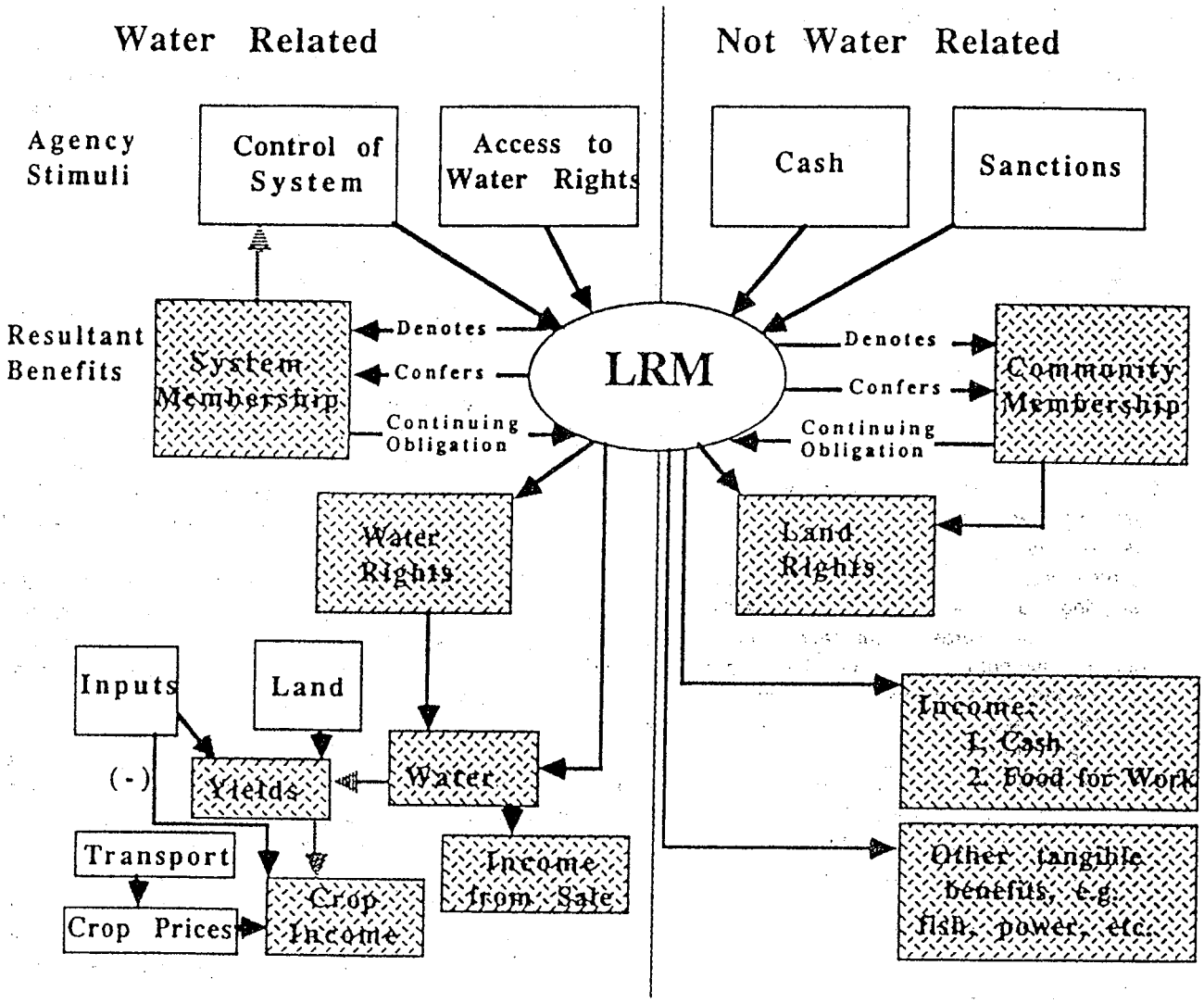
The perception of water supply as a benefit is closely related to whether or not water is a limiting factor in agricultural production. If it is not, the benefits of incremental yield increases must be weighed against the sum of input costs, including not only the costs of water and system operation and maintenance, but of the fertilizers, pesticides, and improved seed needed to maximize the benefits from irrigation.

Not all irrigators see increased yields as a benefit. Once they have met their subsistence needs, some farmers are more likely to be interested in income than in yields per se. Therefore, farmer benefits and incentives other than agricultural production increases may weigh heavily in farmer decisions to contribute their labor and other resources. Labor contribution may either denote or confer system membership. That is, participation in canal cleaning and maintenance in some areas is a symbolic expression of membership in the irrigation system and the perpetuation of one's water rights. Members may prohibit non-members from contributing their labor in these systems. Participation may be a precondition to membership in the system and access to an entitlement. The potential for incorporation of new members into a system is limited by technology, water supply, and politics.

Agencies may provide two stimuli for local resource mobilization that are not related to water. These are wages and sanctions. Resultant benefits to local resource contributions that are not water-related may include income in cash or in kind, land rights, community membership, and other tangible benefits from the system. The latter may include power, fish, and water for food processing, domestic use, milling, brick and livestock. Incorporating design features that accommodate other uses of water may build support for the project and reduce opposition.

Several factors may deter active local resource mobilization. The opportunity cost of providing labor may be high due to i) the coincidence of labor on the irrigation system with peak labor demand in agriculture, ii) the existence of off-farm employment opportunities in the local area, and iii) seasonal labor migration. Slack agricultural periods in the

Figure 1. Agency stimuli for local resource mobilization and possible resultant benefits for farmers.



irrigated zone may coincide with periods of high labor demand elsewhere. In hierarchical societies like those in Nepal, status can be a strong disincentive to labor contributions. The nature of the work may inhibit labor contributions. If the work is arduous and dangerous, participation level may decline precipitously.

Thus, local resource mobilization efforts for irrigation development—whether externally or locally generated—may not necessarily represent the collective will of the community, or even of the community of irrigators. Even when a project support is broad based, the opportunity costs of labor contribution may be high. Furthermore, the absolute availability of labor and other resources cannot be taken for granted, but must be empirically verified.

CONCLUSIONS

Over the past few decades, there has been a dynamic evolution in irrigation policies and institutions in Nepal. The actors in irrigation development have the twin objectives of poverty alleviation and sustained agricultural productivity. The Government of Nepal is making a concerted effort to support rather than supplant people's own development efforts. In empowering local organizations and beneficiaries, the state of Nepal envisions mitigating fiscal crises and supporting decentralization.

Given the aspirations of the public and hopefully the zeal to do better on the part of the irrigation bureaucracy, there are several newer opportunities and challenges for irrigation administration. The irrigation bureaucracies would do better by reducing its transaction costs in being involved in the usual operation and maintenance activities of irrigation systems that can be managed by the users themselves. One should be ready to place faith and confidence in the ability of the users to manage their own systems. We hope that the recent irrigation policy regarding turnover and joint management has been drawn with this in spirit.

Irrigation management and administration should go beyond the irrigation system and also focus on issues of i) managing support services, ii) sustainable development, and iii) watershed and regional approach. Irrigation water is only one input towards agricultural production and a variety of other inputs are equally necessary. The government agencies may not have been very instrumental or effective in delivering the goods, so an alternative that allows the private sector and the users groups themselves to manage support services and their timely delivery may increase the productivity needed for a rising population and sporadic droughts.

A change from rainfed agriculture to irrigated agriculture, and that too a change from traditional agriculture using locally available biomass resources to one derived from the green revolution with a heavy dependence on external inputs have shown changes in the environment. The irrigation practices and agricultural chemicals used in one rural community affect the productivity of neighbouring ones. An inappropriate use of pesticide, chemical fertilizer, water application has endangered the very sustainability of the irrigated land. Not only the soil but also the watertable under it has been found to be unfit for household consumption. With the slow erosion of traditional varieties and seeds and widespread adoption of external technology packages, the changes in the agricultural land composition are more rapid than ever. The escalating population, the search for higher yields, and state promotion of external input-intensive technology all have contributed to the rise in irrigated agriculture.

Given these outcome and processes of irrigation-environment interactions, institutional and legal framework should be established that addresses environmental sustainability not only in terms of the physical environment's preservation or for obtaining current sustenance from it but also in terms of the future generation's right to use and benefit from the environment (Pradhan and Thapa 1993).

Government agencies cannot assume that local resources will be provided for a project, but they can provide stimuli and incentives for different segments of population. They can also encourage local resource mobilization by co-designing structures that irrigators can maintain at a cost they can afford. Finally, they can conduct participatory feasibility and baseline studies that identify factors likely to affect the distribution of benefits, direct costs, and opportunity costs associated with local resource mobilization in order to identify appropriate incentives.

The July-August 1993 floods in this fragile Himalayan ecosystem ranging from mountainous Nepal down to the Gangetic Plain stand as witness to the need for beyond system-level focus, one that looks out towards the watershed and regional cooperation. The watershed approach will assist in establishing the fragile and delicate linkages between the hills and the plains and that an event in one area is intimately associated with the other. At a more geo-political level, regional cooperation is necessary for proper monitoring and advance warnings for potential and possible disasters regarding hydrological fluctuations.

Thus, irrigation management should look beyond mere physical irrigation systems and incorporate the social relations, the environment of irrigated agriculture and sustainability variables in its analysis. On the part of the irrigation bureaucracy, it should play more the role of a management organization that is service oriented and accountable to its clients. One of the positive roles of the irrigation bureaucracy in the post-construction era in irrigation development is to create an enabling environment for local governance, users' genuine participation, and use of local resources and skills. Certain bureaucracies have already begun to tap the knowledge and the appropriate skills of the farmers and

non-government organizations in the endeavour of institutional development of users such that they themselves will own, manage, and operate their systems. The positive roles of the government irrigation bureaucracy can be focussed on: i) being an impartial arbitrator for interdistrict, intersystem water conflicts; ii) undertaking research on its own design and planning procedures to learn from one's own past so as to manage and guide external resources, both human and financial; iii) monitoring activities at watershed and regional levels; and iv) playing an advisory role to the user groups if in need.

In sum, this paper related the various historical epochs of irrigation development in Nepal reviewing key characteristics within them and proposed newer opportunities for the study of irrigation management and newer roles for the irrigation bureaucracy, given the changed political and economic context. Focusing on the concept and operationalization of local resource mobilization, agency expectations and local interests (which may at times be contradictory) were explored. A realistic expectation and understanding of a self-sustaining local resource mobilization process (which is one of the many tasks in an irrigation system) is essential in order to ensure financial and institutional sustainability of the transferred systems.

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Kedar Tank: A Case Study on the Turnover of Tanks to Farmers

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ABSTRACT

MANAGEMENT OF RAINFED tank systems in Tamil Nadu is the joint responsibility of the agency and the farmers as per statute. The agency is expected to maintain the tank system as well as the supply source. The user is expected to maintain the distribution network and field channels including water regulation under the Kudimaramath System. In reality, the expectations are hardly fulfilled.

The government agencies are unable to maintain the system efficiently by carrying out periodic, special repairs because of the innumerable number of tanks (more than 39,000 in number), and paucity of fund allocation. The farmers are unable to maintain the system due to a variety of reasons like fragmented landholdings, poor economic status, no approach to tank assets, and lack of a sound institutional framework to take care of the managerial functions.

The paper discusses the experiences gained in the initiation of the Irrigation Management Transfer Process set forth in the Kedar Tank of Ramasamy Padayachiar District in Tamil Nadu by the Centre for Water Resources (CWR) of Anna University, as part of their field-based action research study on Participatory Management Approach in four rainfed tank systems in Tamil Nadu.

These tanks are being modernized by the State Public Works Department (PWD) under the ongoing tank modernization program through an EEC grant. The research study is being supported by the Ford Foundation, New Delhi.

INTRODUCTION

Farming in Tamil Nadu relies heavily on Irrigation. Canals, tanks and wells are the three principal sources sharing the net irrigated area of 2.9 million hectares (Mha), more or less equally. A tank is a small storage reservoir used to impound the runoff from the monsoon rains which occur during a few months of the year and to regulate the supply of water, mainly for agricultural use. Tanks in Tamil Nadu numbering over 39,000 have a very long history. They are ingenious devices constructed to capture rain water not only to support farming but also to serve a multiplicity of community water needs over space and time. In recent times, tanks have come to attract much greater attention than ever before because of their spread over a large extent of area and their contribution for sustained growth of agriculture, benefitting a large segment of the rural community. These are small irrigation systems capable of yielding quick benefits and are managed by the farming community.

However, many tank irrigation systems over the years have slowly and steadily lost their functional efficiency while some have become extinct due to encroachment, urbanization and neglect. Specifically, the catchment areas have suffered immense damage due to deforestation, over-grazing, soil erosion and encroachment. In most cases, they are denuded of vegetative cover, degraded and exposed to hazards of soil erosion, resulting in sedimentation. In short, the water use efficiency has dipped as low as 25 to 35 percent in many cases, and they have lost their efficiency to effectively serve as good and reliable water sources.

ROLE OF THE UNIVERSITY

As part of its research program the CWR of Anna University undertook a pilot study to rehabilitate the Pandianallur Tank near Red Hills in the Chengai MGR District.

RESEARCH RESULTS

The study undertaken in the Pillaipakkam Tank by the State Public Works Department (PWD) indicated that the major benefit of tank modernization lay in minimizing the conveyance loss of the precious irrigation water by 21 percent

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through the lining of main and field channels. The CWR, Anna University, Madras embarked upon one other research study in the Pandianallur Tank with a view to clearly understanding its problems and prospects.

The main lesson learnt from the Pandianallur pilot study was that adequate attention was not being paid to an intimate understanding of farmers, their concepts on water rights and water distribution practices, and their perception on modernization programs, etc.

In short, it became well recognized that tank rehabilitation and management did not lie within the domain of the irrigation engineers but much beyond that, encompassing the socioeconomic institutional matrix of the rural society. This brought out the need to internalize the farmer beneficiaries' commitment to planning, designing, implementing, operating, maintaining and managing tank irrigation systems. The concept of the participatory approach for modernization of these small irrigation systems traditionally managed by farmers has the potential to mobilize not only indigenous wisdom, experience and ingenuity but also the much needed manpower, materials and resources.

DEVELOPING AN EXPERIMENT

The CWR, Anna University, diligently planned to launch an experiment with a view to learn and develop methodologies for enlisting farmer participation in tank rehabilitation and management on a sustainable basis besides educating the farmers on scientific water management practices. The experiment is conceived to be a comprehensive design to capture the socio-cultural, institutional, economic, political and technological parameters to build and strengthen the process of development in tank rehabilitation and management. The research study is guided by a state-level steering committee chaired by the Secretary, Public Works Department with representation from other government departments who are associated with the development of the tank in one way or the other. Such an experiment is currently being carried out for promoting farmer participation in the following four rainfed tank systems in Tamil Nadu which are being modernized by the State Public Works Department.

STUDY AREA

As stated above, the research study was undertaken by Anna University in June 1988 in the following four tanks, in two phases:

i)	Kattiampandal Tank in Chengai MGR District	)	Phase I
ii)	Kedar Tank in Ramasamy Padyachiar District	)	
iii)	Sowdarpatty Tank in Madurai District	)	Phase II
iv)	Kannangudy Tank in Pudukottai District	)	

KEDAR

Kedar is a semi-urban village in Villupuran Taluk of Ramasamy Padayachiar District. It is a fairly well-developed village with good infrastructural facilities in terms of transport and communication, education, banking, medical and health care, farm input supply centres and such other services. Sellankuppam is the only hamlet of the main village. Kedar village has a large population of 3,889 and a significantly high portion is engaged in agriculture. Handloom weaving, mat making, pottery, agricultural processing and other small business are the other occupations. Grounder account for nearly 60 percent of the population, more or less equally distributed, followed by the scheduled castes with about 20 percent.

DISTRIBUTION OF LANDHOLDINGS

There are 294 farm holdings in the command area, and people of the Mudaliar caste are the most predominant in terms of numbers as well as area owned. Out of the 294 farms, 88.44 percent are less than one hectare (ha) in extent, accounting for 56.29 percent of the cultivated area. Only 4 farms are above 2 ha. Nearly 50 percent of the farms are less than 0.20 ha in extent and cover 12.35 percent of the area.

SOURCES OF IRRIGATION

The Kedar Tank has both free and intercepted catchments. The average annual rainfall is 1,047.20 millimeters (mm). Rain is fairly heavy during the northeast monsoon, amounting to 514.00 mm. The tank provides irrigation for 116.73 ha. Field-to-field system of irrigation by flooding is the most common practice. There are 59 functioning wells to

supplement any irrigation needs. The wells are more or less evenly distributed in the head, middle and tail reaches of the tank command.

CROPPING PATTERN

Out of the total irrigable area of 116.73 ha, the area sown with rice in the first season exceeded 90 percent in 4 out of 8 years. Rice occupies the entire area in the first crop season which is followed by a second crop of rice, if adequate water becomes available. Cotton, groundnut, ragi and other oil seeds are also grown in the second season. Here again, inadequate water yield due to poor and erratic rainfall and the neglected condition of supply channels, storage and regulatory structures have seriously affected irrigated farming.

FIELD TEAM

The study is one of the Philippines models wherein an Institutional Organizer had been placed to play the role of catalyst involved in all facets of the rehabilitation and management activities, like planning, execution, operation, and maintenance of this rainfed tank system. The Institutional Organizer, has been ably supported by a Technical Assistant. The day-to-day processes and crucial activities are being documented by a Process Documenter. In short, the field research team comprises one Institutional Organizer, one Technical Assistant and one Process Documenter.

PROGRESS MADE

The interaction of the research team with the village community had enabled the farmers to accomplish the following:

* A Water Users' Association was formed at Kedar and if registered under the Tamil Nadu Society's Registration Act of 1976 on 26.07.89.

* The rehabilitation estimate for the Tank was prepared based on the needs of the farmers.

* The government in PWD (GO Ms. No. 1464 dated 16.7.1990) had complied with the request of the farmers of this place in awarding the work contract to the farmers organization (FO), and granting a loan of Rs 50,000 (US$1,600) as seed money to take up the rehabilitation works at an annual interest of 12 percent.

* The FO had taken up the execution work during November 1990 and the entire work costing over Rs 20 lakhs (US$64,000) had been successfully completed by the FO during August 1993. The quality of work turned out by the FO is one of high order and acclaimed by all visitors.

* Convinced with the interest and involvement of the farmers of this place, the Fisheries Department had readily responded to the requirement of the farmers and issued an order wherein the FO of this place had been permitted to enjoy the usufructs of the tank water (vide GO No. D2 dated 13.02.1992). This GO enables the Association to have a replenishable annual resource base to carry out operation and maintenance functions of the tank which is being modernized at heavy cost.

FARMER RESPONSE

Rehabilitation work of the tank undertaken by the FO has already developed the necessary skill and confidence among the farmers to manage their affairs efficiently.

AGENCY RESPONSE

Sensing the attitudinal change of the farmers, the research team initiated action on this "Turnover Process" by taking up the issue in the Steering Committee meeting held in August 1992. Dr. John Ambler, Program Officer, Ford Foundation, New Delhi Office supported the idea of making the farmers the owners of the tank, by "turning over the tank system" to them for its ultimate maintenance and management. Naturally, this may help promote better interest among the farming community for its sustained maintenance. Dr. John Ambler also felt that such a step, apart from providing a sense of ownership to the farmers about the tank, will also kindle interest in the community to tap resources better from this new asset base by exploring ways and means such as the following:

* Planting trees along the tank bund.

* Collecting a toll from the persons who have brick kilns inside the tank water spread during the off-season.

* Collecting fines from the owners of the stray cattle which enter and destroy crops in the command area.

Such an agreement will also help implement a better "watch and ward" arrangement to protect the tank components from encroachment and to protect the crop from cattle.

The Chief Engineer, [Minor Irrigation (MI)] who is the present owner of the tank system as well as the farmer representatives of Kedar welcomed this suggestion. The Secretary PWD, as the Chairman of the Steering Committee, welcomed the suggestion and assured the Program Officer, Ford Foundation, that he on behalf of the government will favorably consider the suggestion. He also wanted the research team to go in to details about this concept of "turning over" the tank system to farmers, with suitable recommendations for consideration by the government.

FOLLOW-UP ACTION

The Kedar farmers were quite happy about the decision of the Steering Committee and convened a General Body Meeting during February 1993 to discuss further on the above issue. Before convening the General Body (GB) they had a number of sittings with different sections of farmers of the various hamlets as well as with the local government officials of PWD, Revenue and *Panchayat.* When their views were elicited, all of them responded positively towards taking over the tank from the government for its more efficient management by the community.

The GB of the FO convened on 06.02.1993, deliberated on this issue in detail and wanted to know whether the Association had the financial capability to shoulder the responsibility efficiently. The Secretary of the Association was able to convince the GB by providing details on the asset position of the Association. The GB then unanimously resolved to request the government to "turnover the Kedar System" to the FO.

The GB also made certain decisions to support the cause of "turnover" as follows:

* In the tank system, the encroachers should be evicted by the government agency before it is handed over to the FO.

* The tank system should be entrusted to the FO on lease for a minimum period of 25 years, to enable them to build up developmental activities.

* The FO needs legal authority to take action against irrigation offenders.

* The FO should have the legal rights towards the enjoyment of usufructs of the tank system and pisciculture rights of the tank water.

* Right to collect and share a portion of the land revenue including water charges from tank farmers.

* All emergency major repairs and special repair works should be done by the government.

The farmer's association at Kedar put forth an official request to the Chief Engineer (MI) during March 1993 to initiate action to effect the process of "Turnover," and also requested the Director, CWR to interact with the government to accelerate the process. The research team of CWR, after deliberation with the farmers and the agency officials like the District Collector, Executive Engineer, PWD *Vilupuram* and Deputy Chief Engineer (MI), finalized the Memorandum of Understanding (MOU) for this process and forwarded the same to the Chief Engineer (MI) during January 1994.

FARMER PERFORMANCE

In anticipation of approval of their request for management transfer by the government, the farmers had already swung into action to take care of the managerial functions of the tank systems.

The actions initiated by the FO to overview better managerial functions are as follows:

* Clearing of the upper Paliandur tank supply channel which had helped them to have an additional quantity of about 13 mcft (0.368 mm^3) of water during 1993.

* Providing additional earthen field channels in the command area for a length of 2,400 meters, to facilitate better water flows to the tail end of the command.

* Appointing two more *Neerkattis* (Water Guides) to take care of the internal water distribution based on the roster prepared by the Association.

* Deciding that farmers with wells should not use tank water when the water level in the tank goes down below a certain level.

* Active involvement and the disciplined behavior of the farmers during the 1993-94 crop season; which yielded better results both in the matter of area cultivated as well as on productivity, say 14.2 percent overall (Table II).

FARM FRONT

The performance at the farm front when the managerial functions were taken over by the Association during 1993-94 was much better than during the previous years when it was managed by individual farmers. The data available for the years 1991-92 to 1993-94 were analyzed. The following inferences can be drawn from them:

* The crop coverage for the first and second crop during the year 1993-94 was better compared to 1992-92, even though the water yield to the tank was better during 1991-92. This is attributable to the organized behavior of the farmers during 1993-94 which was not so during 1991-92.

* During 1991-92, the tank had surpluses for about a week. Even then, water shortages was felt by the farmers for crop maturity. No residuary storage of water was available in the tank after the first crop season to have a second crop. The well owning farmers alone were able to have a second crop.

* During 1993-94, when the managerial functions were taken over by the Association, the position was different. There was an increase of 13.5 percent of area covered during the first crop than during 1991-92. The tank had a residuary storage of 6.654 mcft (0.188 mm^3) at the end of the first crop season. The farmers were able to have a coverage of 233.76 acres (94.64 ha) during second crop season (Tables I and II).

* Cognisable improvement has been noticed in water use efficiency as well. The tank system worked at a duty of 3.57 Ac.ft (1.09 ha.m) during 1991-92 and at 3.05 Ac.ft (0.93 ha.m) during 1993-94, registering about a 17 percent increase.

RESOURCE MOBILIZATION

Apart from these agricultural operations, the Association had also procured about 17,000 fish fingerlings and reared them in tank water during 1993-94. The expenditure towards fish rearing was Rs 8,000 (US$256).[3] They sold the fish during 1994 for Rs 75,000 (US$2,400), excluding the expenses; the Association was able to get a profit of Rs 60,564 (US$1,938).

The farmers of Kedar created a maintenance corpus fund by contributing Rs 247 (US$7.90) per hectare from individual land owners. Thus, they collected a sum of Rs 28,800 (US$921.61) under an ongoing farmers' subsidy program through farmer associations that create such corpus funds to qualify for an equal amount as subsidy from the government. The Kedar Farmers' Association also received a subsidy of Rs 28,800 (US$921.61) from the Director, Irrigation Management Training Institute (IMTI), Trichy during December 1993 (Table III).

The Kedar Farmers' Association is thus well set for taking over the tank system from the government, and they eagerly await the turnover process to take place at the earliest, which may entrust them with additional powers than at present. They are:

* To punish irrigation offenders.

* To collect water charges and have their own water rates.

[3]US$1.00 = Rs 31.25.

* To collect tools from brick makers and other users of tank silt.

* To plant and grow trees in the tank area to augment the resource base of the association.

The experience at Kedar demonstrates that farmers of any rainfed tank system where water availability is not that reliable can perform well, provided they are given adequate legal, financial and technical support.

LOOKING TO THE FUTURE

The future of such farmer association needs examination in the changed context of the amended Panchayat Act of the state government during April 1994.

As per the amended Panchayat Act, the village Panchayat enjoys absolute right over all village assets including the tank. It is made responsible to carry out the 28 functions listed under article 257 of the Appendix I of the said Act. Item 1,2,3,5,6, 28 and 29 of the Appendix are relevant to the tank and its management (see Appendix).

The Panchayat is an autonomous body elected by the people. The Panchayat president voted to office enjoys absolute power under this act. In the village administrative set up, the tank is one of the primary sources for augmentation of resources through the Panchayat as follows:

* Social forestry in tank water spread.

* Selling fish.

* Auctioning trees growing on the tank bund, and so on.

The sustenance and success of the farmers association hinges on the linkage that is to be established between the Panchayat and the FOs in sharing the tank resources between these two.

It is considered essential that a select committee at the government level should go into the related aspects and to define:

* The roles and responsibilities between a legally constituted farmers' association and democratically elected Panchayat body.

* The legal support and autonomy of the farmers' association that should be allowed for its smooth functioning and to safeguard its interests.

* Measures to pool and share the tank resources between the Panchayat and farmers' association.

The one possible alternative may be for the FO to enter into an agreement with the Panchayat President to perform its function as an Association. It must be made obligatory to the Panchayat to lease the enjoyment rights of the tank assets to the legally constituted farmers' association. The MOU to be entered into between the two may spell out the terms and conditions mutually acceptable to both.

CONCLUSION

The experience gained so far at Kedar Tank justifies the need to promote the cause for "irrigation management transfer (IMT) from the agency to the user beneficiary, which alone can pave the way for better productivity and sustainability in system maintenance over a period of time. The farmers have to be provided with adequate legal, financial and technical support during the early years of the IMT process by designing suitable irrigation support service activities like transferring the fishing rights to the Kedar Farmers' Organization. The creation of such an appropriate environment is a must to realize the ultimate objectives of the IMT.

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MAP

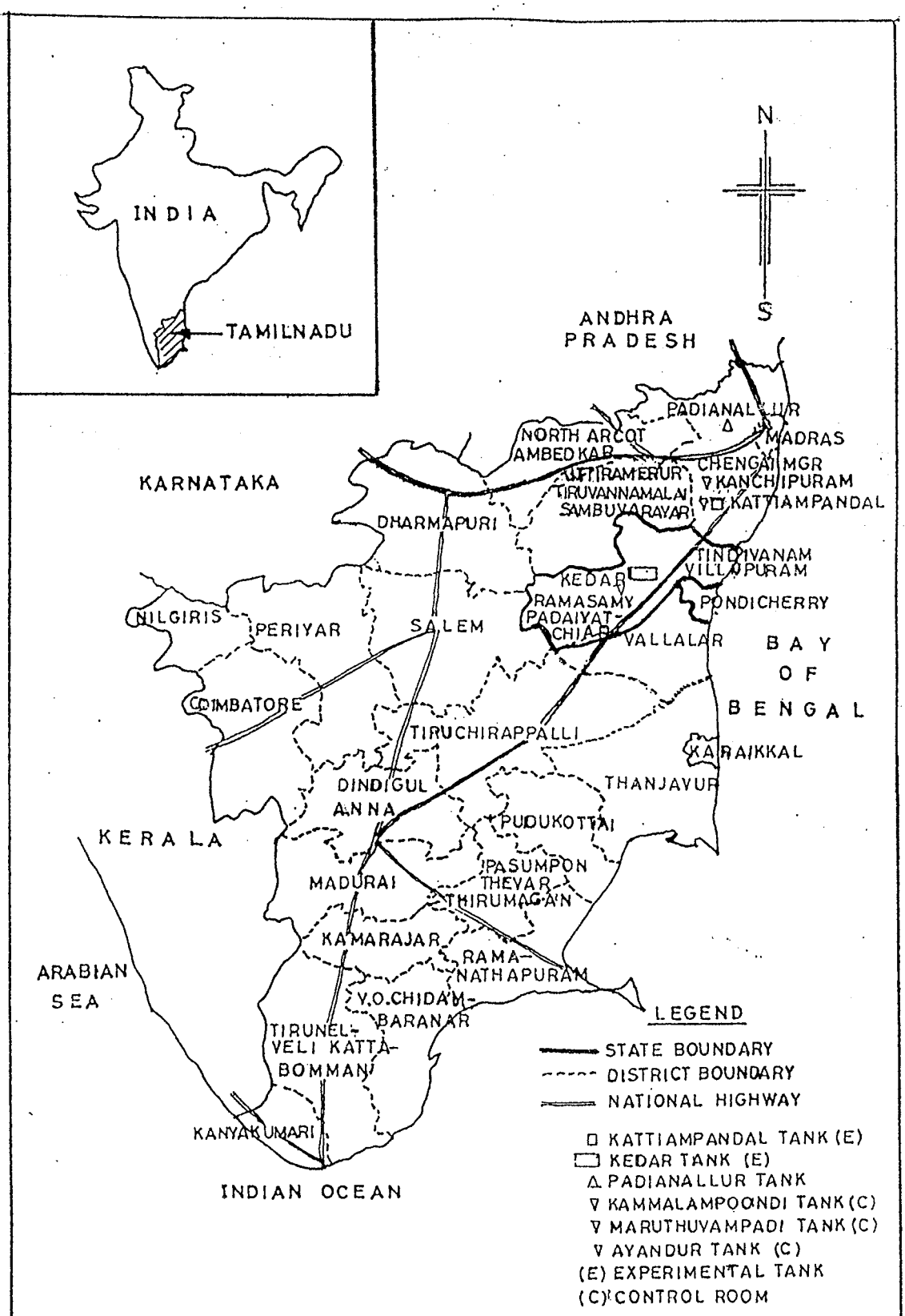

FIGURE LOCATION OF STUDY TANKS (TAMILNADU)

Table 1. Kedar Tank Command Crop coverage details.

From 1991-92 to 1993-94.

SL No. Monsoon Year Rain in mm	First crop area cultivated			Second crop area cultivated			Remarks
	Crop	Extent ha.	Total ha.	Crop	Extent ha.	Total ha.	
1. 1991-92 SWM 293 NEW 743 --- Total 1036	Paddy	*82.08		Paddy			
	Sugarcane	14.05					
	Cotton	4.60		Cotton	2.23		
	Oilseeds	1.62		Oilseeds	8.30		
	Plantain	1.21		Ragi	2.63		
	Blackgram	0.28		Kambu	4.05		
	Groundnut	3.04	106.88	Groundnut	7.04	25.06	
2. 1992-93 SWM 129 NEW 691 Total 820	Paddy	27.67		Paddy	1.21		
	Sugarcane	14.71		Groundnut	7.04		Year of deficit Rainfall
	Plantain	1.14		Oilseeds	8.30		
	Cotton	13.12		Cotton	2.23		
	Oilseeds	37.56		Ragi	2.59		
	Grass	0.08		Cumbu	4.05	25.42	* Paddy area reduced by 63.3 %
	Blackgram	0.20					
	Millet	3.21					
	Cumbu	4.58	102.27				
3. 1993-94 SWM 284 NEW 763 Total 1047	Paddy	93.73		Paddy	2.87		
	Sugarcane	16.60		Oilseeds	76.32		* Paddy area increased by 14.2 %
	Groundnut)			Groundnut)	15.45		
	Cotton)	2.72		Cotton)		94.64	
	Blackgram	0.81					
	Ragi	1.00	114.86				

Notes: NWM-South West Monsoon * The percentage of Paddy area cultivated has been worked out as 1991-92 as reference year. Total command area: 116.73 ha
NEM - North East Monsoon Average Rainfall SWM 454 mm Average Rainfall NEW 514 mm / 968 mm

Table 2. Kedar Tank Command productivity analysis of sample farmers.

Reaches	Water regulation carried out by individual farmers before farmers association had taken the responsibility Year 1991 - 92					Water regulations carried out by Farmers association by appointing water guides Year 1993 - 94					Farmers% increase of productivity after appointing water guides by Farmers Association
	No. of Samples	Total area in hectare	Total Cultivable area in hectare	Total paddy cultivable area in kgs	Total production in kgs/ha	Productivity in hecatare	No. of Samples	Total area in hectare	Total Cultivable Production in kgs	Total paddy Cultivation in kgs/ha	Producti-vity Paddy
Head	15 [47]	17.07 [34.87]	9.37*	47557	5075 [47]		15 [34.87]	17.07	8.00	41625**	52032.5
Middle [68]	19 [25.41]	14.46	9.34	40950	4384 [68] [25.41]		19	14.46	11.21	56400	503114.8
Tail [97]	31 [56.45]	23.60	21.10	93986	4253 [97] [56.45]		31	23.60	19.18	98025	511120.2
Total [212]	65	56.35 [116.73]	40.82	182495	4411 [212]		65 [116.73]	55.13	38.39	196050	510614.2

Paranthesis shows total ayacutdhars and their extent of cutivable land

Note: The displays the water use practices resorted by sample farmesr during the years and its impact on productivity

* when they are unorganised
** when they are organised

Table 3. Kedar farmers association balance sheet as on 10.06.1994.

SL NO.	RECEIPTS	AMOUNT RS.	PAYMENT	BALANCE
1.	Contract Bill Receipts	99,654 (US$ 3188.93)	Expenditure of Maintenance	12,600 (US$ 403.20)
2.	Refund on Income Tax	25,000 (US$ 800)	Admininistration	5,300 (US$ 169.60)
3.	Subscription, Fish sales	1,18,764 (US$ 3800.45)	Others	
	Income and Matching grant		(including Fish rearing)	19,185 (US$ 613.92)
	Refund of loan to farmers		Refund of loan to farmers	29,870 (US$ 955.84)
		Rs. 2,43,418 (US$ 7789.38)		Rs. 66,955 (US$ 2,142.56) Rs. 1,76,463 (US$ 5646.82)

ASSET POSITION AS ON 10.06.1994

Details	Amount	Total
I. Fixed Deposit Details		
(A) Association Funds		
1. Corporation Bank at Kedar F.D.R. No. 213102 No. 213102 dated 30.11.93 (one year)	Rs. 28,800 (US$ 921.6)	
II. Corporation Bank at Kedar F.D.R. No. 366906 dated 10.06.94 (one year)	Rs. 60,000 (US$ 1920.00)	Rs. 88,800 (US$ 2841.6)
(B) Europus fund/Account		
I. F.D.R./T.D.R No.1 327200 dated 21.1.94 (Five years)	Rs. 43,200 (US$ 1382.40)	
II. F/D/R/T.D.R No. II dated 21.1.94 (Five years)	Rs. 14,400 (US$ 460.80)	Rs. 57,600 (US$ 1843.20)
II. Current Accounts		
I Saving Bank Account No. 4693 at Corporation Bank at Kedar	Rs. 25,463 (US$ 814,82)	
II Current Account of State Bank of India at Villupuram	Rs. 4,600 (US$ 147.2)	Rs. 30,063 (US$ 962,02)
Total:	Rs. 1,76,463 (US$ 5646.82)	

F.D.R. - Fixed Deposit Receipt, T.D.R. - Term Deposit Receipt

APPENDIX I

TAMILNADU AMENDED PANCHAYAT ACT OF APRIL 1994

SCHEDULE - IV
(See Section - 257)

1. Agriculture, including agricultural extension.
2. Land improvement, implementation of landreforms, land consolidation and soil conservation.
3. Minor irrigation, water management and watershed development.
4. Animal husbandry, dairying and poultry.
5. Fisheries.
6. Social forestry and farm forestry.
7. Minor forest produce.
8. Small scale industries, including food processing industries.
9. Khadi, village and cottage industries.
10. Rural housing.
11. Drinking water.
12. Fuel and fodder.
13. Roads, culverts, bridges, waterways and other means of communication.
14. Rural electrification, including distribution of electricity.
15. Non-conventional energy sources
16. Poverty alleviation programme.
17. Education, including primary and secondary schools.
18. Technical training and vocational education.
19. Adult and non-formal education.
20. Libraries.
21. Cultural activities.
22. Market and fairs.
23. Health and sanitation, including hospitals, primary health centres and dispensaries.
24. Family welfare.
25. Women and child development.
26. Social welfare, including welfare of the handicapped and mentally retarded.
27. Welfare of the weaker sections, and in particular, of the Scheduled Castes and the Scheduled Tribes.
28. Public distribution system.
29. Maintenance of community assets.

Irrigation Investment and Management Transfer in Colombia

by Jorge Ramirez[1]

ABSTRACT

AFTER WORKING AS Chief of Agricultural Planning for the Colombian Government, and having the opportunity to write the new irrigation policy, I became the new Director General of the National Irrigation Institute (HIMAT) in charge of its implementation. The following discussion paper describes my own experience as the leader of the new irrigation law, and the implementation of the new irrigation policy of President Gaviria.

Unlike some Asian and African countries where irrigation has a long history and has proven to be a necessary input in agricultural production, investment in irrigation in Colombia has had only a comparatively short period, and only recently has its importance had been highlighted. Although there is evidence that some native Indians have used some type of simple irrigation structures, the oldest large district in Colombia was built at the end of the nineteenth century, by an American trading company, the United Fruit Company.

This discussion paper, besides showing the recent history of irrigation investment in the country, describes the new irrigation policy and its effect on current management of the existing irrigation schemes. In addition to this, it presents some of the constraints found in transferring the management of these systems to the users, and some considerations on the role of irrigation investment in the development of the agricultural sector of Colombia.

INTRODUCTION

Unlike some asian and African countries where irrigation has had a long history and has proven to be a necessary input in agricultural production, investment in irrigation in Colombia has had only a comparatively short period, and only recently has its importance been highlighted. Although there is evidence that some native Indians have used some type of simple irrigation structures, the oldest irrigation district in Colombia was built at the end of the nineteenth century, by an American trading company, the United Fruit Company.

The process of "apertura,"[2] or liberalization started in 1990 and has begun to influence agricultural production. Dismantling of the price support structure, exposure of Colombian farmers to competition from imports, and declining international prices, have together resulted in negative growth in the crop sector. Annual crop areas remained at low levels caused by the 1992 drought. Irrigation has been considered, during the period of President Gaviria in the early 1990s, as a strategic instrument not only to increase the welfare conditions of some rural people of the country, but also to give more possibilities to commercial agriculture in local and international markets.

Besides showing the recent history of irrigation investment in the country, this discussion paper describes the new irrigation policy and its effect on current management of the existing irrigation schemes. It also attempts to explain the lack of interest in new irrigation investment during the seventies and eighties. And in addition to this, it presents some of the constraints found in transferring the management of these systems to the users, and some reflections on the role of irrigation investment in the development of the agriculture sector of Colombia.

PAST INVESTMENT IN IRRIGATION

Colombia has an estimated 18.3 million hectares of cultivated land of which 7.4 million hectares (ha) are either irrigable or would benefit from drainage. In 1990, only an estimated 2.9 million ha were used for arable crops and just over a further 0.9 million supported perennial or semi-permanent crops. Only about 750,000 hectares of cropland are equipped for irrigation and drainage.

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[1]President of FINDETER, Financiera de Desarrollo Territorial, and former Director General of HIMAT.

[2]Name given to the new economic model of opening the economy to international markets and removing most of the agricultural subsidies, tariffs and barriers.

Private Irrigation

Colombia's earliest modern irrigation was built privately, by the United Fruit Company in the 1980s. From them until the 1960s irrigation development continued to be largely private. Subsequently, private irrigation expanded at an average rate of around 10,000 ha/year, with an investment rate of US$3 to US$8 million/year.

The 463,000 ha in private irrigation currently occupy just over 60 percent of the total national irrigated area. Almost all the sugarcane, export bananas and flowers, and significant areas in rice, sorghum, soybeans, cotton and oilpalm, are under private irrigation. The cost of developing one irrigated hectare ranges from US$1,000 to US$2,700 at present, depending on how sophisticated the systems are.

Public Irrigation

Public involvement in irrigation dates from around 1950, and was given a major stimulus by the Agrarian Reform Law of 1962. The land reform agency, INCORA, sought in irrigation and drainage projects a means of alleviating Colombia's massive and socially disruptive problems of rural poverty. Some marginal lands were expropriated from large landowners for irrigation and redistribution to the poor, and at the same time whole areas were also equipped by the government with primary irrigation or drainage infrastructure. This strategy made it possible to obtain external financing from the World Bank and elsewhere.

By 1976, land reform had assumed a lower political profile and the government sought to separate it from irrigation development. Administration of the public irrigation/drainage districts was transferred to HIMAT.[3] The 22 districts at present under HIMAT sponsorship total about 337,000 ha with 62 percent of farms under 5 ha.

The land reform law of 1962 allowed the government to impose cropping plans with irrigators under threat of expropriation, as well as to provide all support and O&M services. By 1976, when HIMAT took over the INCORA districts, scheme deterioration and high costs, particularly of excessive staff, led irrigators in two districts to propose transferring O&M to themselves. Seven out of the 22 HIMAT districts are now run by users' associations under delegated authority agreements which, however, still leave HIMAT with the right to review major tariff, staffing and other decisions by the users. The other fifteen districts remain under direct HIMAT administration.

Some analysts have argued that in Colombia a paradox exists in irrigation investment. They say that alongside the deficient performance of public-sponsored irrigation schemes, a sizeable and efficient private irrigation sector has emerged. But this is clearly understood by looking carefully at the recent history of irrigation investment and by identifying the effects of implementing the old policy.

Most public schemes were developed by the land reform institute (INCORA) in the 1960s, a highly politicized institution, and by previously landless farmers with little experience and little interest in either agriculture or irrigated farming. INCORA's schemes were constructed in a great rush, and of the 260,000 ha developed, only 69 percent was fitted with on-farm infrastructure needed to take full advantage of the main works constructed. Twenty years after the construction of these districts, much of the tertiary infrastructure remains undeveloped. The supply-driven approach to developing these districts did not accomplish its objectives.

The very high subsidies given to basic agricultural products combined with the ones given to land reform beneficiaries for buying the land and for working capital, created what was obvious—no incentive for taking advantage of the irrigation districts given to them. Small farmers were assured of a stable and sufficient income level that, together with an inefficient technical transfer arrangement available to the government at that time, did not offer any incentive for developing tertiary infrastructure; paying for the cost of water, and for providing adequate operation and maintenance. This is why the current situation of these districts is one of poor operation and maintenance and one where farmers have been cultivating the same crops for years.

Another reason for the relatively poor productivity and returns of much publicly funded irrigation was that the schemes developed by INCORA did not initially give priority to economic objectives. Additionally, the crops that the farmers grew in the past were financially viable when large product subsidies existed. In the early 1990s, when the government of President Gaviria totally or partially removed agricultural subsidies, a number of crops became unprofitable. Farmers of old districts found themselves with a significant fall in their income levels and a great deal of uncertainty in terms of new market development under the new economic model of apertura. Adjusting cropping patterns and technologies to the new price structure is going to take some time.

Cost recovery on past investments in irrigation in Colombia has been based on the "Estatuto de Valorizacion," a tax on the difference in the historical values of land before and after the investment, plus a low interest rate charge. The amounts collected in the past have been very small. This mechanism has proven to be effective for developing

[3]Instituto Colombiano de Hidrologia, Meteorologia y Adecuacion de Tierras, or the Colombian Institute for Hydrology Meteorology and Land Development. HIMAT administers the water resources of the country.

urban infrastructure but the experience in irrigation has been highly disappointing. This is why the new irrigation law develops an alternative cost recovery mechanism which ex-ante determines the amount the user has to pay, followed by an agreement between him and the developing agency on debt amortization scheduling and the collateral needed to guarantee his financial obligation.

THE SEVENTIES AND THE EIGHTIES: TWO LOST DECADES

The major puzzle in the history of irrigation investment in the country is why during the seventies and eighties almost nothing was done in terms of new irrigation investment and institutional strengthening. Most of the obvious deficiencies at that time were not dealt with or corrected. The main institutional effort was concentrated on rehabilitating existing systems with some doubtful results. In the next section of this discussion paper, an attempt is made to solve this puzzle.

Two major obstacles occurred, in my opinion, in both the demand and supply side of the irrigation investment equation during these decades that explain the negligence of the government in developing the irrigation sector efficiently. In the first place, the economic model that prevailed in the past and full or economic distortions within the agriculture sector, discouraged farmers from investing in irrigated agriculture, especially given the low profitability added by irrigation. This created no incentive whatsoever for the traditional pressure groups (i.e., Agricultural Producers Associations, SAC, and others) to have irrigation investment as part of their lobby agenda for the government.

From the supply side, the main agency responsible for the lack of irrigation capital in the country was the Multilateral Bank. In the past, most of the public investments in irrigation were developed with resources and the know-how brought to the country by the World Bank. During the seventies and eighties, the World Bank believed that Colombia should apply what was prescribed for other Asian and Latin American countries where their irrigation potential was mostly already developed. This was the recommendation to shift from building new irrigation systems to rehabilitating existing ones. Colombia at that time had more than 90 percent of its potential yet to be developed and at a lower cost compared to other countries (i.e., less than US$2,000 per ha).

This decision to emphasize rehabilitating old systems was unproductive. For an irrigation district conceived under the old policy, with a high level of social and economic difficulties, it was unlikely to obtain an increase in the welfare conditions of the agricultural producers of these districts. Instead, new potential districts were not developed and had to wait until new policies and financial conditions arrived.

If one evaluates the success of the rehabilitation program launched by the government in the past and financed by the World Bank, just looking at the increase of welfare of the farmers living in the INCORA districts, one has to admit that the results of this program have been very far from expectations, despite the large amount of subsidies given to them. The poor results have been documented in different local studies,[4] contrary to the favorable ex-post reviews given by the Project Completion Reports of the World Bank.

However, this program has achieved some degree of success in Coello and Saldana districts built in the 1950s, which had more production-oriented objectives than the traditional land distribution orientation that characterized INCORA's districts.

On the other hand, an important fact for the low level of private irrigation investment during these decades was a legal obstacle coming from the land reform law of 1962. This law established that any land that was developed under irrigation was potentially subject to government intervention for land reform. This meant that if a farmer wanted to develop irrigation on his land, he had to take the risk of having his land expropriated by the government for land redistribution purposes.

A NEW IRRIGATION POLICY IS BORN

The new irrigation policy recognizes that both private and public investment are necessary to engage in an ambitious development program. The complexity of some irrigation and drainage schemes provides a justification for state intervention and for subsidization of a part of investment costs. Without public intervention some relatively complex but economically worthwhile irrigation schemes would not be constructed for two main reasons. First, some developments require the construction of large intake works, with benefits and costs beyond those affecting the irrigation community. Second, the organizational and financial requirements of large water development schemes are often beyond the capability of private financial institutions.

The need to correct the mistakes made in the past gave birth to a long-awaited irrigation law—Ley de Adecuacion de Tierras No.41 of 1993 which has profoundly altered the nature of public involvement in irrigation in Colombia. Law

[4]See for example INCORA Evaluation Reports.

41 stipulates that public investments in irrigation and drainage can only be made in the future if there is demand on the part of the communities which will benefit by it. Potential beneficiaries are required to make prior commitments to form a users' association to take over public schemes once they are completed, to participate in planning, and to guarantee individually or via an association the commitment of their own complementary resources for minor and on-farm works. Public schemes should lie close to ports or other export routes, and to large consumption centers. These should show a rough balance among beneficiaries between small, medium and large landholdings, and bring social, economic and other types of benefits. Law 41 provides for the Ministry of Agriculture, as the national body responsible for public irrigation and drainage development, to be assisted by a coordinating and advisory board, CONSUAT, which includes five public-sector members from different ministries and public agencies. There are also four private sector CONSUAT members, representing commercial farmers, peasant farmers, irrigation users' associations and indigenous communities.

Public-sector works can be financed from national, regional or municipal resources, special development funds or loans. Law 41 requires CONSUAT to establish levels of cost recovery for publicly funded works, stipulating that small farmers should receive a 50 percent subsidy. It is intended that future capital cost recoveries should substantially exceed the 20 percent or less of real values customarily recovered by HIMAT in the past, while all O&M costs should ultimately be paid by users via associations.

In terms of cost recovery, a new approach has been introduced which envisions farmers playing a greater role in initiating irrigation investments and in financing their development. Two alternatives are presently under consideration. Both foresee a minimum level of cost recovery of 50 percent of total project costs. Option 1 would involve the recovery of 100 percent of on-farm costs, plus 50 percent recovery of all other investment costs. Option 2 differs from the first, only in that the amount in excess of the 50 percent minimum to be recovered would be apportioned amongst beneficiaries according to farm size, with larger farmers paying more per ha.

Although the new policy has been received with enthusiasm from farmers, large and small, and other political groups, there have been some crucial obstacles the country has encountered.

In the first place, for lack of interest in new investments, the feasibility and design studies were old and sometimes obsolete and, therefore, they had to be updated. It took time and financial resources to rebuild an investment portfolio of potential projects. This delayed the ambitious investment program that the government had planned in 1990.

Also the stock of human capital specialized in all stages of an irrigation project, such as local consultants, and social specialists, was depreciated, disseminated and in some cases lost after years of abandoning the irrigation sector. Building this local human capacity again has become one of the major objectives of the government.

In terms of institutional strengthening, HIMAT has been restructured and slimmed down in the last two years. By the end of 1993, HIMAT had placed a limit on the total number of positions of 1,426. This resulted in a net reduction in staff of 1,016 workers (the difference accounted for by vacancies). At the end of 1993, HIMAT had 1,565 positions, of which over 500 were vacant. There are currently 16 regional directorates, intended to promote projects among potential beneficiaries in their areas and to support users' associations.

COLOMBIAN EXPERIENCE WITH IRRIGATION MANAGEMENT TRANSFER (IMT)

When INCORA was in charge of the districts, all major decisions regarding the operation and maintenance of the hydraulic infrastructure were assigned to the government. INCORA staff were also given responsibility for the planning and allocation of credit for investment or working capital, and the provision of agricultural extension services. Such was the paternalistic attitude towards beneficiaries, that the Agrarian Reform Law of 1962 enabled the national government to formulate crop plans and required farmers to adhere to them, under the threat of expropriation for those who failed to comply.

By 1976, national support for agrarian reform had subsided and the government sought to separate land reform from irrigation and drainage development. It transferred the administration of irrigation and drainage districts over to HIMAT, a newly created institute charged to administer water resources and irrigation investment. By this time the poor quality of operation and maintenance under governmental administration resulted in a significant deterioration of the existing infrastructure and very high costs, mainly due to excess staff. The users of two districts, Ceollo and Saldana felt that they could improve the quality of services and signed a "delegated authority" agreement with the government. This enabled the users' associations to achieve a certain degree of financial autonomy, improve service for farmers, and substantially reduce staff and operating costs. Under these agreements the government retains fiscal review authority over users' associations.

The 22 districts presently under HIMAT sponsorship have a total surface area of 340,000 ha. In 19 of them the infrastructure provides irrigation and drainage and in the other 3, only drainage. Eleven of the irrigated districts derive water using gravity, the other 8 require pumping. Since 1990, an additional 5 districts have signed delegated authority agreements with HIMAT and are now administered by their respective users' associations. The remaining 15 are still

directly administered by HIMAT. Of the 7 districts being administered by the users, 6 obtain water at low cost using gravity and only 1 uses pumped water.

Taking advantage of the special powers given to the President by the Constitution of 1991, a new law was decreed in 1992[5] which mandated the transfer (except in exceptional cases duly justified) of the administration, operation and maintenance of all irrigation districts from the state to the private sector, preferably users' associations. It also forbids the use of delegated authority agreements as a form of transfer to user groups and requires HIMAT to replace these with public service concession contracts which would give greater financial and operational autonomy to users' associations than they enjoy at present.

The new irrigation policy establishes that in those cases where some level of subsidy for O&M costs is needed, the operation and maintenance of a district could still be transferred to the users, with some guarantee from the government that the subsidy is transferred every year to compensate for the estimated deficit. Given that this deficit is not exogenous and depending on the performance of the users' association, a method to create incentives to save funds was identified. The incentive works as follows. The savings or the difference between the expected deficit estimated together between the government and the users, and the real or ex-post deficit after the operation for the fiscal year was done, is distributed partially among users via tariffs and the rest goes to the government via fewer future subsidy transfers.

The current policy on IMT is that for those districts where tariffs do not cover the O&M costs, and were built under INCORA's rule, the government should try different administration arrangements, depending on the particularities of the system. For some districts, a concession contract with some transfer of resources to cover an expected deficit would be sufficient. For others, given the weak capacity of some users' associations, HIMAT could let a private company run the district, totally or partially. Also, the combination of these two forms of administration could be implemented. In fact, the oldest district, Prado-Sevilla in the coastal region, is still administered directly by HIMAT, but the role of maintaining the system has been given to a private agricultural trading company. The results have been more than impressive; the maintenance cost has been reduced in half, and the quality of the works has improved significantly.

The new districts built under the current irrigation policy are expected to achieve financial self-sufficiency. The operation and maintenance costs should be financed fully through tariffs and Law 41 establishes that after one district is built its operation and maintenance have to pass on to the users' association.

The recent experience in Colombia with the small-scale irrigation program has shown that districts that were built under the new irrigation policy have a high probability of achieving success. Most of the recent schemes are managed and operated completely by farmers; farmers owned the infrastructure; and have even gone further in forming agricultural trading associations. The role of the government has concentrated on giving technical assistance in all different aspects of management and agricultural production.

CONSTRAINTS FOUND TO TRANSFER THE MANAGEMENT OF OLD IRRIGATION SYSTEMS TO USERS' ASSOCIATIONS

The success stories of IMT in Colombia are either for the oldest districts (i.e., Coello, Saldana and Prado-Savilla) or the newest (and most of these are small-scale). Because the government's initial aims for public irrigation after the sixties were as much social as economic, finding old districts that were financially self-sufficient has been difficult. This created the need for implementing different forms for administering these districts, as discussed above. It is too recent to judge the success of IMT in the system transferred to farmer management in the 1990s.

Although the more recent transfers are having some problems (e.g., lack of start-up capital, limited expertise to run the systems), the 7 districts run by users are now fully independent from the state. The principal feature which has allowed the transfer has been a high level of organization of users, coupled with the presence of well-trained professionals within their leadership. The remaining districts, on the other hand, are still highly dependent on governmental subsidies and have weaker users' organizations. In some cases, their O&M costs are so high in relation to farmer incomes that farmers are understandably reluctant to take over responsibility.

In Colombia, water rights are not well defined. This has created some difficulties in negotiating the terms of transferring some districts. Some users' associations have demanded that the legal situation be solved before any negotiation is completed. Unfortunately, this could not be done given the lack of legislation on this matter. Currently, the government is working on preparing a bill that tackles this problem.

When the government was working on the regulation of the law, an issue was raised that has not been decided on. The question is whether the government should allow a users' association to run other types of businesses such as trading agricultural products or selling production inputs. The National Federation of Irrigators (FEDERRIEOS), a newly

[5]Decreto Ley 2132.

created association, is in favor of this, arguing that this new dimension gives them more degrees of freedom in terms of generating additional monetary resources to manage the system, and also that through the generation of other activities, producers would have other incentives to work and stay together. The argument from the government side against this proposal is that the risk of the association getting distracted from its main function of administrating and operating the system is too high.

Another constraint that the government encountered in trying to transfer the old districts was what could be called the "vicious circle of irrigation demand." When agricultural prices are high (with the apertura model they became tied to international prices), together with high rainfall levels, the demand for good performance of irrigation systems is low. In this particular case, the willingness to pay for appropriate operation and maintenance is lower than when the situation is the opposite. With low prices and low rainfall, the financial condition of producers becomes weak, which makes them less willing to repay irrigation investments with the argument that the government built the districts for them without charging any fees, and therefore it is the government's responsibility to take care of them. This last scenario occurred during the last four years in Colombia. Combined with the strong political pressure that INCORA farmers still have, this makes it difficult to transfer some irrigation systems. For these districts, it became necessary to increase the O&M fee level as an ex-ante condition, but this could not be accomplished.

Law 41 established that once an irrigation system was built, the property of the civil works and machinery could be passed directly to the users' association. This has not been regulated yet and the government is waiting for more elaborate regulations from the Constitution. The possibility of transferring the property to users has some advantages and disadvantages. On the one hand, the fact that farmers can own the district gives them a sense of ownership that could also be used as collateral for future financial obligations. On the other hand, owning the irrigation infrastructure could create problems for them in terms of legal liabilities with potential damages to infrastructure in the future.

The fact that the possibility of infrastructure damage is contemplated in the law, combined with the fact that some old districts have incomplete works and old damaged infrastructure, has given INCORA farmers a sense of insecurity, and for this reason they are reluctant to take over the systems.

The largest constraint that existed in Colombia for transferring the systems was the legal ties to HIMAT of the O&M staff of INCORA districts. HIMAT had more than a thousand staff protected by law who could not be laid off. Additionally, two labor unions existed in HIMAT. In past delegation agreements, a special clause had to be included that made clear the rights of these workers, and the users' associations could not replace them even though the district had already been transferred. Under this situation, one might understand that farmers would not want to operate the systems by themselves. They wanted to have control over their employees. Fortunately, this major constraint was removed by the new Constitution which allowed a significant institutional reform in HIMAT, which permits the laying off of these workers with some financial compensation.

Finally, another problem that we found to be important was the difficulty of convincing irrigators of the importance and the need of generating an equipment replacement fund. This implied an increase of the O&M fees which they have generally not been willing to accept yet.

CONCLUSIONS AND RECOMMENDATIONS

"Apertura" represents a laudable commitment by Colombia to open its economy and to exploit its international comparative advantages. Benefits to some categories of agricultural producers have been less than anticipated however, in part due to declining world commodity prices and to continuing export subsidies by competitor countries. However, the next Colombian government has already decided to continue with the policy of the open economy. One of the strategic instruments that will continue to be implemented to achieve a comparative advantage of the agriculture sector, will be to invest in infrastructure for the agriculture sector.

The institutional and financial setting in Colombia has often constrained efficient investment in irrigation. In the case of public irrigation, the major problem was institutional, in which, the development of the supply-side schemes, without any farmer participation in any of the stages of the project cycle, has not allowed for good designs or achieving any cost recovery. On the other hand, for private irrigation, the basic bottleneck has been a lack of a clear financial policy. The credit lines were not adjusted to demand conditions for private sector projects. Also, the lack of clear regulations for private irrigation has brought on some environmental problems.

The new irrigation Law removes most of the past constraints in achieving an efficient and dynamic irrigation program. There now exists a new institutional framework and some fresh financial resources to implement the program. This is an excellent opportunity for the new government to restart irrigation investment in the country.

The Colombian experience with implementing IMT is already two decades old. The degree of success has been modest to date, depending on how the systems were conceived and the form of IMT which is being implemented. Currently, under the new Law, the country is committed to building demand-driven systems. Once constructed, their operation and maintenance will be the responsibility of users' associations. This should increase the probability of

success in future IMT programs. All this makes Colombia an interesting place to learn about which strategies of IMT are successful and the necessary conditions to accomplish the proposed goals of IMT.

Finally, a lesson was learned during these last four years; it takes more than a presidential period to reconstruct an irrigation program. Writing a new policy; redefining the legal framework; making the political will sustainable; strengthening the institutional capacity, and obtaining the necessary resources, constitute a long-term and difficult enterprise.

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Figure 1. Yearly Isohyetel Lines in Taiwan.

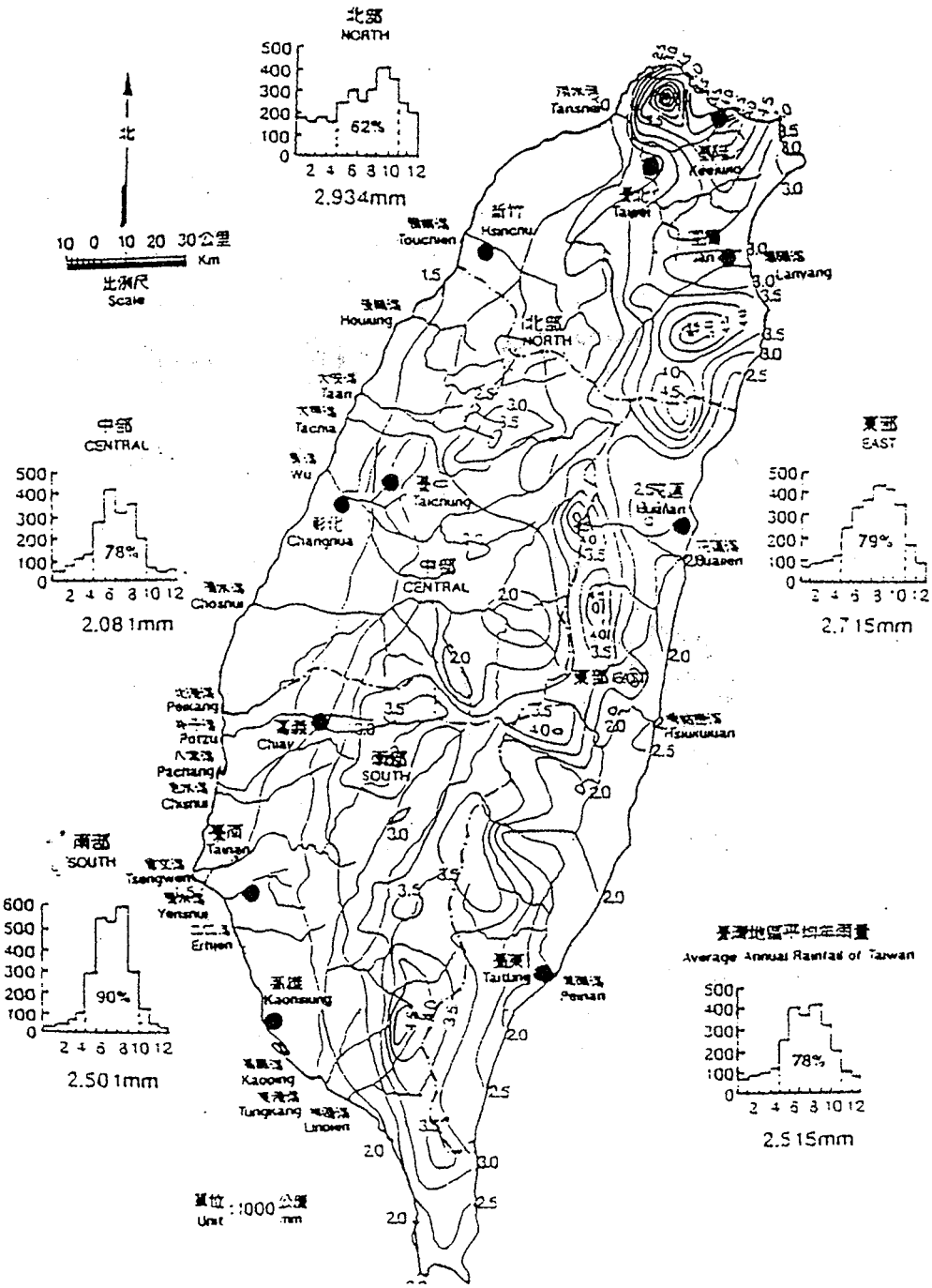
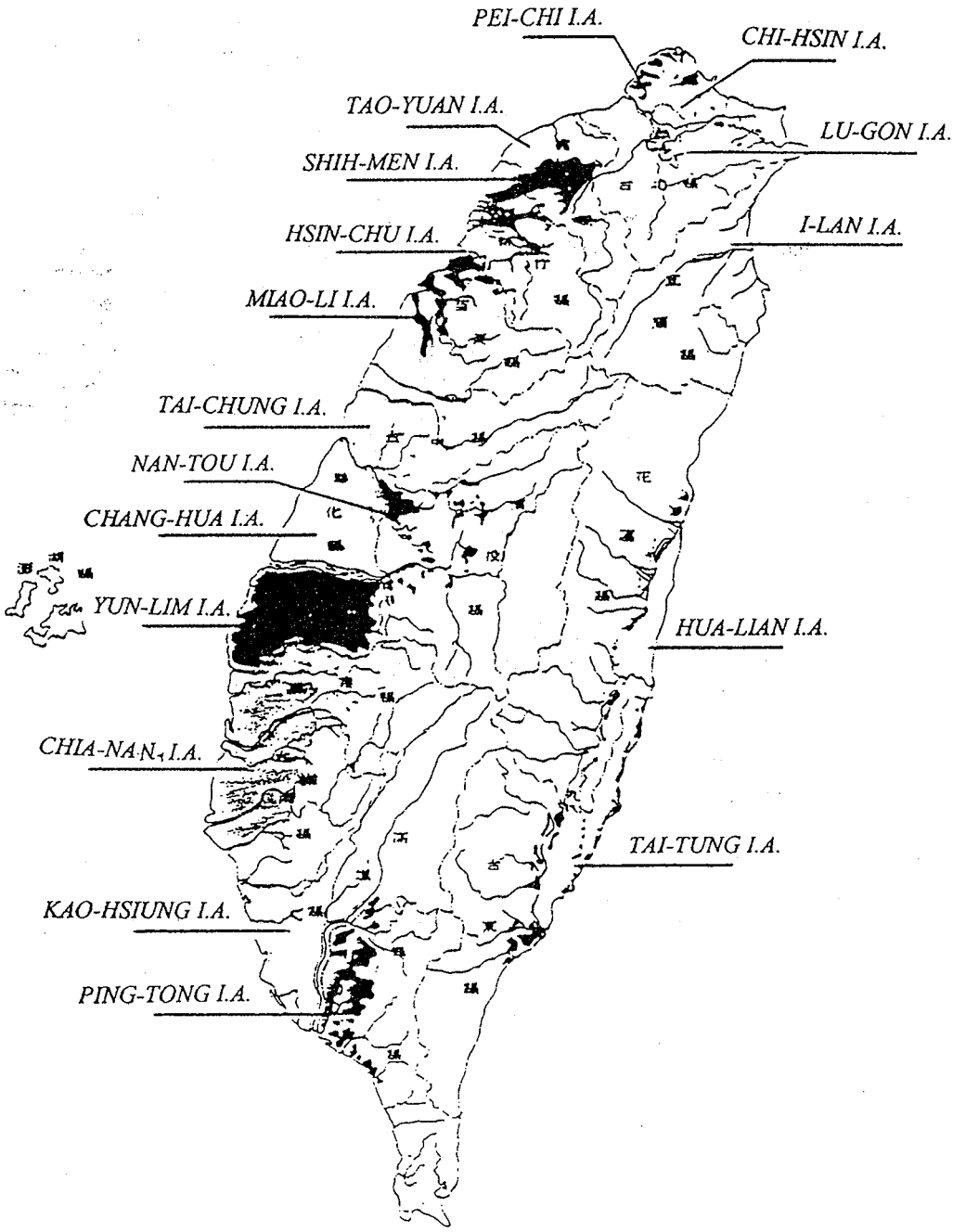


Figure 2. Distribution of Irrigation Associations in Taiwan.



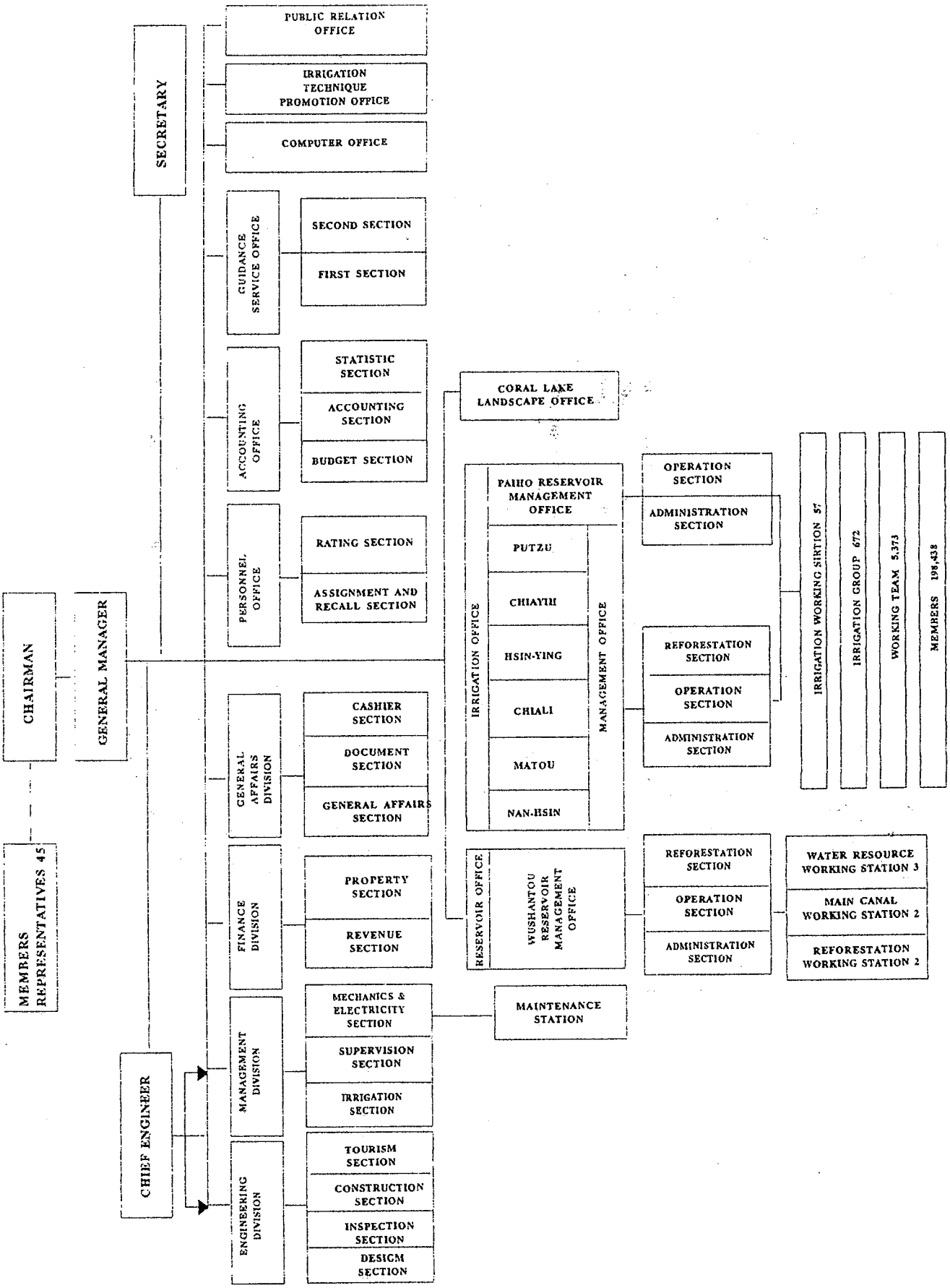


Figure 3. Irrigation Management in Chia-Nan Irrigation Association.

Figure 4. Organization of Chia-Nan Irrigation Association.

	Delivery system structures & purposes		Drainage system			Management system	
		Head work					
		Measurement device				Water source	
	Intake.....	Through tunnel or open channel				working	
Water		How into the reservoir or ponds				stations	Water
resource						Outlet	source
↓	Reservoir or pond	Dam, spillway, outlet				working	management
Outlet	Releasing gate	according to water deman				station	office
↓						Main canal	
leading canal	Distribution gate ..	Regulating & distributing of				working	
25193m		canal system				stations	
↓	Waste gate	Protection of canal	River, Sea	Tide bank	Irrigation		
Main canal	Check gate	Checking and raising - water	Managed by	Flop gate	working		
177.067		level flow into the lateral	Government	Bank protection	stations		
↓	Intage gate.....	Diverging water from the	↑	Inlet			Mgt.
Lateral		main canal with measurement	Main-drainage	Outlet drop			div.
349,605m	Waste gate	Protection of canal	↑	8,120.902m			of Iri.
	Conveyance structures	Drop flume siphon etc.	Sub-drainage			Irrigation	Assoctn.
Sub-lateral		Water distribution on the				working	
608,935m	Turnout	Farm ditch with measurement				stations	
↓		devices					
	Division box	Water distribution on the rotation					
Farm ditch		block	↑				
8,960,661m	Cheak gate	Check and raise water level flow					
		into the farm.					
↓		Supply water farm level					
	Pipe inlet.....	Pre-installed for irrigation	Drainage				
		located at the end of the farm	Auxiliary			Irrigation	
Auxiliary	End drop	ditch to prevent erosion	drainage			groups	
Farm ditch	.....	Supplementary delivery					
1,507,098m		system for the farm level	↑				
		irrigation		Surplus or			
Farm ———			Farm	rainfall drain			

Irrigation area 81,212 Has.

Table 1. Estimation of Surface Water Resources in Taiwan.

units: 10^8 m^3, percent

District	Area km^2	average run off (1)			lowest yearly charge(2)	Average (3)	Lower (4)	Lowest (5)
		largest	lowest	yearly				
Northern part	7347(20)	10099(63)	6052(37)	16151(100)	9,259	7,305	4,986	3,093
Middle part	10507(29)	13273(73)	3707(22)	16980(100)	9,704	6,858	5,019	3,572
Southern part	10004(23)	15574(91)	1609(9)	17179(100)	6,623	3,260	1,920	1,317
Eastern part	3144(23)	12452(76)	4010(24)	16462(100)	8,495	6,681	5,682	3,883
Total	36002(100)	51398(77)	15374(23)	66772(100)	34,081	24,104	17,607	11,865

(1) Average from 1949 to 1990
(2) Lowest discharge: In the district eastern part and I-Lang in 1963, Northern Part in 1954, middle and southern parts in 1980.
(3), (4) & (5) Over 50 percent, 75 percent and 95 percent Yearly discharge, respectively.

Table 2.: Estimation of under Ground Water Resources in Taiwan.

District	Area km^2	Location	Area km^2	%	Recharge by rainfall (10^8 m^3)	Pumped in 1992 (10^8 m^3)	Remark
Northern part	7,347	Taipei basin, Taoyuan, Chungli table land, Hsinchu along the sea and Lanyang plain	2,410	32.8	4.72	5.37	Land subside, subsidence Taipei basin because of overpumping was happened
Middle part	10,507	Miaoli along the sea, Taichung district and alluvial far along Choshui chi	3,340	31.79	16.14	25.92	
Southern part	10,004	Chianan plain, Pingtung plain	3,650	36.59	16.64	37.97	Land subside nice along the sea
Eastern part	8,144	Hualian, Taitung valley and plain	930	11.42	2.5	2.13	
Total	36,002	9 districts	10,330	28.69	40	71.39	

Table 3. Basic data of agricultural management in Taiwan.

Item	Taipei district	Hsinchu district	Taichung district	Tainam district	Kaohsiung district	Eastern district		
Country or City	Ilan Taipei Keelung	Tao Yuan Hsin-chu Hiao li	Chang-hua Taichung Nan-tou	Yun-Lin Chiayi Tainan	Kaohsiung Pinglung	Hua-lien Taitung	Total or average	Difference (1993-1985)
Total land area (km3)	4595	4573	7396	5444	5733	8144	35885	+11.8
Cultivated area (ha)	68768	115222	194845	269731	130225	91587	870378	-15610
Index of cultivated area (96)	15	25	26	50	23	11	25	-0.5
Farmer's family	69537	97554	222349	240667	123455	40133	793695	-3469
Agricultural population	378408	526066	1194437	1086041	670238	204882	4060072	-182875
Agricultural population per ha	5.5	4.6	6.1	4	5.1	2.2	4.58	+0.02
Average cultivated area per family (ha)	0.99	1.18	0.88	1.12	1.05	2.28	1.25	0
Area of paddy rice (96)	52	65	52	62	46	30	51.2	-2.1
Area of upland crop (96)	48	35	48	38	54	70	48.8	+2.1
Double paddy rice field (96)	90	99	96	30	81	96	82	+0.7
Single paddy rice field (96)	10	1	4	70	19	4	18	-0.7
Irrigation by Irrigation association (ha)	24852	93572	89931	139426	39660	22758	410199	+21980
Irrigation by Irrigation association (96)	36.1	81.2	46.2	51.7	30.5	24.8	45.1	+5.1
Paddy rice	35814	74622	100787	166648	60066	27.079	465016	-121465
Vegetable	34255	11788	66828	82544	31500	7499	234414	+2189
Sweet paotato	1253	1947	2513	3879	1915	404	11911	-15056
Tee tree	5323	7274	6549	2124	188	1124	22582	-6202
Orange	8	19	4	1	---	4	36	-9257
Peanut	438	592	5101	27478	831	1179	35619	-15038
Green manure	2067	2013	1190	12956	2070	4202	24498	+10719
Citronella	---	---	---	---	---	---	---	-270
Water melon	382	2409	4458	10548	1229	1940	20966	-1807
Wheat	---	---	1402	---	---	---	1402	+385
Sugar cane	---	169	6912	33476	15455	6331	62343	-19479
Cassava	---	15	2	120	460	9	606	+606
Rape	1326	180	501	1734	19	1397	5157	+3655
Flax	---	---	---	---	---	---	---	-2741
Tobacco	---	---	2174	1958	2643	297	7072	-2003
Mushroom	---	69	275	537	59	---	940	+940
Soybean	4	---	46	3765	206	174	4195	-1340
Corn	89	1277	5622	52239	4479	13442	77148	+24617
Green bean	---	15	---	557	4	8	584	-571
Peppermint	---	---	---	---	---	---	---	0
Red bean	---	---	8	37	5401	7	5453	-8878
Kenaf	---	---	---	---	---	---	---	0
Banana	25	52	4372	608	5202	245	10504	-139192
Pineapple	15	26	1338	2836	3923	213	8352	-220707
Mulberry	---	46	---	6	13	149	214	-816
Licorice	---	---	---	---	---	---	---	0
Harron	---	---	---	---	---	---	---	0

Source: 'Taiwan Agricultural Yearbook (1993 Edition)

Table 4. Estimation of Water Requirement in each Purpose Use of Water in Taiwan.

Units: 10^8 m^3,%

Year		1981	1990	2001	2011
Water Used for Agriculture	Irrigation	137(37)	121(62)	127(62)	127(60)
	Aquaculture	21(11)	32(16)	22(10)	22(10)
	Animal Husbandry	0.8(37)	1.1(1)	1.4(1)	1.4(1)
	Sub-total	159(85)	154(79)	150(73)	150(70)
Domestic use of water	Public water supply	11(6)	21(11)	30(15)	36(17)
	Private water	3(1)	3(1)	2(1)	2(1)
	Sub-total	14(7)	24(12)	32(16)	38(18)
Industry	Use of water	15(8)	17(9)	23(11)	25(12)
Total		188(100)	195(100)	205(100)	213(100)

Table 5. Main Office and Business Unit of Management on Water Resources.

Functions	Main Office			Business Unit
	Central	Provence	Country	
Flood control	Ministry of Economy	Water Conservancy	Water Conservancy Section	--
Tide protection	Ministry of Economy	Water Conservancy	--	--
Regional drainage	Ministry of Economy	Water Conservancy	Water Conservancy Section	--
Reservoir	Ministry of Economy	Water Conservancy	--	Irrigation Association Domestic Water Co.
Water power	Ministry of Economy	--	--	Electric Power Co.
Irrigation	Agriculture Commission	Water Conservancy	Water Conservancy Section	Irrigation Association
Farm drainage	Agriculture Commission	Water Conservancy	Water Conservancy Section	Irrigation Association
City drainage	Ministry of Interion	Residence Bureau	Water Conservancy Section	--
Water supply	Ministry of Interion	Department of Reconstruction	Water Conservancy Section	Domestic Water Co.
Soil erosion	Agriculture Commission	Water Conservancy	Water Conservancy Section	--

Table 6. Irrigation Area and the Number of Members, Staff and Working Station of Irrigation Association in Taiwan.

Item Association	Irrigation Area (ha)	Service district	Staff	Members	Teams	Irrigation groups	Working station	Staff in working station
Two years	404,517		3,338	950,334	14,123	3,551	261	3,393
before One year	390,577		3,240	943,817	14,126	3,551	264	3,223
before Total	403,395		3,153	963,206	13,350	3,525	292	1,331
Taiwan	401,888		3,086	959,543	13,329	3,492	290	1,326
Province	19,069	I-Lan County	126	50,779	502	186	10	56
I-Lan	5,416	Taipei County, Chi-Lung City	32	11,040	353	59	4	13
Pei-Chi	26,083	Taipei County, Tao-Yuan County	209	51,924	2,138	339	13	0
Taur-Yuan	25,648	Taipei, Tao-Yuan, Hsin-Chu County	99	22,781	366	110	7	42
Shih-Men	6,752	Hsin-Chu City, Chu-Pei City, Gon-Lin, Heng-Sang Town, Hsin-Pu, Kong-Si, Chu-Tung Town	56	21,334	120	102	4	22
Hsin-Chu	10,059	Miao-Li County, Hsin-Chu County, Hsin-Chu City	86	30,040	602	119	10	39
Miao-Li	33,022	Miao-Li County, Tai-Chung County, Tai-Chung City	241	90,717	1,071	320	23	127
Tai-Chung	12,577	Nan-Tou County, Tai-Chung County Chang-Hua County	100	38,625	475	122	9	58
Nan-Tou	46,198	Chang-Huan County, Nan-Tao City, Min-Gin Town	330	143,796	1,290	414	32	182
Chang-Hua	66,384	Yun-Lin, Chia-I, Nan-Tou	546	175,339	1,592	500	54	0
Yun-Lin	78,926	Chia-I, Tai-Nan County and City	658	176,720	2,007	682	73	464
Chia-Nan	20,186	27 towns in Kao-Hsiungg County, City District North to Tainan County ER-Jen Chi east to Ping-Tung County South-Western sea side	213	49,653	388	146	16	123
Kou-Hsing	25,606	Ping-Tung County	224	59,958	1,089	202	18	111
Ping-Tung	13,505	Tai-Tung County	92	17,270	897	110	9	51
Tai-Tung	12,457	Hua-Lian County	74	19,572	439	81	8	38
Hua-Lian	1,507		67	3,663	21	33	2	5
Taipei City	1,025	Shih-lin, pei-tou, nia-hu, nan-kang, shih-chih	33	2,445	0	20	0	0
Chi-Hsin	482	Taipei City, Suang Sang, Ta-Shih, Chung-Shang, Wen-Shang Districts and Part of Shih-Lin District and Taipei County, Shih-Tin City.	34	1,218	21			
LU-Gon								

Lessons from Management Transfer in the Columbia Basin Project, USA[1]

Mark Svendsen and Douglas Vermillion[2]

INTRODUCTION

THIS PAPER DISCUSSES a representative case of transition to farmer management in the American west. It first discusses the national policies which govern irrigation management in the United States and institutions which implement them, and then describes the Columbia Basin Project. There follows a summary of the results of the analysis of the impacts of the transition, organized around four topics--technology adoption, hydrologic performance, financial performance, and farm profitability. It then offers several general conclusions and goes on to identify conditions felt to have influenced and facilitated the successful transfer. Finally, it suggests important lessons for those attempting similar transfers in developing countries.

BACKGROUND

Currently there is keen interest in many developing countries in transferring responsibility for operating large publicly constructed irrigation systems to the farmer-beneficiaries of the systems. To understand the implications of such a shift on the performance of a system and the conditions under which it can take place successfully, a case study was undertaken. The Columbia Basin Project (CBP) in Washington State, USA was selected for this study. This selection was based on the facts that the United States has had a policy mandating transfer of managerial responsibility for publicly developed irrigation to users for almost 100 years, that good quality historical records describing system hydrology and financial performance were available, and that transfer in the CBP occurred more than 20 years ago, providing ample time for the post-transfer situation to stabilize and for longer-term problems to emerge.

The CBP is a large multi-purpose reservoir-based project located on the Columbia River in the state of Washington near the Canadian border (Map 1). Construction of the dam was begun in 1933 and water first reached the command area in 1951. The current irrigated area is about 230,000 hectares, while facilities for a roughly equal area included in the original plan have never been constructed. All water used by the irrigation system must be lifted 85 meters, from which point it is distributed to the command area largely by gravity flow.

The national irrigation development agency, the US Bureau of Reclamation, constructed the project and operated it from 1951 until 1969, when management was turned over to a set of three farmer controlled irrigation districts. These districts had been established in 1939 while construction was still underway and had signed repayment contracts with the Bureau obligating their members to reimburse the government for part of the cost of building the system. Each district today consists of 2,000 to 2,500 landowners and is controlled by a 5 to 7 person board elected from among them. The districts operate on a non-profit basis and are required to cover their own operating costs. Districts purchase water from the Bureau and then resell it to their members. Payments to the Bureau include an energy charge for basic water lifting from the reservoir, but the rate applied is highly subsidized. The Bureau continues to operate some common facilities and retains formal ownership of all system facilities, though the right to operate and maintain them, and to collect revenue from the sale of irrigation service, rests with the districts.

Districts require farmers to pay for basic water service in advance of the season or no water is delivered. Districts have the right to foreclose on farm property in the event of unpaid bills and have done this on a number of occasions. Water delivery to farms is on an arranged demand basis, and deliveries to individual farms are measured volumetrically for accounting and billing purposes.

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[1]The study on which this paper is based in reported more fully in Svendsen and Vermillion 1994.

[2]Mark Svendsen is an agricultural engineer and irrigation specialist working as a consultant and advisor on irrigation management issues. He lives in Oregon, USA. Douglas Vermillion is a sociologist and irrigation management specialist with the International Irrigation Management Institute, living in Colombo, Sri Lanka.

THE TRANSFER

The Transfer Process

The primary interests of farmers in the transfer were in obtaining more local control over water allocation, water fee structures, O&M expenditures, and drainageways and in minimizing water charges. In negotiations with the Bureau farmers and their lawyers asserted the right to local control over a resource for which they were paying, with the underlying assumption that local management would be both cheaper and more responsive.

Bureau officials in the Columbia Basin had a long-standing mandate to transfer management to the farmer-controlled districts as soon as they could reach agreement on the terms and conditions. The Bureau was also interested in shedding responsibility for farm-level water deliveries and water service contracts to enable it to focus on its development mission and on basin-level regulatory functions. These interests were reciprocal. The farmers did not like the cumbersome administration and unresponsiveness of government management and the Bureau did not want the troubles of having to deal with thousands of individual farmers.

In the early 1960s, Floyd Dominy, Commissioner of the Bureau of Reclamation, gave the CBP a strong push to move ahead quickly with transfer negotiations. The districts hired lawyers who, together with elected district board members, entered into a protracted process of negotiation, hydrologic and economic studies, and legal analysis with project staff. The research helped reduce some of the uncertainties about the cost and equity implications of various options being considered. Negotiations began in earnest in 1966, and transfer agreements were signed in late 1968.

Over a period of about five years, the districts gradually came to agreement over water and cost allocation and which works should be (a) reserved by the Bureau, (b) managed jointly between districts, and (c) transferred to individual districts. Mutual concessions were made by districts regarding alignment of O&M responsibilities and apportionment of costs. One of the last obstacles was overcome when the Bureau dropped its insistence that districts cover severance payments for Bureau staff transferred to the districts.

In 1963 farmers agreed to repay a total of US$325 per ha to the Bureau for the cost of scheme construction and additional drainage facilities. This allowed a 10-year deferral period and a repayment period of 50 years, without interest. Hence the repayment rate was US$6.50 per ha per year. However, this agreed repayment constitutes only about 12 percent of the total construction costs of the project. The remaining 88 percent is recovered through hydroelectric power sales.

In contrast to many transfer programs in developing countries, the transfer process in the CBP was characterized not by efforts to organize and motivate farmers to comply with government programs, but by extended negotiation until terms and conditions mutually acceptable for the government and the farmers were agreed upon.

Terms of Transfer

The following are the more important terms and conditions which were negotiated and agreed to between the farmer-controlled irrigation districts and the US Bureau of Reclamation. The key rights transferred to the districts include the following.

A measurable, volumetric water right.

* The right to plan and implement all system operation and maintenance.

* The right to apply fines and other sanctions against members who violate district rules.

* The right to deny access to water to district members who fail to pay fees or to non-members of the district.

* Districts can set the levels of basic and excess water charges to farmers, although charges for the basic allocation remain related to land productivity classes.

* Districts can enter into water service contracts to sell excess water to farmers outside the districts. However, districts may not sell water *rights* since the transfer of water rights from one landholding to another is prohibited.

* The districts have rights of eminent domain and foreclosure on land. They are not liable for damages resulting from the storage, conveyance, seepage, overflow, and discharge of water either to other districts or to individuals.

* Districts are allowed to purchase heavy equipment and supplies from the project with a ten-year payment schedule. This included such vehicles as tractors, road graders, and pick-up trucks.

* The districts have the right to obtain revenues from sources other than water fees, including developing power generation stations within the system. The right to generate power was considered concessional by the Bureau, since the districts pay an extremely low rate for the primary lifting of water from FDR reservoir.

Key district responsibilities include the following:

* Districts must comply with the agreed construction repayment schedule, which includes partial repayment for drainage construction.

* Districts are responsible for all operation and maintenance for facilities used individually and jointly by the districts, in accordance with Bureau standards of performance and financial viability.

* Districts are responsible for paying their mutually agreed proportions of the recurrent costs of special "reserved works" which were retained for management by the Bureau.

* Districts are responsible for making annual payments into a capital replacement reserve fund at a rate equal to 30 percent of five-year average annual O&M costs. They must eventually replace deteriorated facilities with this fund.

* Districts must report maintenance plans annually in advance to the Bureau.

Key rights held by the Bureau after transfer were as follows:

* The Bureau has the right to resume direct management of the system if the districts fail to make their construction repayments, pay for the O&M of reserved works, or properly maintain the system.

* Bureau staff affected by the management change would be transferred either to other Bureau projects (as was the case with most construction staff) or to the districts themselves (as was the case with most O&M staff). By agreement, most of the initially-employed district management staff were former Bureau CBP employees.

* Salaries and benefits of transferred Bureau staff members such as ditchriders and watermasters remained at the levels prevailing before transfer. Federal retirement plans for transferred staff were cashed in or suspended and new district retirement plans were started, although without seniority.

Key responsibilities of the Bureau relative to the districts after transfer were as follows:

* The Bureau has responsibility to manage the "reserved works" which serve the entire project. These included the Grand Coulee Pumping Plant, Banks Lake, the Main Canal, and Potholes Reservoir.

* The Bureau conducts operation and maintenance reviews (or "examinations") every three years to audit O&M performance standards of the districts and make recommendations for improvements.

* The Bureau retains ownership of the facilities operated by the districts at least until completion of repayment or replacement of facilities by the districts. However, under current law, wholesale transfer of ownership of system facilities to the districts, would take an act of Congress. The districts favor the retention of legal title for facilities by the Bureau, since they believe this protects them from certain legal liabilities.

* The Bureau must report, in advance, its maintenance and repair plans for its reserved works to the districts on an annual basis.

* The Government will acquire needed rights-of-way for water movement within the project area.

The negotiations between the Bureau and the districts regarding the terms and conditions of the transfer were complex and occurred over the course of several years. Legal council was involved on both sides and political influence was sometimes invoked by the districts. The results were embodied in a set of three legally binding transfer agreements, which were, in essence, contracts between each district and the Bureau of Reclamation. These agreements remain in force.

The strong legal position of the farmer irrigation districts and the protracted period of negotiation between them and the Bureau resulted in a relative balance between district rights and responsibilities. In developing countries there is a tendency for governments to emphasize transfer of responsibilities to the neglect of transfer of rights. A balance between transferred responsibilities and rights, and expected increase in local control and net financial gain to the farmers, were motivating conditions which made the transfer acceptable to CBP farmers. Where this is not the case, considerably greater resistance to transfer on the part of farmers is probable.

IMPACTS OF THE TRANSFER

Technology Adoption

There was substantial technological change in the CBP following transfer of management in 1969. Some of this change, such as the widespread shift from open channel water application to center pivot systems, resulted from individual decisions of farmers responding to prices and returns. Other changes, such as installation of automatic gaging stations and telemetry systems, were initiated by the districts. It seems clear that the transfer to district management has not hindered the adoption of new technology in the CBP and may have accelerated it.

Causes and effects of technological change are sometimes complex and indirect. For example, the reduction in water demand which accompanied the rapid shift to sprinkler irrigation in the 1970s was shown to be largely a result of a shift to crops with lower water demand, rather than to the adoption of more efficient sprinkler systems *per se*. However, it is likely that the installation of center pivots improved water control and facilitated the shift to new, less water intensive, often higher value crops. The willingness of farmers to invest in expensive new water application technology is itself, in part, a function of their confidence in the reliability of water supplies delivered by the district. District managers assert that the shift to center pivot irrigation has also had implications for main system management, requiring less frequent changes in turnout settings, but causing larger, more abrupt changes in demand, leading to increased main system losses.

Hydrologic Performance

The quality of irrigation service received by CBP farmers does not appear to have been affected significantly by the change to district management. Quantity of water delivered did not change markedly after 1969 and reductions in water supply in later years can be explained largely by reductions in aggregate water demand resulting from changing cropping patterns. Demand-based equity of water distribution among the districts did decline in the 1970s and 1980s following transfer, but then improved again and, on average, equity among districts was about the same before and after transfer. The CBP operates on an arranged demand system of allocation wherein timeliness of water deliveries must be measured against the timing of orders for water. Farmers appear to have been satisfied with the timeliness of deliveries both before and after transfer and generally rate this aspect of service highly.

An examination of the hydrologic efficiency of the system reveals some interesting changes (Figure 1). It appears that the system's new managers had a learning period of five or six years after transfer before they were able to operate the conveyance system as efficiently as did the Bureau prior to transfer. This demonstrates the complex and subtle nature of the control that is required to operate a large system like the CBP efficiently. Farmers increased tertiary level efficiency steadily from the mid-1970s. Improvement in water use efficiency was driven by a shift from surface to sprinkler irrigation across much of the project area. That rise has now stopped and overall tertiary level efficiency may even be declining slightly at present.

One very puzzling aspect of system hydrology is the continuing 15-year decline in conveyance efficiency which began in 1978. This decline appears to be a result of deterioration in the condition of major system canals resulting in increased conveyance losses. Evidence from the maintenance audits conducted by the Bureau, supplemented by

statements of project managers, lends support to the idea that system facilities are deteriorating (Table 1). Whether or not this has resulted in increased conveyance losses is not known with certainty but this is reasonable to assume.

Financial Performance

Upon assuming management responsibility, districts moved quickly to cut water assessments to district members. On average, real per acre assessments (adjusted for inflation) under district management were only 78 percent of their level during the Bureau period, dropping from approximately US$27 per acre in 1969 to US$21 per acre in 1989 (Figure 2). At the same time districts diversified income sources, increasing the share of revenue from hydropower generation, water sales and interest on deposited funds. This partially offset lost water assessment income (Table 2). Sale of water to non-members of the district also increased sharply, demonstrating the power of vested water rights, financial autonomy, and quasi-volumetric pricing to shift water to more profitable uses within the irrigation sector.

On average, costs of operating the system do not exhibit well-defined shifts associated with management transfer, and average expenditure levels before and after 1969 are roughly similar. Although it is impossible to know what expenditure patterns would have prevailed had the Bureau retained operating responsibility, the Bureau's agency-wide O&M cost index has grown to a higher level than more general cost indices, suggesting that CBP operating expenses under Bureau management might have been higher than they presently are, other things being equal.

Three-quarters of operating expenses are made up of staff and O&M costs, and, ignoring the one-time costs of the transition, these have held remarkably constant across the transition. However, USBR staff levels have fallen sharply since 1969, above 500 in 1969 to below 100 in 1983 (Figure 3). Major expenditure components show peaks just after transition, reflecting the one-time costs of the transfer. A ten-year decline in total expenditure from the 1969 peak is largely attributable to falling costs of reserve works. During the last decade, total costs have risen again to their long-term average, driven by increases in reserve works expenditures (which includes primary pumping costs and costs of maintaining the main system components serving all three districts) and administrative and other costs.

Since district O&M costs have not declined since transfer, it can be assumed that maintenance levels at the district level have not been reduced appreciably. However, conveyance efficiency has declined in all three districts. It is possible that, while district expenditures on O&M have held constant, they should in fact be increasing to counter accelerating deterioration as the system ages. Some support for this hypothesis is provided by an analysis of maintenance audits, which show an increasing number of problems being flagged in recent years (Table 2). This would suggest that if O&M expenditures continue to hold constant, gradual system deterioration will continue and that more general rehabilitation will be required in the future.

Farm Profitability

Gross returns to irrigated agriculture have risen steadily in the CBP over the past 30 years (Figure 4). Although information on net returns is sketchy, there is some indication that real net returns have risen also. Water assessment levels have fallen by about one-third since districts assumed management responsibility. This is very roughly estimated to comprise about 15 percent of average net farm income.

ENABLING FACTORS

Policy Context

The established federal government policy mandating transfer to farmer management of all irrigation systems constructed by it gave the transfer an air of inevitability. It also meant that considerable experience with the transfer process had accumulated before transfer was attempted in the CBP. Farmers were brought into the picture at the outset through their irrigation districts. Their agreement to participate in the project, to undertake partial capital repayment, assume eventual management of the project, and to cover the "full" cost of O&M (which in fact is only partial) was required. The offer could be refused and was by some. The legally binding nature of the agreements reached provides a sense of legitimacy for the districts in the eyes of farmers and permits strong sanctions to be applied by the districts against members, when required.

Federal policy also requires a continuing Bureau presence in the project as a repository for the project water right, the legal owner of the system physical facilities, and provider of ultimate oversight. This presence is also valued by the districts as it offers certain sovereign immunities and an ongoing relationship with the Bureau. The "partnership culture" between the districts and the Bureau permitted joint problem-solving during the transfer, leading to a mutual decision to continue Bureau management of jointly-used reserved works, contracting by the districts for technical work to be performed by Bureau staff, and the creation of satisfactory Bureau-to-district personnel transfer arrangements.

The relationship is currently being utilized in implementing a program of artificial drainage installation within the project and could possibly facilitate future assistance for system rehabilitation or major repairs.

Federal water resource policy allows cross-subsidization of irrigation construction costs by power revenues and this tends to increase the profitability of irrigated agriculture under Bureau projects. By providing power for lifting water at rates which are far less than current market rates, the government continues to subsidize system operating costs. The government charges the districts only 1/2 cent per kilowatt hour for pumping water our of the Columbia River. The open market price for electricity during summer season is approximately 17 cents per kilowatt hour. However within this subsidized context, irrigation districts are required to operate with balanced budgets.

Perhaps most importantly, federal irrigation policy has remained fairly constant since its inception. Although there have been changes in particular features from time to time, the basic outlines and the principle of system management by financially autonomous irrigation districts have remained. This consistency provides farmers with the confidence to make investment decisions and other longer-term commitments which might otherwise seem excessively risky. It also provides the assurance that private investments which they might decide to make will not be duplicated or provided to others at no cost at some future date.

Social Context

By contrast to the situation in many developing countries, the project area consisted originally of a relatively homogeneous population of settlers who were well educated and commercially oriented. There were virtually no landless poor or others with insecure tenure resident in the project area. Farmers were experienced at creating voluntary associations for a variety of purposes and appreciated the usefulness of joint action. Farmers and their districts had considerable legal and political power and secure land and water rights. Farmers were able to negotiate as equals with the Government and obtained numerous favorable concessions for themselves, such as low power and construction repayment rates and relaxed limits on farm sizes. Such concessions ensured that farming would be a relatively stable and profitable enterprise. Initially farmers employed their considerable political clout to influence Bureau decisions through their elected national representatives. More recently farmers have begun to rely more heavily on legal action to pursue and promote their interests in the public arena.

Institutional Context

A number of important institutions undergird the successful assumption and execution of management responsibilities by the three CBP irrigation districts. Fundamental is the existence of a reliable system for specifying, allocating and recording rights to the use of water. Without this, it is unlikely that farmers would have been willing to assume responsibility for the common irrigation facilities and make the requisite corollary private investments in on-farm equipment and facilities. The strong legal basis underlying the creation of quasi-municipal irrigation districts also contributed to successful devolution and management by the districts. The relative autonomy of the districts allows them flexibility to control costs and to diversify sources of income. The relationship between the Bureau and the districts rests on a set of repayment contracts which spell out the duties and obligations of each party. The legitimacy and enforceability of these contracts is an important feature of transfer. Supporting and enabling all three of these institutions--firm water rights, legally constituted quasi-municipal irrigation districts, and contract law--is a relatively impartial and accessible legal system which provides a mechanism for enforcing contracts and adjudicating disputes.

Another area in which underlying institutions are important is that of financial probity. The state, which charters the districts, requires that regular audits of district accounts be carried out by certified public accountants. This system of mandatory external audits is another important element in the institutional environment facilitating the viability of the irrigation districts.

US Bureau of Reclamation

The Bureau of Reclamation has been characterized by a high degree of competence and professionalism both before and after transfer. Bureau staff receive salaries which provide for an adequate standard of living and enjoy job security under the federal civil service system. That security was preserved during the transfer process, since most staff were transferred to new positions with the districts, retaining former salary levels and insurance and pension benefits. Remaining staff were reassigned elsewhere, accepted early retirement, or were given new roles within the Bureau. These steps no doubt helped limit opposition on the part of affected Bureau employees which might otherwise have been considerable.

It is noted that the Bureau is not financially autonomous in the sense that its operating expense budget is unconnected with the revenue its activity generates. The three CBP irrigation districts do meet this criterion. Financial

autonomy has been identified as a key attribute of effective irrigation service providers in developing countries (Small and Carruthers 1991; Svendsen, Adriano, and Martin 1990) and appears to play a critical role here as well.

Irrigation System

The physical elements and basic operating rules of the irrigation system also form a relevant part of the transfer context. First, the system has an ample and reliable water supply. Second, allocation has been capably handled on an arranged demand basis both before and after transfer. This permits considerable flexibility and responsiveness to market conditions by farmers in choosing crops and cropping patterns. Third, there are clear points of demarkation of responsibility and control where transfers of measured quantities of water are undertaken according to widely accepted agreements and rules, including payment rules. Deliveries to districts and to individuals are thus treated as contractual obligations and water is regarded as an economic good rather than a social entitlement. Fourth, the system has adequate conveyance capacity to deliver required amounts of water throughout the system. Fifth, system physical facilities were upgraded as a part of the transfer agreements and were received by the districts in good working order. The transfer was thus not the disposal of a dilapidated public property, but rather the concessional sale of a valuable and productive asset. Additionally, much of the technical expertise needed to operate the system was transferred with it through the hiring of Bureau staff members by the districts.

LESSONS FOR TRANSFER IN DEVELOPING COUNTRIES

Lessons which can be taken from the CBP experience for use in developing country settings can be grouped into two categories. The first of these comprises policy and institutional issues which can affect the success of a transfer program. The second relates to the process of transfer itself.

Policy and Institutional Issues

An assessment of the relative effectiveness of the various policies and conditions supporting successful transfer of management responsibility in the CBP is beyond the scope of this paper. Moreover, large public irrigation systems occur in a tremendously wide range of situations around the world, and even if such an assessment were carried out, the lessons learned could not be conveyed directly to new settings.

Nevertheless, it is possible to identify from the preceding analysis some policies which appear to have been influential in enabling a successful transfer of management responsibility. Some of these factors will be important only in the context of this particular case, or a relatively narrow range of cases, while others will have more wide-ranging importance. Listed below are policy conditions which are judged to be important and to possess a measure of general applicability. They are recommended not for immediate and uncritical implementation but for careful consideration of their relevance for particular situations by planners and managers of management transfer programs in developing countries.

* *Put in place a clear and consistent policy mandating irrigation management transfer.* Transfer is a slow and deliberate process, and basic outlines of policy governing transfer must remain relatively constant for an extended period to elicit desired responses. Where policy on transfer shifts repeatedly, meaningful and sustainable change is unlikely to occur. On the other hand the USBR experience in general, and the CBP experience in particular, demonstrates that where sustained commitment to the practice of transferring system management responsibility exists, the process can work effectively.

* *Do not require full cost recovery* (for both capital and operational costs) in the first instance. In most cases, such insistence will result in such a drastic increase in the farmers' costs for irrigation service which may place any proposed management transfer program into a sea of political protest. Cross-subsidizing irrigation service delivery costs with other water resource-related revenue streams, such as power generation or aquaculture maybe a more practical option.

* *Manage financial autonomy* on the part of the managing entity. This has been shown to be effective and critically important in a wide variety of circumstances in both higher and lower income countries. Causing the irrigation district or farmers' organization to generate sufficient income to cover its costs in operating the system provides an essential set of feedback links needed to make system management accountable to its members. It is not necessary that no public subsidies be involved, but only that they be specified

in such a way that they do not increase automatically to make up shortfalls in revenue from irrigation operations.

* *Provide a strong legal basis for irrigator organizations.* Such organizations should have the authority to make contractual agreements, obtain credit, and apply sanctions against members.

* *Provide a system of secure, well-specified and long-term water rights* which can be assigned to irrigation systems to offer security for investments of time and money.

* *Invest to bring physical facilities up to standard.* Experience in a number of countries, including the United States, has shown that programs which couple physical upgrading (if needed) with transfer are more likely to succeed than where transfer of systems with faulty infrastructure is attempted.

* *Create a fair and transparent professional auditing system* and mandate its use by managing organizations. This system can be established in either public or private sectors, but should be carefully regulated to ensure its integrity.

* *Provide new employment or compensation for displaced irrigation agency staff.* Civil service employees of public irrigation agencies often have considerable political influence and must not see themselves as losers in the transfer process. They should be integrated into the planning for the transfer and compensated for lost employment through early retirement inducements or transfers to new positions.

Process Issues

The following issues relate to the processes employed in facilitating management transfer. Some of these have policy and institutional implications which should not be ignored. In general there is a well developed literature and body of experience with the process of organizing farmers into associations. (FAO 1985; Uphoff 1986; Korten and Siy 1989; Uphoff 1992) Less attention has been devoted to some of the other factors in the listed below.

* *Involve farmers early on in the planning for the transfer.* A sense of full partnership in the process on the part of farmers is essential for successful assumption of responsibility.

* *Empower farmers* to successfully negotiate with the public irrigation agency. This is difficult to do, though one new approach worth exploring is the vesting of farmers groups with water rights, rather than granting them to the managing agency.

* *Use contracts* between irrigator groups and the managing agency to specify roles and responsibilities. This can be a very powerful tool as it implies a voluntary relationship between equals and creates mutual obligations and rights, i.e. mutual dependencies.

* Develop a locally appropriate water allocation system with *volumetric measurement and payment* at some level. Measurement does not have to be at the level of the farm turnout, as in the CBP, but can apply to groups of farms and farmers.

* *Provide experience* with organization and management for farmers and farmer leaders. This is a central subject of the farmer organizational literature mentioned above.

* *Provide assistance* to operating agencies to improve management and human relations skills. Technically trained personnel often lack this kind of expertise which they need to work effectively in a decentralized management environment.

* Specify an *ongoing role for the operating agency* in "partnership culture" with the farmer-based organizations assuming management responsibility. Experience has shown that there often remain tasks which a public agency is better equipped to perform. Relative comparative advantage should be clearly identified and means for continued cooperation worked out.

CONCLUSIONS

From many angles, the transfer of management from the US Bureau of Reclamation to irrigation districts in the Columbia Basin Project can be considered a success on a large scale. While the Bureau was able to back out of its partly unwanted role in O&M, the districts gained local control over management and costs. This was an extended process, beginning in 1939, 13 years before water began flowing through the irrigation system, and culminating with the signing of the transfer agreements 30 years later.

The study made a concerted effort to document the hydrologic and financial results of the transfer. In general, there appears to have been little or no effect on the quality of irrigation service received by farmers. Service was of high quality before the transfer and it remained so afterwards. However conveyance efficiency in the main and branch canals of the three districts declined following transfer and took five or six years to recover to previous levels. This is interpreted as a learning period, during which the new managers learned to operate the system efficiently. Subsequently a long steady decline in conveyance efficiency set in which is thought to be a result of a failure to keep up with increasing maintenance demands as the system ages. Even though system O&M expenditures held roughly constant, in real terms, before and after the transfer, an increasing number of maintenance problems were observed as time passed, suggesting that maintenance requirements were accelerating.

In the wake of the transfer in 1969, Bureau staff levels fell dramatically, and the Bureau assumed new roles as a wholesaler of water, an environmental regulator, and a water resource planner and manager. Many of the staff released by the Bureau were subsequently reemployed by the districts providing some operational continuity, but the managers of the districts were selected from outside this personnel pool.

Districts moved quickly to develop supplementary sources of income and to reduce operating expenses and water charges to district members. Supplementary income sources included investment income, power generation revenues, and sales of water to non-district members. Average water charges following transfer were only 78 percent of their level during the Bureau period. Real gross returns to irrigated agriculture have risen steadily in the CBP over the past 30 years with some indication that net returns have risen also. This trend appears unrelated to the management transfer. The fall in water assessment levels as a result of the transfer, however, appears to have increased net farm income by about 15 percent.

It is impressive that management of irrigation for 230,000 thousand hectares (with approximately 7,000 landholders) can be handled by three local irrigators' organizations. Indeed this is a recurring pattern throughout the American West, even on larger scales. The King's River Irrigators Association near Fresno, California, for example, successfully services an area more than twice as large as the CBP. A number of lessons relevant to developing country policy makers and implementers emerge from this experience. These do not comprise a prescription for change, but are factors which should receive serious consideration in planning programs involving transfer of irrigation management responsibility to farmer-based groups.

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Map 1. The Columbia Basin Project.

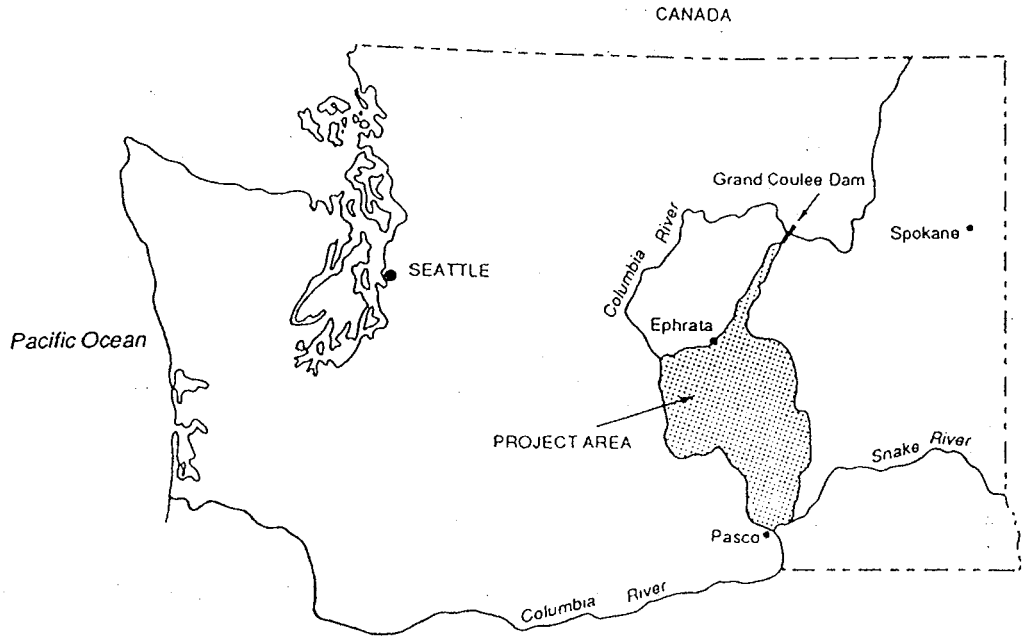


Table 1. Results of the USBR O&M audits in the three districts of the CBP.

Number of Recommendations					
			New Recommendations		
Year/s	Previous Recommendations Uncompleted	Category 1	Category 2	Category 3	Total
1973	2	0	0	0	0
1975	0	0	5	1	6
1977	3	0	0	1	1
1979-81[a]	4	0	12	2	14
1982-84	1	0	8	2	10
1986-88	3	0	5	1	6
Total	13	0	30	7	37

Source: O&M audits, USBR, Columbia Basin Project.

Note: Category 1: Urgent remedial maintenance required; Category 2: Important preventive maintenance needed; Category3: Less important, preventive maintenance would help improve O&M.

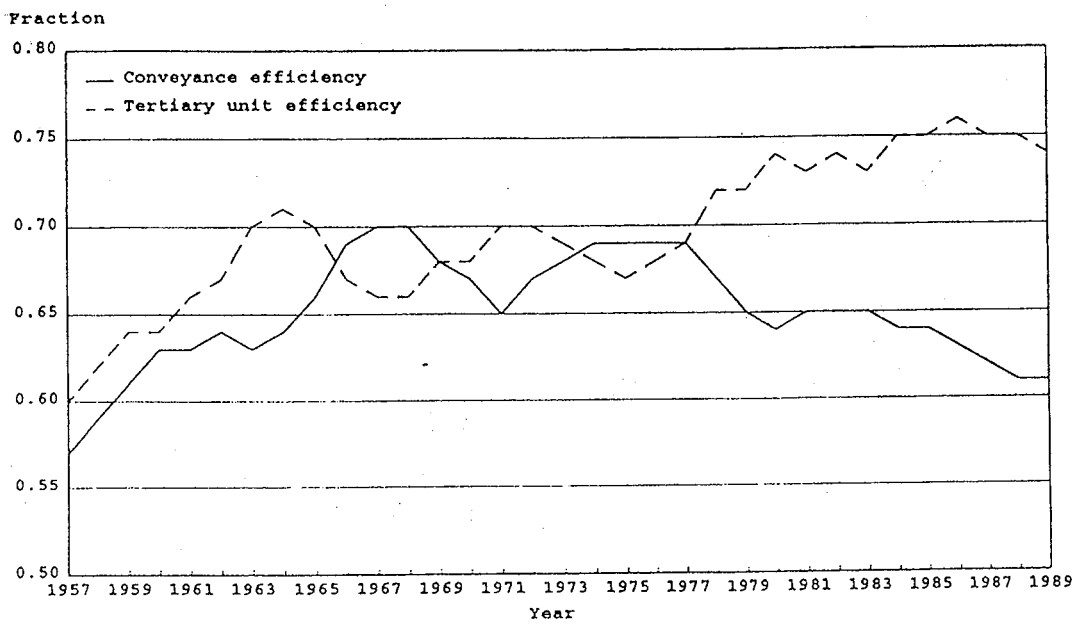
[a] In later years, audits were not conducted in each district during the same year.

Table 2. Share of total revenue, 5-year averages, the CBP, 1969-89.

Year	Water Assessment	Water Service Contracts	Excess Water Charges	Interest and Other Income	Power Revenue	Total
1969	0.806	0.003	0.122	0.070	0.000	1.000
1970-74	0.764	0.014	0.126	0.095	0.000	1.000
1975-79	0.778	0.033	0.116	0.075	0.000	1.000
1980-84	0.729	0.042	0.060	0.166	0.004	1.000
1985-89	0.674	0.057	0.076	0.148	0.045	1.000

Source: Data from CBP irrigation districts.

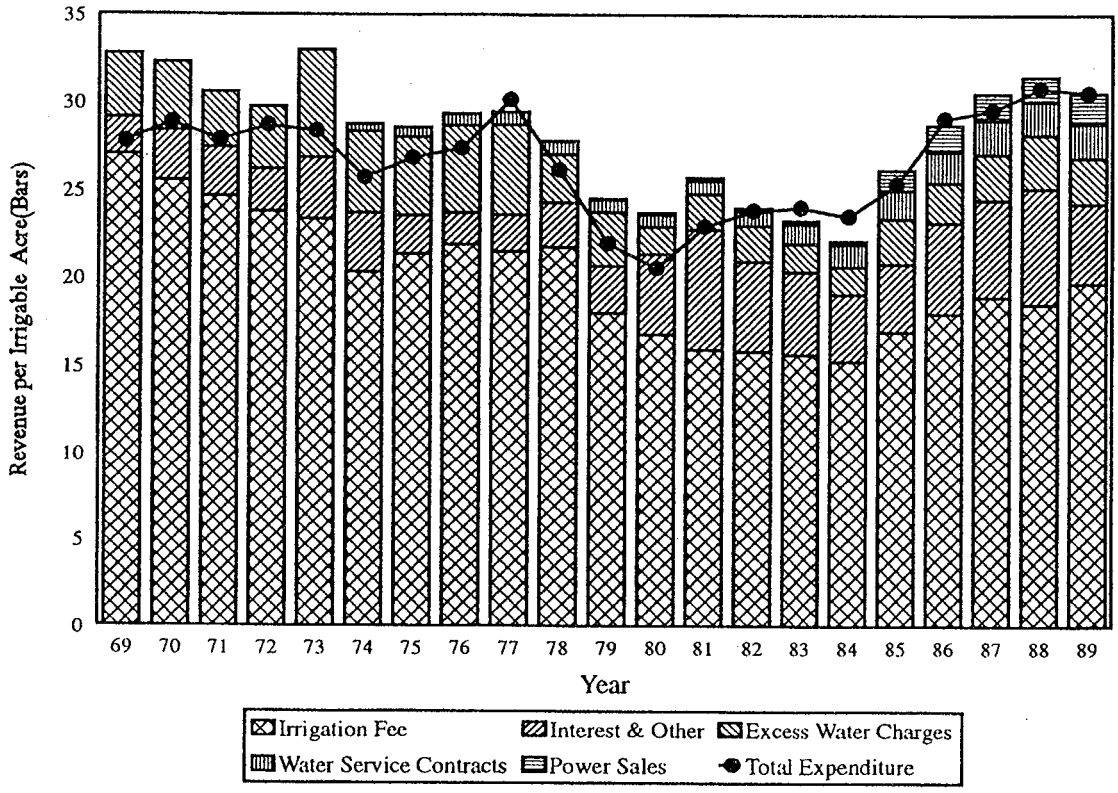
Figure 1. Conveyance and tertiary unit efficiency for the three CBP districts, 1955-89 (3-year moving average).



Source Water Distribution and Crop Production Reports for the CBP, U.S. Bureau of Reclamation

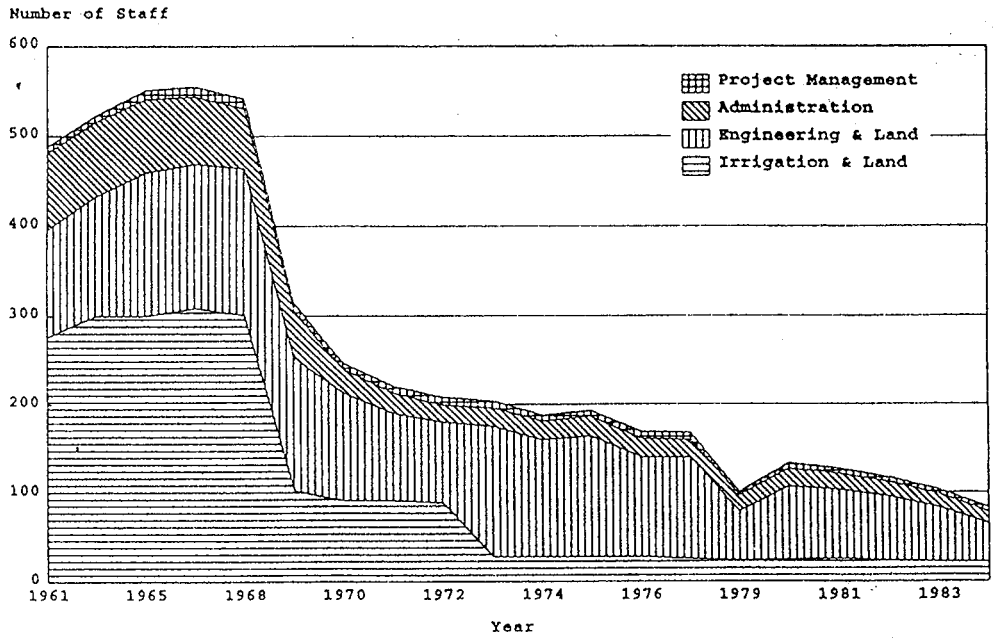
Note Years shown on graph scale are final years in each 3-year period.

Figure 2. Revenue and expenditure per irrigated acre, the CBP, 1961-89.



(Adjusted for inflation, in 1989 Dollars)

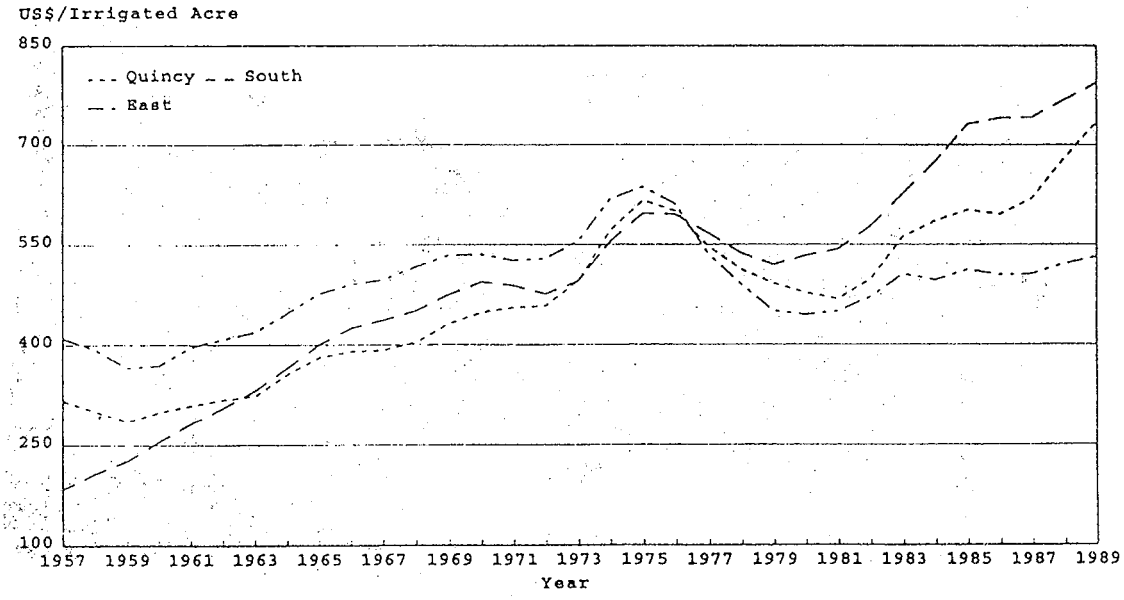
Figure 3. Number of USBR staff assigned to the CBP, by division, 1961-85.



Source: U.S. Bureau of Reclamation data

Note: Data are missing for the years 1962, 1964, 1966, 1978 and 1984. Figure excludes Power Division which became independent in 1969.

Figure 4. Average value of total crop production per acre, the CBP, 1960-89 (3-year moving average).



Source: Crop Production Reports for the CBP, U.S. Bureau of Reclamation. President of the United States, Economic Report of the President (Washington, D.C.: U.S. Government Printing Office 1991).

Note: Prices adjusted by index of prices received by farmers in the U.S.A., (1982=100).

Irrigation Management Transfer in Vietnam

Ha Luong Thuan

FARMER INVOLVEMENT IN IRRIGATION MANAGEMENT

ACCORDING TO PHAN Khanh (1981), Vietnamese farmers have been involved in irrigation system construction and management for more than 2000 years:

> *It can be said that these were the first public welfare works in the villages of Vietnam, from which every member of the community could more or less receive benefit. That is why people are not surprised to find that the irrigation systems could rely so heavily on the active and willing participation of the community, whose members came to see their labor as duty without pay. These investments and obligations were thus gradually included in the self administration regulations and other village rules.*

However, the most striking period that relates to development of the agriculture during the past years is the period from 1945 onwards. This can be divided into three phases with reference to socioeconomic conditions and agricultural policies:

1. Period from 1945 to 1960: This was a period of rehabilitation of irrigation systems that had been constructed during the time of the French and the simultaneous construction of new ones in North Vietnam, such as the Bac Hung Hai System. Once these systems were in place, the farmers then used traditional approaches to get water to their farms. Groups of several water users or self-helping units were established to share the water delivery from common intakes. Farmers discussed and agreed to contribute from their own resources to construct, manage and maintain the intake structures. Throughout this period, agriculture used traditional farming practices. Agricultural intensification was as yet insignificant and the irrigation infrastructure was poor, nevertheless farmers were involved in irrigation construction and management processes.

2. Period from 1960 to 1988: This was the most intensive period of irrigation development in Vietnam. Statistics show that up to the year 1976, a total of 2,188 irrigation structures were constructed. By 1990, that figure had reached 4,919 (see Figure 1).

   The irrigated area increased with these irrigation systems (Table 1). Crop production increased from 11.827 million tons in 1976 to 19.225 million tons in 1990, and to 24.0 million tons in 1992.

   There were two forms of irrigation management during this period. These are as follows:

   i. Irrigation agencies managed the systems from the headwork to the primary or secondary canals (depending on the scale of the system), with the rest managed by the cooperatives.

   ii. The cooperatives managed and maintained the pump stations they had constructed as well as secondary and tertiary canals. The management was undertaken by groups of farmer irrigators selected by the cooperatives. Water delivery and maintenance of the waterways were the prerogative of the farming units or cooperatives. Labor for canal digging or system construction was raised by the cooperatives. Decision makers were the cooperative leaders. Farmers played only an indirect role. Since farmers were not permitted to take part in discussion, they did not recognize the irrigation systems as their own, thus responsibility for the systems rested entirely with the cooperatives and governments.

   Farmers have repeatedly shown that they will not perform operation and maintenance tasks to the satisfaction of irrigation agencies if they are not given any real authority or real ownership. (John S. Ambler)

Figure 1. Development of Irrigation Works.

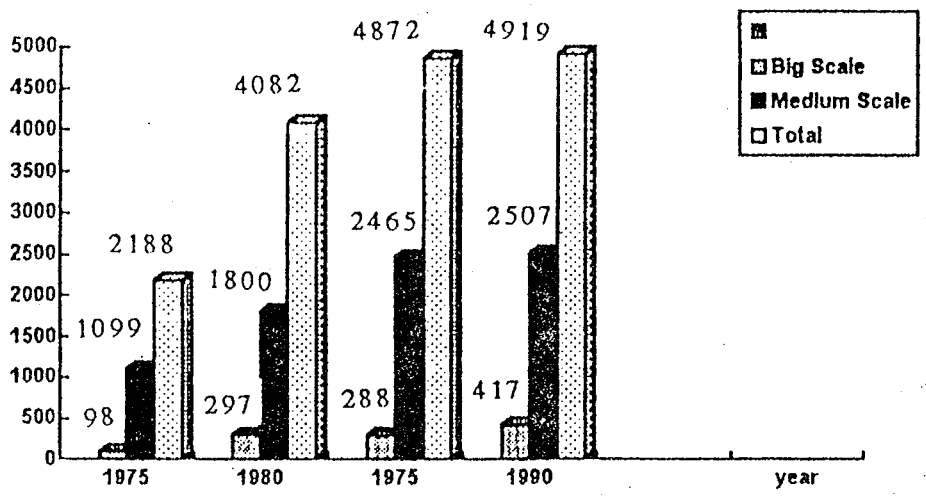


Table 1. Irrigated Rice Area by Crop Season (in 1,000 ha).

Year	Total Area	Area by Season		
		Spring Crop	Autumn Crop	Winter Crop
1955	1,043	488	318	555
1976	3,251	1,203	317	735
1980	3,736	1,582	437	717
1985	4,472	1,689	791	992
1990	5,045	2,011	1,127	907
1992*	5,313	2,154	1,233	1,926

Sources: Statistical data of water resources sector of Vietnam (1986-1990).

Note: Data for 1955 are for Northern Provinces only (from Quang Binh to Cao Bang Province)
*Data from hydraulic journal-29.

During this period, a number of small structures were built with cooperatives funds and owned by the cooperatives. Thai Binh, for example, a typical agricultural province, had 700 electric pumping stations. Of these, only 194 were built with government funds, the rest were built by cooperatives. In Bghe An, close to 400 reservoirs and 360 small pumping stations were built by the cooperatives.

3. Period from 1988 to 1992: This period was characterized by fluctuations in policies. "Decision 10" and "Decision 100" caused radical changes in agricultural production. The farmers became responsible for their

- own farms. The role of the cooperatives was not as before. Irrigation structures that had been built by the cooperatives were now handed over to the commune authorities. The involvement of the farmers in operation, management and water distribution was thus more direct and had greater depth.

Irrigation agencies were still empowered to operate from the headwork to the primary or secondary canals of large- and medium-scale systems.

At that time, most of the systems had already been operating for 20 to 25 years, and some for more than 30 years. Most of the systems had lost their efficiency and needed major repairs. There were difficulties in raising funds. In order to escape this burden and to delegate responsibility, some small- and medium-scale systems were handed over to the localities to manage. This period was marked by the direct return of water distribution and canal management to the farmers.

The above three phases are outlined in Figure 2 below:

Figure 2. Chart showing interrelations between the government and the people in irrigation management, 1945-1992.

Duration	Relationship	Technical Status
1945-1960	Irrigation agencies and farmers	Very poor condition
1960-1981	Irrigation agencies and cooperatives	Greater capacity Better engineering Small-scale systems built
1988-Present	Irrigation agencies and farmers ---------- Irrigation agencies to local management	Greater capacity Better engineering Small systems

The following can be seen from the chart:

* *The period 1945-60 and 1988-to date* are relatively similar in that there is cooperation between the irrigation agencies and the farmers. The dotted lines show the tendency to transfer systems from the irrigation agencies to the local management.

* *The period 1960-88:* The irrigation agencies and the cooperatives played the major role in system management. At the same time, the cooperatives built small-scale systems from their own budget and for local use.

MANAGEMENT TURNOVER AND IRRIGATION MANAGEMENT TRANSFER

There had been no specific study or statistical data gathered with regard to irrigation management transfer in Vietnam. A preliminary survey shows the following:

* 81 medium-scale systems in Lao Cai Province of Northern Vietnam designed for irrigating 5,941 hectares of land have been handed over to local management. In addition, farmers have built and operate 537 other systems with an irrigation capacity of up to 30 ha each.

* In Tinh Gia District of Thanh Hoa Province in Central Vietnam, 45 other small reservoirs and 6 pumping stations are operated by the communes, in addition to larger systems managed by irrigation agencies.

* In Vinh Loc District of Thanh Hoa Province, the irrigation agencies operate only 4 pumping stations out of the 5 reservoirs and 19 pumping stations; the rest are run by communes.

Yoder observes the following when studying irrigation management in Nepal.

> *In order to improve irrigation performance and to transfer the operation and maintenance cost to the irrigators, programs have been initiated in a number of countries to turn over the management of an entire system to the irrigators for them to operate and maintain. The objective is to transform the system from being agency managed to being locally managed.* (Robert Yoder)

Thus, some irrigation management transfer from irrigation agencies to local management has taken place in Vietnam. Research should be conducted on management transfer as soon as possible in order to work out appropriate models and draw lessons from experience for further application.

When considering the transferred systems, the following can be said:

* The systems are small scale with up to 300 hectare irrigation capacity. These include pumping stations, reservoirs and diversion dams. The systems usually cover territory belonging to one village or one commune.

* Reservoirs in systems built during the seventies have silted up due to deforestation. The structures have been damaged and canals are filled with sediment because there has been long periods of operation without proper maintenance. The effectiveness of the pumping equipment is low.

* As a result of the market-oriented economy, the irrigation agencies have become self-accounting, meaning that the agencies must cover all their costs without government subsidy. Irrigation fees have not been enough to cover operation and maintenance expenses. As a result, the systems have deteriorated rapidly. The resulting financial deficit has led to the transfer of some systems to a locality in order to release the financial burden on the agencies. The financial burdens of self-accounting have speeded up the process of transfer to a large extent.

* The process of transfer has not been well planned on both sides. In many cases, the process has been as simple as issuing a decision and some instructions. That is why the farmer see the transfer as governmental. There has now been the building of an institutional framework (for example, the relationship between water users and an operation board) necessary for the systems to be accepted at the local level.

* Farmers have not been provided with minimum knowledge about water management and distribution. Usually the people who are to manage and operate the systems have not been well trained. If they have, their training has been only in machine operating skills and not in managerial techniques.

* The concept of water user association and its activities is insufficiently perceived. Some of the expatriate NGOs such as CIDSE, OXFAM-UK and QUAKER SERVICE have projects with farmer involvement in irrigation management or organizations of water users.

According to an evaluation by an outside consultant:

> *Although the term Water User Association was generally known (apparently after being regularly used in discussions with OXFAM staff) at all levels there was little understanding of its conceptual meaning. Informants in hamlets, communes and the district had different opinions about what was meant by it.* (Nooyans, Thuan et al.)

Although studies are insufficient, the following lessons can be drawn from the above analysis as well as from the evaluation reports of NGO projects.

1. It is essential to consider carefully the socioeconomic conditions of the locality, including conventional and modern farming practices as well as the soil and water potential for food production.

2. It is important to help farmers appreciate the necessity of transferring the systems from irrigation agencies to local management as well as to provide people with managerial knowledge. Guiding farmers in organizing

water user associations and in electing a management board is but one step in transferring authority and responsibility to the local authorities.

3. The transfer process should start from the smaller to the larger systems, within one commune or one village. Prior to transfer, the status of the system should be studied (in terms of quantity, technical situation, quality and intermediate repairs necessary to keep the system operational and to take care of difficulties during the first years after receiving the system, because early system breakdown will discourage farmers the most).

4. Transferring staff must have not only a knowledge of engineering but also of management and organization, and of activities of water user associations. This knowledge must be extended to include socioeconomic awareness and know-how in dealing with farmers.

5. Training in irrigation management is essential both for irrigators and farmers. Methods and points to be made during training are different for each of the groups.

Things to be Done in Vietnam

There is much to be done. This conference is an early step that has special significance for Vietnamese participants. Before talking about what needs to be done in Vietnam, I think it's necessary to point out the following:

1. Irrigation management is the responsibility of both the irrigation agencies and the farmers. In the past, the irrigation agencies worked well. That is shown by 5,319,000 hectares of land irrigated annually. But that does not mean that irrigation efficiency is high. There have been financial difficulties in operation and maintenance and the systems have deteriorated. These difficulties can be assuaged if farmers are encouraged to take part in the management processes as the management is being transferred to them.

2. In other countries such as India, Sri Lanka, the Philippines, Nepal, Thailand, etc, there are many studies, activities and successful models of farmer management. However, these are not well known in Vietnam. There may be a great time lag in awareness and practice (among both the agencies and the farmers) if Vietnam is compared with neighboring nations.

3. The new laws on land holding and agriculture give farmer the rights of ownership that encouraged them to invest their effort and to take part in the management of irrigation systems. Thus there were favorable conditions at the start.

There are already systems that have been built and managed by cooperatives. These can be examples for the transfer program.

Both the Government and the Ministry of Water Resources have acknowledged the importance of system management. Mr. Nguyen Canh Dinh, Minister of the Water Resources Ministry had the following to say:

> *It is work to retrain cadres for the new managerial requirements to improve the management system and to promote the spirit of responsibility, while encouraging the motivation of the irrigation management teams. The three tasks to be executed: administration of the water management works, economic management and communication with farmers.*

When assisting in irrigation projects, NGOs often pay attention to the participation of farmers in system construction and try to help localities in setting up an institutional framework with management training. From there projects, we may be able to draw models for system management and management transfer. This can be verified in evaluation reports of QUAKER SERVICE irrigation projects:

> *Operation and maintenance were well organized in both villages, with active management committees whose members were well known and accessible to all villagers..*
>
> *Management is at present ensured by management committees which are also in charge of the operation and maintenance of the system. The Chief of the village has been appointed by the commune as leader of the committee, and the other members have been chosen by the villagers.*

During the evaluation visit, it appeared that the committed in Ngoc Village was more active and effective than the one in Cung Village, the system in Ngoc Village in general being in better shape and the population continuing to work on improvement and extensions. (Nooyans, Thuan et al.)

Things to be Done

Both irrigation agencies and farmers need to learn how to do irrigation management transfer.

* Researches need to inventory and study the general irrigation management status in Vietnam to identify problems surrounding irrigation management.

* Other detailed research is needed. IIMI may be able to help us with specifics such as ... methodology, direct experience and even offer suggestions for financial assistance.

* We should study successful local management systems especially from NGO projects and gather lessons from their experience.

* A research division for irrigation management will be established this year. It's function will include researching irrigation management, and training and cooperation with international organizations.

* Helping local people to manage irrigation systems by themselves, step by step.

CONCLUSION

Management transfer has started in Vietnam. But successful management transfer needs assistance from neighboring countries, especially that of the IIMI experts. [We are looking forward to exchanging ideas with all of you. In this report we have talked mainly about the situation in Vietnam and not so much about the experiences we have had. We hope to have the cooperation of all the participants of this Conference and of the International Irrigation Management Institute. Thank you very much.]

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Srey Ampil Irrigation Scheme Rehabilitation Experience Kingdom of Cambodia

Giorgio Vecco

INTRODUCTION

THE REHABILITATION OF the Srey Ampil Irrigation Scheme has been carried out by the Cambodian Ministry of Agriculture with the technical and economical support of the Italian Non-Government Organization (NGO), Mani Tese.

The rehabilitation has taken place over a nine-year period, which can be divided into two distinct periods The first period, 1985 - 1986, was characterized by the donation and installation of equipments During the second period 1992 to 1994 the main concern has been the establishment of a Public Irrigation Scheme.

The administration staff of this Irrigation Scheme are engaged in technical activities related to water distribution, system maintenance and administration, planning and monitoring, assistance and extension to farmers in managing water resources at the local level.

The staff are supplied with equipment and monetary assistance. They are responsible for all the work of rehabilitation and for maintaining close contact with the farmers.

Initially, the rehabilitation work was done on essential hydraulic structures But with the continuation of the rehabilitation the farmers started to see other priorities and important areas needing work.

Besides the necessity for making the management of the irrigation scheme self-sufficient, the rehabilitation requires a growing presence of the farmers and their participation in the decision making.

LOCALIZATION

The Srey Ampil Irrigation Scheme is located 25 kilometers (km) south of Phnom Penh on Road Number 1 (Phnom Penh -Saigon) in an area of about 3,400 hectares (ha), between the Mekong and the Bassac rivers, district of Kien Svay, Kandal Province.

DESCRIPTION

Srey Ampil Irrigation Scheme was one of the many projects built during the Pol Pot regime with a loss of a great many lives.

The Irrigation Scheme is composed of two reservoirs, Boeng Thom and Boeng Tauch, which are filled by the flooding of the Bassac River, through the Bassac intake (four gates, five m high, 2.6 m wide) an 8.3 km dam and several lesser outtakes The water is then distributed for irrigation to a network of primary canals of approximately 50 km.

When the level of the water at the reservoir is 6 to 7.5 m from sea level, the irrigated area can be fed by gravity.

With satisfactory operation of the hydraulic structures, this level of the water at the reservoir is reached between the months of September and April, in normal years.

The irrigation period goes from October until March.

During the first rehabilitation period four motor pumps were installed in order to take the water from the reservoir to the irrigated area and allow the farmers to cultivate a second crop of rice.

At that time there were not sufficient conditions to communicate directly with the farmers They were considered as employees by the government, as they did not own the land The government was charged with providing equipment for the production of rice, including fuel.

When the second rehabilitation period took place the political situation of the country had changed From the rehabilitation point of view the following changes are important:

1. The change in government policies regarding agriculture, land tenure, and farm - products marketing The return of private and family-based farm and landholding system.

2. The end of Cambodia's international isolation and the normalization of relations with foreign countries. Consequently, the international presence in the development process grew through bilateral, multilateral and nongovernmental cooperative projects.

3. The flood of 1991, which caused extensive damage to the supporting infrastructures, irrigation systems and trails An enormous amount of maintenance and repair work was required to bring the system back to functioning.

4. The new political process first under the United Nations Transitional Authority in Cambodia (UNTAC) supervision and then with the election of a constituent assembly (now a parliamentary body), a new constitution for the kingdom and a new institutional framework.

The flood in September 1991 completely destroyed one of the four gates at the intake from the Bassac River, damaged an 8.3 km dam, (that separated the reservoir from the irrigated land), the gates along the dam and the irrigated area It destroyed roads around the scheme and removed the earth from around the concrete hydraulic structures The power of the water destroyed the embankments of the canals and small dams. The earth structures had not received ordinary maintenance prior to the flood The canals at the irrigated area had considerable sedimentation with dense vegetation growing on its flow-bed The canals inside the reservoir that linked the reservoir with the intakes of the irrigated area had enough sedimentation to prevent all water from being used for irrigation purposes.

The maps available reported only parts of the main roads or canals and were without reproductions of the administrative divisions, farm plots, and other structures in the irrigation scheme There was not a single register of data describing the operation, maintenance, climatic records and level of the water at the reservoir.

The four motor pumps installed in 1985 were still working, even though they were not used for a second rice crop. They were just used to prevent any water shortage in an unique crop.

Once the most essential repairs and maintenance requirements for the flood-damaged system were identified and completed attention focused on gaining a better understanding of the project area and the target beneficiaries.

The farmers participated actively at this rehabilitation work not only in the area of the Irrigation Scheme but also along the 8.3 km dam and at the intake of the Bassac River For their work the farmers were paid in rice

A household survey was conducted to identify the owners of individual plots of land The results of the survey (quantified information) regarding the ownership, their households, farm activities and exact location were transferred on to the maps and computers. A set of large-scale maps for the entire project area were prepared The maps included minute details regarding the administrative territories; location, quantity and boundaries of the farmland plots; and the location of roads, dikes, canals and flood control structures.

On the whole, the major achievements of the Srey Ampil Rehabilitation Project have been:

* An overall restructuring of the irrigation and flood control system in parts of the nine communes of the Kien Svay district.

* The establishment of a solid village-based development center with essential structures and equipment.

* The training of a capable and efficient administrative and technical staff, composed entirely of Cambodian nationals.

* The establishment of strong links with the local and national authorities The rehabilitation has also generated positive reactions from the farmers.

FARMERS' PARTICIPATION

The rehabilitation at the Srey Ampil Irrigation Scheme has tried to ensure the local people's participation in all decisions and work processes.

Farmers are already grouped in an administrative division. The 6,500 families with plots in the project are a grouped in 27 villages. A group of 2 to 4 villages forms a *khum*. The district of the projects known as Kien Svay has 9 khums This is the only division recognized by law.

The representatives of the khums participate in the operation of the intake at the Bassac River and make proposals to the district authorities regarding major rehabilitation work to be carried out.

With the creation of the Srey Ampil Irrigation Centre, a team of persons was able to focus exclusively on water management. Most of the water management duties of the district were entrusted to the Centre and district staff persons started to work daily at the Centre.

The farmers' participation in rehabilitation work was always a priority The administrative divisions of the farmers were respected, but for each part of the rehabilitation work the farmers needed to elect a group of people to serve as a link

between them and the Centre in the decision-making process These groups would then be responsible for coordinating the farmers in the work to be done and for transferring the technical information from the Centre's personnel. After the infrastructure rehabilitation, the group will be responsible for the maintenance, protection and operation of the rehabilitated structure.

Almost all of the rehabilitation projects were a response to a specific request from the farmers, or were simply measures necessary for the operation of the Irrigation Scheme.

The establishment of a Public Irrigation Scheme at Srey Ampil also had some positive benefits.

1. It became possible to ensure water by gravity to all the farmers at the irrigation scheme by the rehabilitation of structures and better water management.

2. It became possible with the personnel at the Srey Ampil Centre to collect a considerable amount of technical data This information is now being used for the operation and maintenance of the scheme.

3. The personnel of the Srey Ampil Centre are responsible for the use and maintenance of the mechanical equipment.

4. It became possible to coordinate the work of a complex operation and maintenance of large canals and dams.

5. The personnel at the Srey Ampil Scheme are supported by the Ministry of Agriculture, and some also have plots in the irrigation area.

At present the management of the Srey Ampil Irrigation Scheme can be considered of mixed control As for the administrative division of villages and communes in the irrigated area of Srey Ampil, we can consider these already existing groups of farmers as farmers associations These associations have the advantage of being already recognized by the local institutions and by the farmers They preserve the traditional social habits of the rural communities.

The purpose for the establishment of these associations is to motivate farmers in full participation in the planning and execution of the improvements and to take subsequent responsibility for the operation and maintenance of the tertiary canals.

A farmer can devote his or her surplus labor time to the management of the tertiary canals provided that he or she is instructed how to do the work by the technician The farmer is also more likely to be motivated if he or she sees the work as part of a common endeavor with all the farming community participating in similar activities.

Other associations were created in addition to the one described above Important are the association for the use of motor pumps,for farmland in the area of the reservoir, and the association for the use of the storehouse.

The rest of the irrigation network, as mentioned before, at the Srey Ampil Irrigation Scheme is managed by government officials, making the management of mixed control.

FUNDING

At present the rehabilitation work is done with international funds with the local government contributing to the supply of local technicians and to a portion of the technicians' salaries.

The farmers are contributing their labor and for this effort they can receive "food for work." They are also paying for the use of the motor pumps, tractors, threshing machine, seeds, fertilizers and insecticide.

[In Srey Ampil 50 percent of the plots are in between 0,1 ha with no plots bigger than 1,5 ha.]

Almost all the rice produced is for consumption by the farmers and their families Some farmers have other forms of income Along the Mekong River the farmers created a large amusement picnic structures where tourists from Phnom Penh can come to eat There are also several silk weaving shops.

Along the Bassac River there is extensive cultivation of flowers, tobacco, vegetables and fruit Almost all the farmers own cattle The farmers are very concerned that their efforts in cultivating rice during a four-month period will succeed, because it allows them the rest of the year for doing more lucrative activities For that reason, once they feel confident that there is a reliable water source, their investment in fertilizer and men-labor increases, with subsequent increases in the productivity.

The monthly money provided for the Irrigation Scheme is about US$3,000 This amount covers the expenses of management, operation and maintenance and some constructions It does not cover the amortisation of the equipment (3 tractors 1 excavator) Considering that the surface cultivated is about 3,000 ha, the cost of water is about US$1/ha month of cultivated rice In a production of 60 sacks(of 50 kg) per ha the cost of the water is just one sack of rice /ha/year.

Water fees to farmers will be the last step towards making the management of the Srey Ampil Irrigation Scheme technically and economically self-sufficient The water fee will be charged by the administration division and each village will have to pay their own quota to ensure the water for the entire dry season.

Since all the operation and maintenance are to be financed primarily by the beneficiaries, the farmers' association will be able to exert a strong influence on the institutional management.

CONCLUSION

Only as the rehabilitation proceeded at the Srey Ampil Irrigation Scheme did the transfer of management to the farmers become necessary. This was motivated not only by internal factors like the collection of data or the control of equipment, but by institutional factors such as the lack of a legal framework recognizing associations other than the administration division.

Throughout the rehabilitation process the farmers participation has been a crucial element. The management could only begin to be transferred to the farmers when it became clear what the results from the water control would be.

The success of the rehabilitation and the management is demonstrated by the water supplied by gravity, to the farmers, during the rice season. Only now the water-use fee can be charged. This will not only make the system self-sufficient but will also help in transferring the management to the farmers.

Institutional Reform in Two Irrigation Districts in North China: A Case Study from Hebei Province[1]

Douglas Vermillion,[2] Wang Xinyuan,
Zhang Xiying and Mao Xuesen[3]

INTRODUCTION

CHINA HAS INCREASED its total irrigated area from 16 million hectare (ha) at the founding of the People's Republic of China to 48 million ha in 1992. Twenty-one million ha of this growth has been due to the construction of 5,363 large- and medium-scale irrigation districts (which have areas over 667 ha), during these 32 years. The rest of the growth has occurred mainly through the development of small-scale irrigation and extension of previously existing irrigation systems. One half of the cultivated land in China is irrigated. The irrigated area produces 65 percent of China's food grains, 75 percent of its cash crops and 90 percent of its vegetables (Chen and Ji 1994). Rainfall in China varies from 200 millimeters (mm) in the arid northwest to 1,600 mm in the humid southeast. Despite great diversity of physical environment, overall, China has a considerable shortage of water relative to its high demand. Water demand is increasing rapidly due to vast population pressure and rising needs for water for household and industrial uses and agriculture. The average annual supply of water per person in China is 2,700 cubic meters (m^3). This is only 25 percent of the international average water supply per person (Ibid).

Similar to other developing countries, China invested heavily in constructing new irrigation projects from the 1950s through the 1970s. Unlike most other countries, a large part of this construction was done by mass labor of farmers, usually unpaid. Much of it was done, especially during the Great Leap Forward, without the benefit of modern engineering expertise. Similar to other developing countries, the 1980s brought a decline of central government revenues available for the irrigation sector, and the emphasis on construction of new irrigation systems shifted to a focus on improving the management and local sustainability of irrigation systems.

Similar to situations in other developing countries, at a time when irrigation management is being transferred to local levels, competition for water between farmers and between sectors (i.e., agricultural, industrial and domestic) is rising dramatically. This creates a dual challenge for China: "how to make irrigation rise to the level of efficiency and responsiveness required by the increasing demand and competition?" and "how to make irrigation management sustainable through local resources and organizational capacities, with minimal dependence on the government?"

During the period of rapid irrigation expansion, from the 1950s to the 1970s, agricultural production and irrigation management were collectivized. The post-Mao reforms introduced by Deng Xiao Ping from the early 1980s introduced a chain of policies which reduced the dependence of irrigation districts on the government and encouraged local financial and managerial self-reliance. The rising pressures for local financial viability, higher efficiency and transferable water rights has resulted in considerable buying and selling of water by irrigation districts, extensive use of professional irrigation management contracting firms, and emerging experiments with irrigation asset valuation and stock share holding arrangements (Jiang and Yang 1994; Mei 1994).

Since the mid-1980s, there has been a world wide trend to transfer authority for irrigation management and financing from government agencies to local organizations, especially water users associations. Irrigation management transfer takes many forms in different countries but the overall commonality is a reduction of the role of the government and a corresponding expansion in the role of farmers and non-governmental organizations in irrigation management (Vermillion 1992). This paper examines how national policy reforms of the 1980s have been translated into local institutional arrangements and managerial practices in two medium-scale irrigation districts on the North China Plain. Data are used from a case study on Nanyao and Bayi irrigation districts which are located in Hebei Province.

Nanyao and Bayi irrigation districts (ID) are located in Pingshan and Yuanshi counties, respectively, in the Shijiazhuang Prefecture in Southwestern Hebei Province, about 280 kilometers (km) south of Beijing (Figure 1). Annual average rainfall in the area is 500 to 600 mm. The two districts are located in areas with slightly hilly or flat topography. There are seven irrigation districts in the two counties with areas exceeding 667 ha and a total of 76 small reservoirs

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[1]Paper presented at the International Conference on Irrigation Management Transfer, Wuhan, People's Republic of China, September 20-24 1994. This was based on a collaborative study conducted during 1993 and 1994 between the International Irrigation Management Institute and the Shijiazhuang Institute of Agricultural Modernization, Chinese Academy of Sciences.

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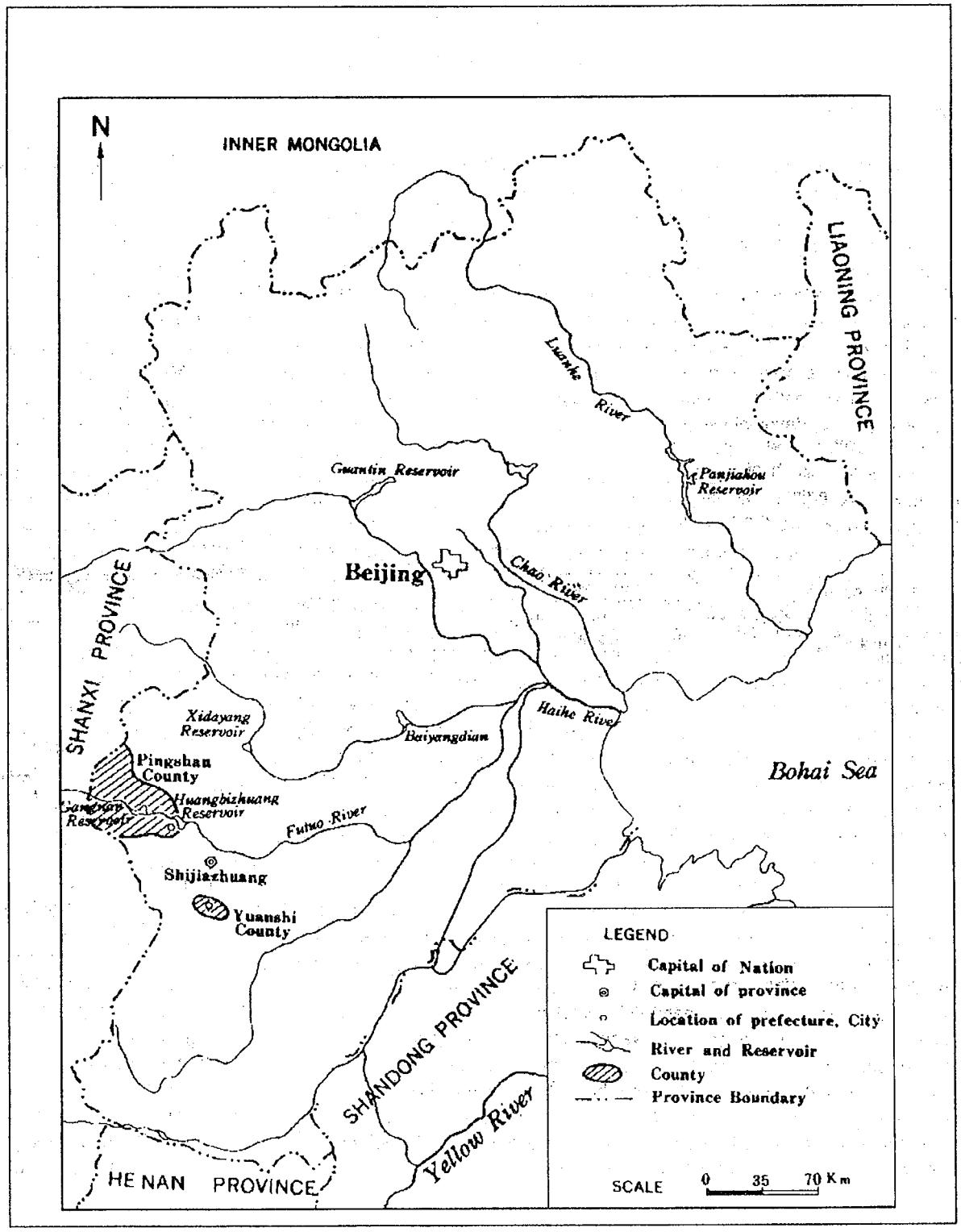
[3]Shijiazhuang Institute of Agricultural Modernization, Chinese Academy of Sciences, People's Republic of China.

Figure 1. Hebei Province, showing the location of Pingshan and Yuanshi counties.



(Table 1). Pingshan County has 1,886 irrigation wells; Yuanshi has 3,358 wells. Both Nanyao and Bayi ID have numerous tubewells located within their irrigation design areas.

Table 1. Irrigation data for Pingshan and Yuanshi counties, Hebei Province.

Item	County	
	Pingshan	Yuanshi
Total cultivated land (10^4ha)	3.05	3.59
Effective irrigation area (10^4ha)	15,608	26,200
Percentage of cultivated land irrigated (%)	50.96	70.96
Number of irrigation districts more than 666.7 ha in area	6	1
Total area of irrigation districts whose irrigation area is more than 666.7 ha (10^4ha)	14,700	5,400
Total irrigation wells	1,886	3,358
Number of reservoirs	42	34
Capacity (10^4m^3)	162,697	9,700
Water supply quantity to agriculture (10^4m^3)	27,097	14,365

Source: Year book of Hebei Water Conservancy Department in 1992.

Nanyao ID was constructed in 1958, diverting water from the Yie He River. Annual total discharge varies from 10.4 to 59 million m^3. Its irrigation design area is 3,333 ha. It includes six townships and 42 villages located in two counties. Bayi ID was constructed in 1961 and receives water from Bayi and Gangnan reservoirs. Annual total discharge varies from 10.4 to 34 million m^3. Its design area is 5,633 ha. It includes eight townships and 45 villages, all in the Yuanshi County.

ORGANIZATION OF IRRIGATION UNDER THE COLLECTIVES

Before the Peoples' Communes were dismantled in 1983 (Shue 1984), they were at the top of a three-level arrangement for organizing agricultural production and distribution and irrigation development and management. Communes were generally the size of townships and consisted of 10 to 15 production brigades. A brigade generally consisted of several production teams which were the basic units for organizing agricultural production. Teams consisted of 10 to 20 households. Payments to farmers in cash and goods were made on the basis of the amount of work points farmers earned through their farm labor and attendance at communal work activities, including irrigation construction and maintenance.

Irrigation development and management was directed by county level water resources (or "conservancy") bureaus, under the Ministry of Water Resources. At the irrigation system level, bureau staff coordinated irrigation management with the aid of labor assignments made by the commune. During the 1950s, 60s, and 70s, about two-thirds of government funds allocated to the water sector were for construction and one-third were for operations (Gitomer,

forthcoming). Subsidies from both central and provincial funds and from the communes supported the management of irrigation systems. General labor on irrigation systems was paid by communes in work points. Irrigation managers were salaried officials of the county water resources bureau. The costs of irrigation O&M not paid by commune revenues was generally funded by the Ministry of Water Resources.

POLICY AND INSTITUTIONAL REFORM

Change at the National Level

As a result of considerable inefficiencies and declining central government revenues available for investment in rural development, the production responsibility system (PRS) replaced the Peoples' Communes in the early 1980s. Under the PRS, households were allocated long-term leases on farm land and were free to organize their own production and marketing and retain profits. With the advent of the PRS government subsidies for irrigation construction declined by over 60 percent from 3.49 billion yuan (Yu) in 1979 to 1.3 billion yuan in 1981 (Gitomer, forthcoming). Between 1979 and 1985, government irrigation construction investment declined as a percent of gross domestic product from 0.87 percent to 0.21 percent. This precipitous decline in government subsidies to the local level, combined with a disruption of the communal organization of irrigation maintenance, leading to a 2 percent net decline in the total irrigated area in China between 1979 and 1985 from 45 to 44.04 million ha, respectively. During the early 1980s there were widespread reports of chaos, water conflicts and rapid deterioration of irrigation infrastructure.

Alarmed at these trends, in the early 1980s the government began introducing a series of reforms, starting with relatively modest measures and moving to progressively more fundamental changes. The first reform was the work post responsibility system introduced in the early 1980s. This was an attempt to introduce a system of incentives to water resources bureau officials to improve their work productivity. Monetary bonuses and penalties were introduced in annual work performance evaluations amounting to 20 percent or more of base salaries. Nickum (1985) notes, however, that this modest reform tended to amount to only, "a threat to withhold a small amount of nominally discretionary wages for poor attendance." The county water resources bureaus remained intact with the demise of the communes. After decollectivization the Ministry of Water Resources added a lower tier below the county level, the water resources stations which were created to replace production brigade functions at the township level. Village irrigation management groups (VIMG) were created at the village level following the demise of the multi-functional production teams. These were to be under the jurisdiction of village governments but were managed and financed independently from the village government.

Two more far-reaching reforms were introduced through national regulations, both of which were decreed in 1985. These were: 1) the national Regulation on water fees and 2) the State Council Regulation on Diversified Sideline Enterprises. The regulation on water fees stated the principle that revenues for operation and maintenance (O&M) of irrigation districts should come mainly from fees collected from water users. The precise level of fees should be determined at the system level according to the local cost of O&M. However, central and provincial governments continue to place ceilings on the maximum level of fees which can be charged to farmers. Even assuming 100 percent collection rates, fees generally did not provide for the full cost of O&M, let alone for rehabilitation and capital replacement costs. The water fee regulation supported development of a widespread tri-partite system of resource mobilization. This included a fixed area fee (based on the area irrigated by a farmer), a volumetric fee (based on an estimate of the amount of water diverted into a farmer's field), and an annual labor contribution for system maintenance. The latter is not a minor input. Chen and Ji (1994) estimate that contributed farmer labor constitutes more than one-third of the total value of resources invested in existing irrigation districts. While the introduction of volumetric fee assessment is spreading, it is not universal since measurement is frequently difficult and costly. Irrigation fees cannot legally be used for purposes other than operation and maintenance for the system from which they are collected.

Irrigation districts often had underutilized assets and resources which had potential economic value. There was generally a gap between the level of resources which could be raised by the irrigation fees (because of political reluctance to require farmers to pay for the full cost of irrigation service), and the actual costs of operation and maintenance. By 1988 it was official policy that no central or provincial government funds could be used for regular O&M in irrigation districts. By the 1980s salaries of irrigation district officials were dropping in real terms below alternative employment opportunities in rural China. Many skilled staff were leaving the service due to low salaries and poor working and housing facilities in irrigation districts. In order to bridge the gap between the limited revenue which could be raised from fees and the amount needed for O&M and to boost salaries and facilities for irrigation workers, the government introduced the concept of diversified sideline enterprises into the irrigation sector. Irrigation districts were encouraged to develop sideline enterprises to raise additional revenue from the profits of businesses to cross-subsidize the costs of irrigation management. Such enterprises developed gradually during the late 1980s and early 1990s, first beginning with underutilized existing assets such as reservoirs (for sale of water outside the district,

fisheries, recreation, tourism) and reservoir bunds and reserved lands (for tea, orange and tree plantations). Later, sideline enterprises spread to all sorts of businesses, from bottling and food processing to restaurants, construction contracting, bicycle repair shops, petrol stations, production of shirt collars, and so on. Although income from sideline enterprises is growing it still generally provides a small percentage of the total resources invested in irrigation.

The Water Law enacted in 1988 introduced a water extraction permit system, new authority to apply sanctions against water use violations at local levels, and procedures for mediating water disputes. The Law establishes measurable water rights and facilitates the allocation of water between sectors through buying and selling. However, implementation of the new Law has proceeded slowly. By 1993 only 11 provinces or autonomous regions had passed implementing regulations for the Law.

These broad national policy reforms were partly the result of a combination of financial and managerial pressure at the national level and "a process of experimentation and trial and error" at the local level (Gitomer 1994, 1). They have resulted in a variety of organizational arrangements throughout China at the level of irrigation districts. What the reforms have in common is an evolution towards local financial and managerial autonomy (both vertical and horizontal). The tri-partite irrigation fee (area and volumetric fee plus an annual labor duty), diversified local financing and village irrigation management groups have resulted in irrigation districts which are increasingly multi-functional and multi-organizational entities with extensive inter-organizational linkages for cross-subsidies and joint accountability. Irrigation districts are also increasingly managed by small, locally contracted "irrigation management firms" which receive multi-year contracts from villages or irrigation districts, depending on the level of management involved (Svendsen and Vermillion 1992).

Organizational Changes in Nanyao and Bayi Districts

Under the commune system, operation and maintenance of the districts was handled first by water conservancy groups, created in 1964. These were soon absorbed financially and managerially by the collectives and later, villages. Irrigation staff interviewed in this study reported that under the commune system, responsibility was often confused and coordination was difficult because irrigation matters were handled by busy multi-functional production brigades and later, by village committees. Irrigation district staff had little authority relative to the communes. When the production responsibility system replaced the collectives, water resource stations and village committees replaced brigades and production teams, respectively. Water conflicts and system deterioration increased dramatically in Nanyao and Bayi ID during the transition period after the collapse of communes but before the new reforms of village irrigation management groups (VIMG), the new system of irrigation fees and sideline enterprises began to be adopted locally. These were phased in during the mid-1980s in Bayi ID, and the late 1980s and early 1990s in Nanyao ID.

At present, Nanyao ID in Pingshan County, the top two levels of canals are managed by the irrigation district and the third and lower-level canals are now managed by VIMGs. Nanyao ID has five levels of canals (as do most districts in both counties). The district office has two tiers, the main office and four sections which are subdivisions of the system (Figure 2). Nanyao ID has 30 staff plus 5 temporary workers. All receive their total salaries from the water charge. There are four geographic sections and three managerial sections supervised by the district office, canal measurement, engineering and irrigation, and financial and administrative. Nanyao has 40 village irrigation management groups (VIMG). Nanyao ID has not yet developed any sideline enterprises under a "Diversified Management Division."

Bayi ID Office has three tiers, the main office, which oversees the entire system and operates the reservoir, five technical and administrative units, and below them, four sections, which manage the main and branch canals and liaise with VIMGs (Figure 3). Bayi ID (including the reservoir) has a total of 67 staff, 20 of which have temporary status. Thirty-two staff are performing water management functions (12 are engineers) and 35 are in the "Diversified Management Division," producing revenues from sideline enterprises. All 32 staff in the Irrigation Management Division (IMD) are ID employees and receive all of their salaries and pensions from Bay ID, not the county water conservancy bureau. None of the staff are civil servants under the water conservancy bureau. Hence the irrigation district is an independent public utility, not part of the government bureaucracy. Bayi ID has four levels (including VIMG) in contrast to Nanyao's three levels. It has five technical and administrative offices which in turn supervise the Irrigation Management and Diversified Management Divisions. It incorporates 45 VIMGs.

In both districts, functions of the section level staff are to: 1) adjust gates along the main canal (gates along branches are operated by VIMGs);

Figure 2. Organizational Chart for Nanyao Irrigation District, Pingshan County, Hebei Province.

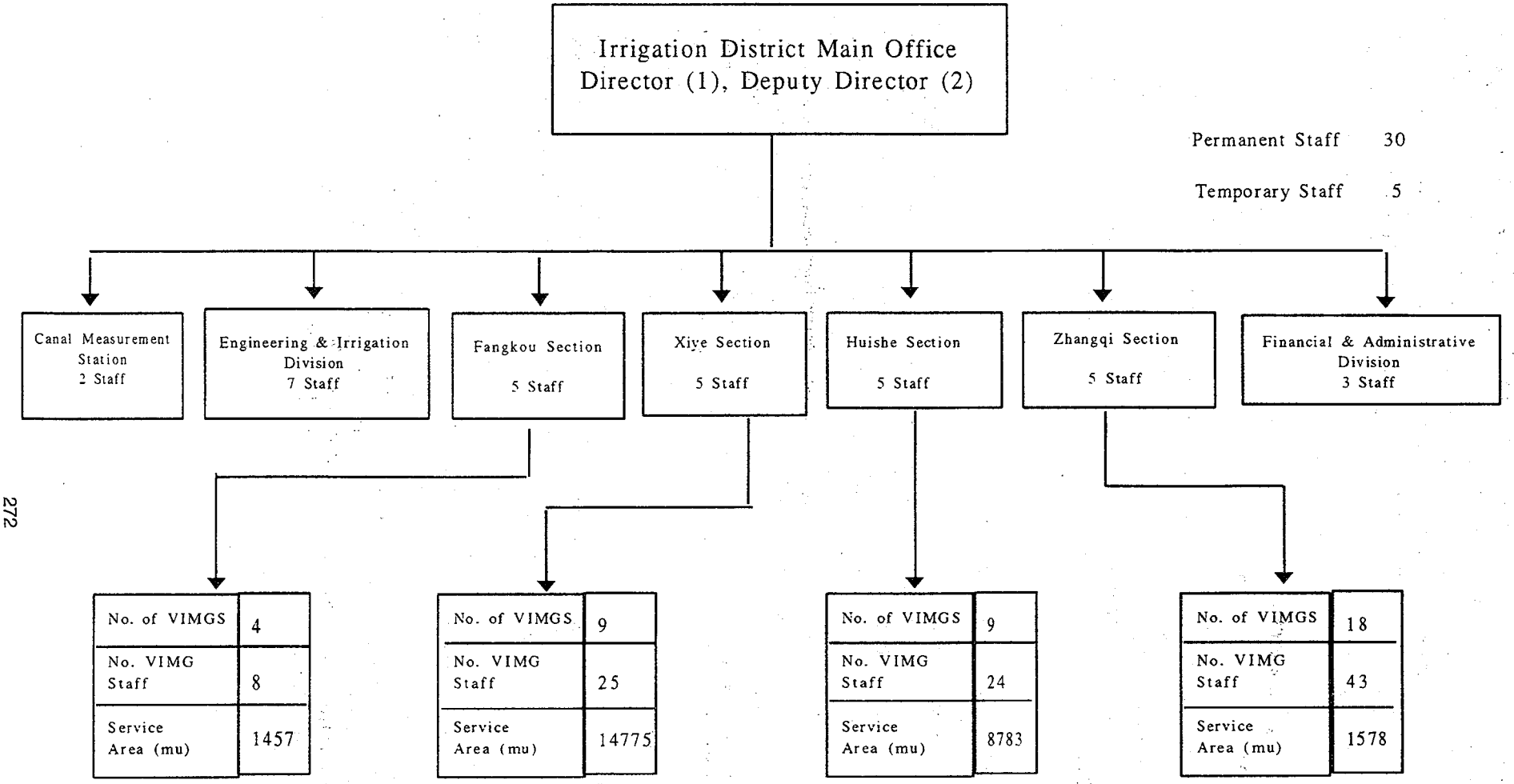
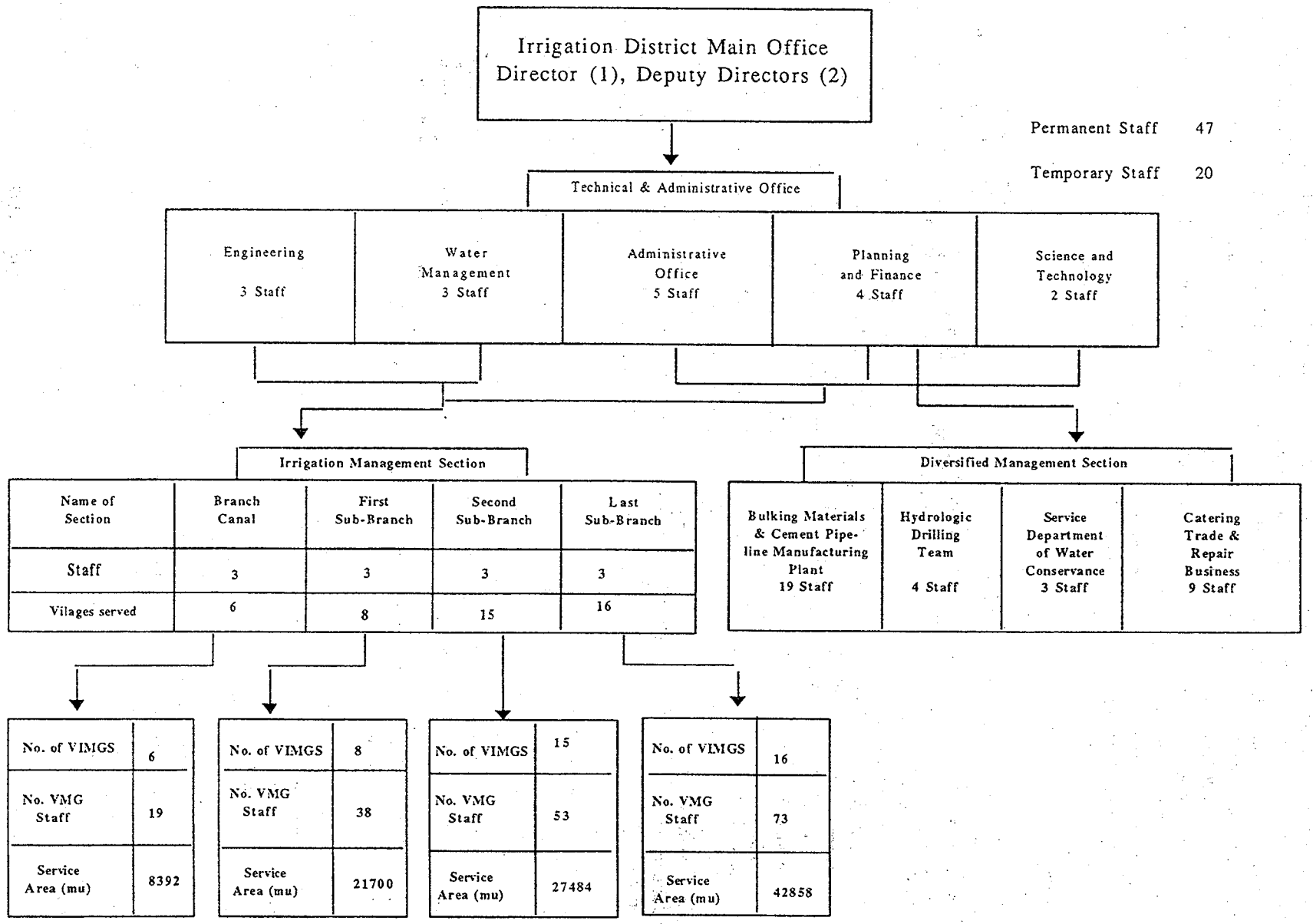


Figure 3. Organizational Chart for Bayi Irrigation District, Yuanshi County, Hebei Province.



Name of Section	Branch Canal	First Sub-Branch	Second Sub-Branch	Last Sub-Branch
Staff	3	3	3	3
Vilages served	6	8	15	16

2) maintain the main canal (mainly by planning and coordinating farmer labor); 3) pass announcements from the irrigation district or county water conservancy bureaus to villages (especially informing villages about section-level meetings for scheduling water deliveries between villages); 4) settle disputes between villages over water use (disputes often occur over which village irrigates first); and 5) encourage VIMGs to pay water fees on time.

As part of the reforms begun in the early 1980s, VIMGs were organized in Pingshan and Yuanshi counties to take over direct responsibility for managing irrigation. A VIMG generally has about three to five members, selected by the farmers in a village. VIMGs normally have a head, a deputy (who inspects canals for problems or damages), a treasurer, a head of water fee collection and a head of maintenance. Their duties are to clean canal sections which pass through the village (normally branch canals and below), distribute water among village farmers, collect water charges ("under the supervision of the ID"), ensure proper passage of water through the canals and maintain, organize schedules among farmers for water delivery and protect field-level irrigation facilities of the county water conservancy bureau (WCB). The VIMG head often is also an official on the village committee. Each VIMG staff member has responsibility for coordinating water distribution between roughly 200 households farms.

Irrigation fees

Both Nanyao and Bayi ID are attempting to implement the new system of water fees. Irrigation districts in the two counties each have different water fee levels, according to availability of revenue sources, variable O&M costs and the number of irrigation turns delivered in a year. While Nanyao ID calculates water charges according to its estimate of water volume delivered, the VIMGs translate an otherwise volumetric water fee into an area-based charge levied against individual farmers. The Hebei Province official water charge rate is 3 yuan per 100 m^3 (maximum allowed). Nanyao ID is charging less than the allowed amount because the farmers refuse to pay more than the current rate. The fixed area fee is Yn 7.5 per mu[4] and the volumetric fee is Yn 2.5 per 100 m^3. The amount of the fee is estimated by the district based on village area irrigated. Both components are combined into a single fee, treated as a fixed area fee, at the rate of 15 yuan per mu. This assumes five irrigations per year.

In Nanyao, if the VIMG collects 100 percent of the fee by the end of March, the VIMG retains 5 percent of it. If they collect 10 percent by the end of April, the VIMG retains only 3 percent. If the VIMG collects less than 100 percent by May then the VIMG must pay a fine of an additional 3 percent of the remaining amount uncollected. The entire fee for the year is collected once a year, in February, 10 days before the first irrigation. Fee collection rates for 1993 were 97 percent, 90 percent and 95 percent for each of three sections.

In Bayi the volumetric water fee is 7.11 yuan per 100 m^3. The area fee is 1.5 yuan per mu. Before 1984 the water fee was only a fixed area fee so the use of water was very inefficient. The volumetric water fee was introduced in the mid 1980s, after 1984, as part of the reforms. The Hebei Province standard rate for the volumetric fee was 3.3 yuan per 100 m^3, but since Bayi ID purchases water from the Bayi Reservoir and sometimes from another county (Pingshan) and have more than 100 km of canal to supply this water to the district, they have a higher fee based on the actual higher costs for water. The Bayi Reservoir and ID propose a fee level which is approved by the county government, based on the provincial standard, modified to take into account actual local costs. So there is some slippage between central or provincial standards and what irrigation districts actually charge for water fees. The fee standards seem to be considered more as guidelines than rules.

Diversified Sideline Enterprises

Nanyao ID is in a poorer area than Bayi and it began implementing the reforms later. It has still not developed any sideline enterprises. Its officials state the desire to establish them but report difficulty in raising initial capital and getting organized. Bayi ID's Diversified Management Division was created in 1984. By 1994 it has become highly diversified. It has 11 kinds of sideline business: 1) survey and design of small-scale irrigation projects, 2) fitting of water pipes and taps, 3) repair of farm machinery and irrigation and drainage equipment, 4) well boring and pump installation, 5) building construction, 6) small restaurant, 6) bicycle repair shop, 7) agricultural products store; and the production of 8) cobblestone, 9) cement tile, 10) cement pipe, and 11) talcum powder. Since 1984 Bayi ID has received many prizes and awards from the county, prefecture and province for its successful Diversified Management Division (Wu 1994). Profits from sideline enterprises provide approximately seven percent of the total revenues of the district. The businesses also provide employment for family members of district staff (as well as others) and thereby enhance the standard of living of staff families.

At the level of Hebei Province, in 1992 a total of 450 million yuan (US$52.3 million) gross income was raised province-wide by the Water Conservancy Bureau from diversified sideline enterprises. Sixty-six million yuan (US$7.7

[4] 15 mu = 1 hectare.

million) of it was invested in construction and rehabilitation of water projects. These enterprises also provided employment for 13,155 people.

POST-REFORM MANAGEMENT PRACTICES IN NANYAO AND BAYI DISTRICTS

Performance Standards

Under the work post responsibility system, yearly personnel evaluations of district and water conservancey bureau staff are required. For irrigation district staff these include an assessment of water fee collection rates, the quality of maintenance work and water distribution. Both Nanyao and Bayi make annual assessments of staff and district management performance according to the same basic set of eight "economic norms" (or performance standards) promoted by the work post responsibility system. They vary in how they calculate points, bonuses or fines. Assessment is done at the level of individual staff, section offices, divisions and at the district office level. The eight criteria used are: irrigation efficiency, proportion of structures which are functional, balance of income and expenditures, total water use, irrigated area, water use efficiency, irrigation schedule targets and crop yields obtained.

Table 2 shows the system of performance measures used in Nanyao ID in 1993. The rating was 96.5 percent of potential. In comparison with problems of advancing siltation and deterioration, this rating lends some support to Nickum's argument (1985) that the water fee assessment system in China is only used in a modest way to remind staff not to shirk duties too much. Performance standards are set for each of these criteria and percentage figures are used to measure levels of achievement relative to that standard. If a staff gets a rating below 60 percent, no annual salary bonus is given and salary is reduced by one grade for that year. This has never happened yet. Apparently as a gesture to increase work incentives, Nanyao recently decided that from 1994 onwards, if a staff is ranked below 79 percent, he gets no bonus and the salary will be reduced by one grade. For scores above 79 percent, the higher the score the higher the bonus. Scores tend to be stable in most years. The overall annual performance rating for Nanyao ID increased from 81 points in 1987 to 96.5 points in 1993. This was likely a combination of some "rating inflation" and real improvements.

Staff grades generally increase according to seniority, promotion and performance ratings according to the guidelines of the National Personnel Ministry. Grade levels determine salary. The Labor Ministry designates base salary levels for all kinds of positions, even in financially independent irrigation districts.

Financial Management

Under the collectives or village committees, general commune or village revenues subsidized routine irrigation costs. Central and provincial level funds are now only available for construction and rehabilitation, on a cost-sharing basis with villages or farmer groups. Financing routine operation and maintenance has always been the responsibility of the irrigation districts and farmers. Officials report that neither Nanyao nor Bayi ID have ever received central government funds for routine operation and maintenance.

While no funds are provided by the government for O&M, between 1988 and 1992 the county water conservancy bureau provided 519,000 yuan (approx. US$85,000) to Bayi ID for canal lining and extension. This amount was one-third of the total expended. As required matching investments, the same amount was invested by both Bayi ID and member villages (mainly in the form of labor), respectively.

In 1992 Nanyao ID's total budget was approximately 365,000 yuan (about US$ 63,000), 350,000 yuan of which was from the collection of current and back accounts for water fees. Expenditures totalled 341,500 yuan, including a 36,500 yuan repayment of its 1991 budget deficit. Nanyao spent 36,500 yuan to purchase supplemental water from the Yie He river. Therefore, Nanyao had a budget surplus in 1992 of approximately 13,500 yuan.

Between 1984 and 1992 Bayi's Diversified Management Division produced 400,000 yuan (approx. US$60,000) in profits. Of this, 260,000 yuan (65%) was submitted to the ID office to finance water management. The other 140,000 yuan (35%) went to salaries and bonuses for staff of the Diversified Management Division, many of whom are spouses of ID staff. In 1992 total revenues from irrigation fees in Bayi ID amounted to 906,000 yuan, while total revenues (i.e., profits) from sideline enterprises amounted to 70,000 yuan. This total income of 976,000 yuan (approx. US$ 168,000) produced a surplus of 258,000 yuan (US$45,000) over total expenditures of 718,000 yuan (US$ 124,000). Purchase of water constituted 360,000 yuan (US$ 64,000) or 52 percent of total expenditures.

In about two-thirds of the villages in Nanyao ID, the VIMG collects water fees from individual farmers, in the other third the villages produce enough off-farm collective income that the village committee pays all of the water fees charged to the village and often also pays for other agricultural taxes, educational fees and village fees. For example, Dong Hui She village has successful collective enterprises, including a brick factory, fertilizer bag production plant and

Table 2. Annual Performance Assessment for Nanyao Irrigation District, 1993.

1) Water Delivery				
Item	Planned (104m3)	Actual (104m3)	Potential points	Points awarded
Total discharge	4500	5600.6	4	4
Irrigation water	2000	2150.6	5	5
Delivery to Yingang canal	1500	3450	3	3
Water delivery days	300 days	307 actual	3	3
Total points			**15**	**15**
2) Irrigated Area				
Irrigated area	273.3	273.3	5	5
Irrigated area x times	12000	14000	5	5
Total points			**10**	**10**
3) Water Use Efficiency (WUE)				
WUE of main canals	0.715	0.715	4	4
WUE of branches	0.82	0.82	4	4
WUE of sub-branches	0.91	0.91	4	4
WUE of whole canal system	0.534	0.534	4	4
Total points			**16**	**16**
4) Irrigation Duty and Efficiency				
Irrigation duty at the head of the main canal (m3/ha)	1522.5	1519.5	3	3
Irrigation duty at the outlet of sub-sub branches (m3/ha)	892.5	892.5	2	2
Irrigation duty in field (m3/ha)	813	811.5	2	2
Annual gross irrigation water per ha	6870	7875	3	3
Irrigation efficiency at the head of main canal (ha/m3/s)	56.7	56.8	3	3
Irrigation efficiency at the outlet of sub-sub branches (ha/m3/s)	96.9	97.1	2	2
Total points			**15**	**15**

(Continued)

Table 2. (Continued)

5) Rate of Functional Structures				
	Planned (10 m3)	Actual (10 m3)	Potential points	Points awarded
Structures	447	447	4	4
Canals and branches (km/number)	48	48	3	3
Total points			**7**	**7**
6) Maintenance				
Lined canals (km)	10	10	6	4
Silt clearance (km/number)	271/62	271/62	4.5	4.5
Structures maintained (number)	35	35	4.5	4.5
Total points			**15**	**13**
7) Income and Expenditure				
Total income	US $31,395.3	US $38,372.1	5	5
Total expenditures	US $26,744.2	US $36,627.9	5	5
Operating and managing cost	US $20,930.2	US $6,046.5	3	3
Annual maintenance cost	US $5,813.95	US $12,558	3	3
Total points			**16**	**16**
8) Crop Yield Assessment				
Grain	3262.5	3045	2	1
Wheat	4425	4605	2.5	2.5
Cotton	600	585	1.5	1
Total points			**6**	**4.5**

Grand total of potential points = 100
Grand total of points awarded = 96.5

fruit orchard. 80 percent of the factory workers are also farmers from the village. Workers are paid on a piece rate basis. Dong Hui She village paid 100 percent of its water fee by 5 March in 1992 and 93 and thereby received a 5 percent rebate.

The Bayi ID collects the water fee from farmers, through the VIMGs, three to five days before the village's scheduled water turn. The VIMG broadcasts with megaphones announcements of pending water delivery three to five days in advance, reminding farmers to come and pay their water fee before delivery. Two members of the VIMG wait at a designated location for farmers to come and pay. At least two VIMG staff must together receive water fees. A receipt is issued to farmers upon payment. Normally, 90 percent of the farmers pay the fee in advance of the water delivery. Others still get water but must pay afterwards or they will not be allowed the next water turn until they pay up--but this is reportedly "very rare."

Compensation of VIMG staff is sometimes from the village committee funds and sometimes from a village-levied surcharge on the water fee. Compensation to VIMG staff ranges from 400 to 1,000 yuan between different villages, varying by the size of village irrigated area, amount of work required and differences in wealth between villages. Most villages in Bayi ID have a surcharge on the water fee of about 2 to 5 percent to pay for the cost of compensation for VIMG staff.

Water Management

Nanyao ID normally obtains its full water supply from the Yie He River according to a withdrawal permit. Occasionally, as in 1992, supplemental water is purchased. Bayi ID obtains water from the Bayi Reservoir. Before 1976 the amount of water in the Bayi Reservoir was 3 to 5 million m^3. By purchasing water from other counties by feeder canals, the amount of water in the Reservoir expanded to 35 million m^3 today. Purchased water constitutes 95 percent of the water in the Reservoir today. All imported water directly or indirectly comes from the Yie He ID. Seventeen to 25 million m^3 of water is imported per year into the Bayi Reservoir. Seventeen million m^3 of water was purchased by Bayi ID in 1992. Bayi pays between 100,000 and 200,000 yuan per year to purchase water. The amount varies according to rainfall and how much BID requests, which can depend on how many turns are requested from Bayi and the VIMGs. In both Nanyao and Bayi ID's wheat and corn are the main crops. Farms normally receive five irrigations per year. Water is distributed by the ID to respective VIMGs according to a pre-announced schedule.

All VIMGs are responsible to schedule, manage and record water deliveries within the village area. Deliveries are arranged to irrigate one farm at a time along a given canal, starting from the farm nearest the top end and working downstream. The duration of each turn depends on how long it takes the water to reach the entire field. This varies between 10 minutes to one-half an hour per mu for furrow irrigated wheat. A member of the VIMG opens and closes canal offtakes for each water turn and records the time of start and finish and assesses the individual volumetric fee on the basis of the actual duration of the turn. If a farmer has not paid the water fee before his scheduled irrigation delivery, the VIMG pays his fee to the district (so that the village-level payment is complete before its scheduled irrigation) and his turn is delayed until he pays. Sometimes water delivery to a village is delayed if the VIMG is late in paying the fee to the ID. Information on volume of water delivery scheduled, schedule dates and times and target fee level assessed to the village are all posted publicly in the village. After the irrigation the information is completed with comparative information on actual schedule and volume of delivery implemented. Actual assessable fee is recorded for comparison with target fee assessment. Adjustments to payments on the basis of actual recorded deliveries, for either adding or reimbursing, are normally made at a meeting of VIMG representatives with irrigation district staff at the end of the cultivation year, usually in December.

In Bayi ID actual discharges are monitored by superiors and compared with targets. Bonuses are given or refused on the basis of the evaluations. The Director of Bayi ID fines staff who do not deliver the right amount of water on time and for the right duration, to branch canals. District staff and a VIMG staff jointly measure actual discharges at the head of each sub-sub-branch canal once a day for the duration of the village's water delivery period. In Nanyao and Bayi, staff gauges, current meters, v-notch and cipoletti weirs and flumes are used to measure water deliveries from the main canal to branch offtake levels. In Bayi water is also measured down to the level of "sub-sub branch" outlets..

Since Bayi ID purchases a considerable amount of water each year it wants to improve water use efficiency. To encourage greater efficiency, Bayi ID gives a small cash bonus to VIMGs for using less water than planned (± Yn 10-20). These bonuses are paid from money collected from fines ID gives to some villages who waste water. (Sometimes a village does not prepare all its land or repair or clean channels properly, so they need and request more water than planned.)

The irrigation districts generally settle irrigation disputes which are not settled by the VIMGs or which are between villages. Common sanctions for breaking rules, such as taking water out of turn are given a fine (the most common method). Farmers who damage structures are required to repair the structures and pay a fine. Irrigation districts also have the legal right to cut off water delivery to farmers, but this is very rarely used.

In Bayi ID farmers caught illegally opening field offtake gates must pay twice the area and volumetric water fee assessed for that irrigation. The last time this happened was in 1985. For repeated offenses they would pay an extra Yn 200 to Yn 500. For closing cross regulators, farmers would pay double the water fee for the estimated amount of illegal extra water taken, plus an additional Yn 100 to Yn 200. If the farmer refuses to pay, he is sent to the police station. This happened sometimes before 1985, but rarely thereafter, except in 1987 which was a drought year. The district never fines farmers for absence at the time of scheduled delivery; they just move his or her turn to the end of the schedule for the village. For damaging structures, farmers must pay for the repairs and the police give a fine. This last happened in Bayi the winter of 1990.

Maintenance

In Nanyao the average annual unpaid maintenance labor contribution from farmers is about 11 days, 10 days for sub-branch canals, plus normally one day on main or branch canal(s). The actual number of farmer unpaid maintenance labor required varies between villages according to the amount of land served and the length of channels used in the village. In Bayi, maintenance labor requirements for farmers vary between villages but are in the order of 15 to 20 work-days per year. Most of this labor is for maintenance and repair of channels below the main and branch canal levels. Farmers are permitted to substitute a payment in cash for a day of maintenance labor not worked, paid at the rate of a standard day's labor cost.

MANAGEMENT PERFORMANCE IN NANYAO AND BAYI DISTRICTS

Management Efficiency

Farmers in the two districts had mixed perceptions about the effect of de-collectivization on water management. Farmer informants and district officials both reported that reforms under the Economic Contract Responsibility System have had some negative effects on irrigation management. Greater group control under the production team mitigated against wasting water, it permitted both day- and night-time irrigation and ensured that farmers would be present to manage their water turn (rather than be away attending to off-farm business). In recent years disputes often arise because farmers are absent at their scheduled time for water delivery and water is often wasted or taken out of turn by others. However, a group of farmers interviewed in Nanyao ID reported that water use efficiency had improved over the last 10 years after the reforms. Ten years ago it took on the average 60 minutes to irrigate one mu of land. This now takes about 40 minutes. Now that individual farmers and village irrigation management groups must pay fees, there is more pressure against open wasting of water. System wide water use efficiency has been calculated to be approximately 0.53 in Nanyao and 0.72 in Bayi ID. 35.5 percent of the 111 km of main, branch and sub-branch canals are lined in Nanyao. 31.8 percent of the 157 km of main, branch and sub-branch canals in Bayi ID are lined. The larger number of tubewells within Bayi might be part of the reason for the higher estimated efficiency, due to a lower need for surface water in conjunctive areas.

Financial Viability

In Nanyao, between 1990 and 1993, total district income increased from approximately 160,000 yuan to 330,000 yuan, an increase of 106 percent. Nanyao however, is not building up a reserve fund. It covers a deficit in one year from next year's water fee collection. It collects the previous year's unpaid fees along with those of the current year. An official in Nanyao ID reported that they have no incentive or ability to create a reserve fund by increasing the water fee (even though the government regulation encourages it), because they expect the government to eventually pay for rehabilitation when it becomes seriously needed.

Over the last several years Bayi ID has had a surplus of income over expenditures each year, which is allocated three ways: 1) 50 percent for a reserve fund for rehabilitation or improvements, 2) 30 percent for staff "welfare" and housing conditions, and 3) 20 percent for staff bonuses. Between 1990 and 1993, total district income increased from 550,000 yuan to 976,000, an increase of 77 percent. The financial viability of both districts appears to be gradually improving as a result of the reforms, especially in Bayi.

The average annual income of farmers 10 years ago was less than 300 yuan. Now it is about 600 yuan per year. Crop yields have increased but the prices have stayed about the same, so there has been only a slight real increase in net income from farming over the last 10 years. Gitomer (1994) reports that in 1985 national-level average annual per capita rural income was less than 400 yuan. He notes that since 1985 there has been no growth in average rural per capita income in real terms. This seems to indicate that the ability of farmers to pay more of the real costs for irrigation has not improved significantly over the last decade. Ability of farmers to pay can vary widely between areas.

Nanyao ID is in a less productive area than Bayi ID. In 1993 Nanyao ID had average combined wheat and corn yields of 7,650 kg/ha compared to a much higher average yield level in Bayi of 12,120 kg/ha.

ID officials and VIMG representatives reported that under the old commune system it was easier to collect the water fee; they always collected 100 percent of it, although the fee was very low. In recent years collection is often late and the rate doesn't always reach 100 percent. The average water fee collection rate in Pingshan County is about 70 to 80 percent. The water fee covers the salaries of ID staff and small maintenance costs. Only 5 percent of the fee goes to the county water conservancy bureau. Farmers dissatisfied with the irrigation service sometimes refuse to pay the water fee. 1992 was the first year Nanyao had ever collected 100 percent of the water fee from the VIMGs before the season. The 1991 collection rate was about 70 percent. By 27 September 1993, Nanyao ID had collected about 85 to 90 percent of the 1993 irrigation fee.

An official in the Pingshan Water Conservancy Bureau noted that the best option for financing sustainable physical structures was to encourage sideline enterprises and hope for future government assistance for rehabilitation, because the farmers cannot bear any additional water charge increase or labor requirements.

Physical Sustainability

According to ID officials, essential structures in all seven irrigation districts in Pingshan County are deteriorating, since revenue and labor inputs only cover district staff salaries and small maintenance activities. After the reforms many farmers have developed highly diversified livelihood strategies which compete with labor for irrigation maintenance. It was easier for the collective production teams to mobilize maintenance labor. Despite problems of rising siltation of canals in both districts, farmers interviewed expressed the opinion that the rate of deterioration was less now than it was 10 years ago. Plans were being discussed between farmers and district officials in both Nanyao and Bayi to perform special large-scale maintenance activities to repair and de-silt main and branch canals through the use of mass labor. It is clear that periodic heavy maintenance or rehabilitation will be needed in both systems. It is not clear whether this can be achieved solely through local resources. There are no indications as yet that deterioration is leading to a shrinkage in the irrigated area of either system. Irrigated area continues to rise gradually. This is partly due to the spread of tubewells within the design areas of both systems. The increasing dependence of the systems on conjunctive use of both surface and groundwater irrigation is cause for concern for the long-term sustainability of irrigated area, however, since the underground water table is dropping at a rate of 1.1 meter per year.

CONCLUSION

National level policy reforms promoting local financial and managerial self-reliance are being adopted, although in a somewhat variable manner, at the level of Nanyao and Bayi Irrigation Districts. Nanyao ID is a smaller system in a less productive area relative to Bayi. Nanyao ID has also been slower in introducing the volumetric water fees and creating village irrigation management groups. It has still not developed sideline enterprises. Bayi ID started its first sideline enterprises in 1982. Nanyao ID has a relatively abundant, river-based supply of water and has often been in water surplus. Bayi ID on the other hand is in a water deficit situation and must purchase large amounts of water each year. This dependence on water purchasing, together with the apparent greater ability of farmers to pay (due to higher productivity), may be the driving influences for development of sideline enterprises in Bayi and greater concern about improving water use efficiency. Both Nanyao and Bayi IDs have implemented numerous rules and practices which create various financial incentives and accountability mechanisms aimed at enhancing water use efficiency and the transparency of financial accounting and water delivery.

It is apparent that the reforms are producing more viable local management of irrigation. They provide reasonably clear delineation of responsibilities, water rights and linkage between rights to water and paying for it. Where sideline enterprises have developed they are helping to stem the flow of skilled staff out of the irrigation sector by improving facilities and standards of living for families of irrigation district staff and water resources officials.

Farmers must pay the water fee in advance in order to receive water. If they do not in fact receive water their fee is refunded. Within limits, farmers may pay a higher level of fee to receive more water. In Bayi ID, this appears to be a powerful mechanism which achieves an impressive level of performance of water and financial management. The village acts as a mediating guarantor to see that these rules apply to the individual farmer. This appears to be resulting in gradual enhancement of self-reliance of irrigation districts. However, as indicated in Nanyao ID, it is apparent that some irrigation districts in less favorably endowed areas may be in need of external technical and financial support services to implement volumetric water delivery, fee assessment and diversified sideline enterprises.

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A Better Reform Form of Management System In Irrigation Districts: The System of Contracted Managerial Responsibility

Gong Xiaohu[1]

ABSTRACT

THIS PAPER DEALS with concrete practices and organization system of contracted management of the West Main Canal in Zhangye of Gansu Province. In particular, it focuses on the benefits and changes brought about by the implementation of contracted and comprehensive management. This fully revealed that contracted management of the water conservancy administrative unit is a better reform method under the present condition in China. It will help reform the management system, transform operation mechanism and follow the road of self-management, self development, accumulating one's own fund, taking responsibility of one's own profits and losses as well as establishing a modern enterprise system. Comprehensive management contributes to improving the welfare benefit of staffs, favours keeping employees' attention on their work, and enhances internal vitality. It is one of the economic pillars for the accomplishment of self-development. Therefore, we should persist in perfecting and popularizing this new system according to local conditions, thus ensuring its development.

The irrigation district of the West Main Canal is located to the west of the ancient Zhangye City in Hexi Corridor of Gansu Province. The principle for diverting water from the Heihe River, the irrigation district is a gravity irrigation area and also a river-well mixed irrigation area, with river water as its main water source and well water as its supplementary water source. The multi-year mean rainfall in the area was 129 millimeters (mm) and multi-year mean evaporation was 2,047 mm. The whole irrigation district has 3 townships, 39 administrative villages, 312 production co-operatives and 23 institution tree farms, totalling about 8,200 peasant households and a farm population of 46,800. The water administrative agency has 144 persons, of which the official employees account for 51 persons, the workers engaging in industry and farming account for 63 persons and the technicians account for 28 persons. The annual diversion duty and pumping water volume varied between 180-200 million cubic meters (m^3) irrigating about 175,000 [mu] of farmlands.

IMPLEMENTATION OF THE SYSTEM OF CONTRACTED MANAGERIAL RESPONSIBILITY

Encouraging changes and significant economic benefits resulted in the implementation of the system of contracted managerial responsibility in the irrigation district.

Before the implementation of the new system all employees enjoyed equal pay, no matter whether they worked well or not. This severely dampened the employees' enthusiasm. Because of the lack of the right of independent action (includes arrangement rights of persons, funds and materials), it could only work out to a lower water price standard and the annual income from water charge only reached 450,000 yuan. Because the annual income of the water administrative agency fell short of the expenditure, it could not accomplish regular maintenance and renovation of water conservancy projects (see Table 1). This has resulted in the deterioration of most installations and led to severe wastage of water resources and inefficiencies in water use, which at present is only about 45 percent.

Over the past four decades the state has invested about 15 million yuan (about US$1.7 million at current prices) for project maintenance and renovation in the irrigation district. The local masses have contributed nearly 9 million labor-days. Following the implementation of the system of contracted managerial responsibility, great changes have taken place and achieved significant economic benefit in the irrigation district.

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Table 1. Survey results of state, ageing and unrepaired canal structures in the irrigation district.

Structures / Conditions		Main and branch canals (km)	Structures (set)	Completed area of field project		Remark
				1,000 mu	Percent (%)	
Existing		109.2	1,580	3.9	24.2	The irrigated area was 161,000 m, prior to signing of the contract
Ageing and unrepaired	Number	64.4	375	0.9		
	%	59	24	23		

Promoting Project Construction and Strengthening Project Management

Since the implementation of the contract system, water prices have greatly increased. The project depreciation charge and annual maintenance fund drawn from the water charge have also increased as shown in Table 2. Relying on the fund drawn from the water charge, the irrigation district has renovated some water conservancy projects as shown in Table 3.

Table 2. Income and expenditure of water charge before and after implementing the contract system.

Item		Before the contract (1987)	After the contract (1989)	After 6 years of contract (1988-1993)
Income for water charges (10,000 yuan)		45	89.81	538.8
Project depreciation charge and annual repair fund	Amount (10,000 yuan)		32.83	197
	%		36.5	38.6

As a result of contracting out to individuals and carrying out the policy that rewards the diligent and punishes the lazy, the beneficiary villagers' enthusiasm to build water conservancy projects was greatly aroused. In recent years local masses had contributed about 525,200 labor-days to drill 21 pumping wells, and accumulated 835,200 yuans of funds through their own efforts, thus making the project management enter into a benign circulation stage. In 1993, some 91 contracted projects and 31 professional groups were [ascertained] which involved 89 contractors and 61 contracts.

Enhancing Project Management Level and Achieving Noticeable Economic Results

Since implementing the contract system in the past 6 years, the irrigation district had accomplished the economic and technical targets set by each year's contract. Gansu Water Conservancy Department has designated the irrigation district of West Main Canal as a second class irrigation area. Overall water use efficiency, irrigated area and economic benefit have significantly increased following the implementation of the contracting system as shown in Table 4.

Table 3 Renovated water conservancy projects relying on the fund drawn from water charge.

Item	Branch canal				Sublateral canal				Major repair			Pumping well	Buried pipeline		Diversion dam	
	Renovation		New structure	Starting and closing machines	Newly built canal		New structure	Starting and closing machines	Canal		Sluice gate				Slurry paved stone	Dry paved stone
	set	length (km)	(set)	(set)	set	length (km)	(set)	(set)	set	length (km)	(set)	(hole)	m	mu	m	m
Number	154	31.1	122	96	12	21.9	402	201	22	32	22	20	22700	7070	344	157

Table 4. Comparison of project irrigation benefits before and after implementing the contract system.

Item / Year	Project perfectness (%)	Irrigation water use efficiency (%)	Canal water use efficiency (%)	Irrigated area* (10,000 mm)	Total crop output (1,000 kg)	One m^3 of water:		Per capita income (yuan)	Percent (%)
						Yield (kg)	Output value (yuan)		
1987	41	45.5	51	16.1	3,790	0.5	0.4	567	49.5
1989	82	48.5	59	17.44	4,624.3	0.63	0.51	891	82.6
1992	86.1	54.5	70	19.58	5,005.1	0.64	0.64	816	87.4
1993				19.98	5,132.3	0.72	0.72	850	

Annual Income of Comprehensive Management in the Irrigation District is Increasing due to the Practising of Overall Operation and Setting up of Economic Entities

Since implementing the contract system, the management scope and content of the irrigation district have extended from farming forestry and sale to building material industry, machinery and large-scale commerce. For example, the irrigation district has established a concrete pre-cast workshop, a factor for manufacturing small-sized water conservancy equipment, a service team for pipeline installation and a motor-pumped well maintenance, etc. In addition, it set up a flour-producing factory capable of processing of one million jin of wheat per year and invested about 400,000 yuan to establish a petrol station in 1993. Relying on favourable local conditions such as the area abounding in such special products as wheat, corn, beans, buckwheat, jujube and other fruits, it has established lateral economic ties with Zhanjiang Youth Canal Administration in Guangdong Province and set up a joint sale company of farming and side-line products, thereby laying a basis for developing the coastal market. Having set up some economic entities in light of local conditions, the income of comprehensive management grows steadily from year to year (see Table 5).

In addition, it has purchased some engineering equipment with development fund drawn from contracted management, as shown in Table 6.

Table 5. Comprehensive management benefits before and after implementing the contract system.

Item	1987	1988	1989	1992	Six years between 1987-1992	Remark
Net income (100,000 yuan)	0.7	8.39	10.3	12.7	62.69	
Per capita bonus (yuan)	0	250	300	350		Maximum 700

Table 6. Engineering equipment purchased after implementing the contract system.

Equipment	Bulldozer (set)	Concrete mixer (set)	Steel mould board (ton)	Air compressor (set)	Well-washing equipment (set)
Amount	1	2	10	1	1

In addition, it has built ten units of staff residences with heating radiators, liquefied gas cookers, icebox, electric ovens and boilers. Other already built facilities include 45 m^4 bathroom, entertainment room, library, and reading room. Moreover, there are 23 observation sites equipped with TV set. All of these successful works greatly aroused the enthusiasm of employees and obtained significant economic benefit. In 1989, the irrigation district was recognized as one of China's 100 advanced irrigation districts, and in 1991 the Ministry of Water Conservancy set the irrigation district, up as a unit with prominent contribution to comprehensive management of water conservancy project.

All these facts mentioned above clearly showed that the system of contracted managerial responsibility is a better form of water administrative units under the present conditions of China. It helps to reform the administrative system; to transform the management mechanism; to follow the road to self-management, self-accumulation and self-development as well as to take the responsibility for its own profits and losses. Therefore, we should continuously perfect and actively popularize this system.

SOME METHODS OF IMPLEMENTING THE SYSTEM OF CONTRACTED MANAGERIAL RESPONSIBILITY IN THE IRRIGATION DISTRICT AND CORRESPONDING ORGANIZATIONS

The principle of contracted management separating proprietary rights from the management right, was the guiding thought for contracted management. This can be elaborated as follows:

Ensuring the social benefit, contracting the base number of income, checking up the expenditure, extra earning can be used for individual expense but no subsidy will be offered to the debtors.

The main methods include perfecting organizations and implementing contract at different levels. The concrete steps taken are as follows:

First, seriously checking up the base number, setting preliminary targets and setting the contract schemes. For this purpose, it is necessary to carry out a general investigation of all-level canals and installations, to check up fixed assets and to evaluate the present management states of the irrigation district. Based on the preliminarily calculation, such items as contractor's requirements, contract forms, duration, rights and responsibilities of contractor, ways of reward and punishment are decided. The next step is to issue the bid for contract among cadres in the irrigation district, to evaluate the contractor's qualification, and to select the contractor by vote. Finally the contractor signs the contract with the Zhangye Office of Water Conservancy and Power.

Second comes the perfecting of the relevant organizations.

Third is the distribution of the contract targets level by level to the divisions, stations, sections and individuals. With ten indexes as the examination standards, namely, irrigation area, project perfectness, income and outlay, crop yield and production value, water use efficiency, irrigation quota, rebuilding project, safety, technical popularization and training, the contractor will be examined at the end of the year. The diligent contractors will be rewarded while the lazy ones will be punished. Those who finish the contract completely will be given a bonus in addition to raising their wages 2 to 3 times more than the employees' annual mean wages. On the other hand, if the contractor fails to finish the targets set by the contract, 10 percent of his wage will be deducted. If he fails to complete the contract within two consecutive years, his post will be abolished.

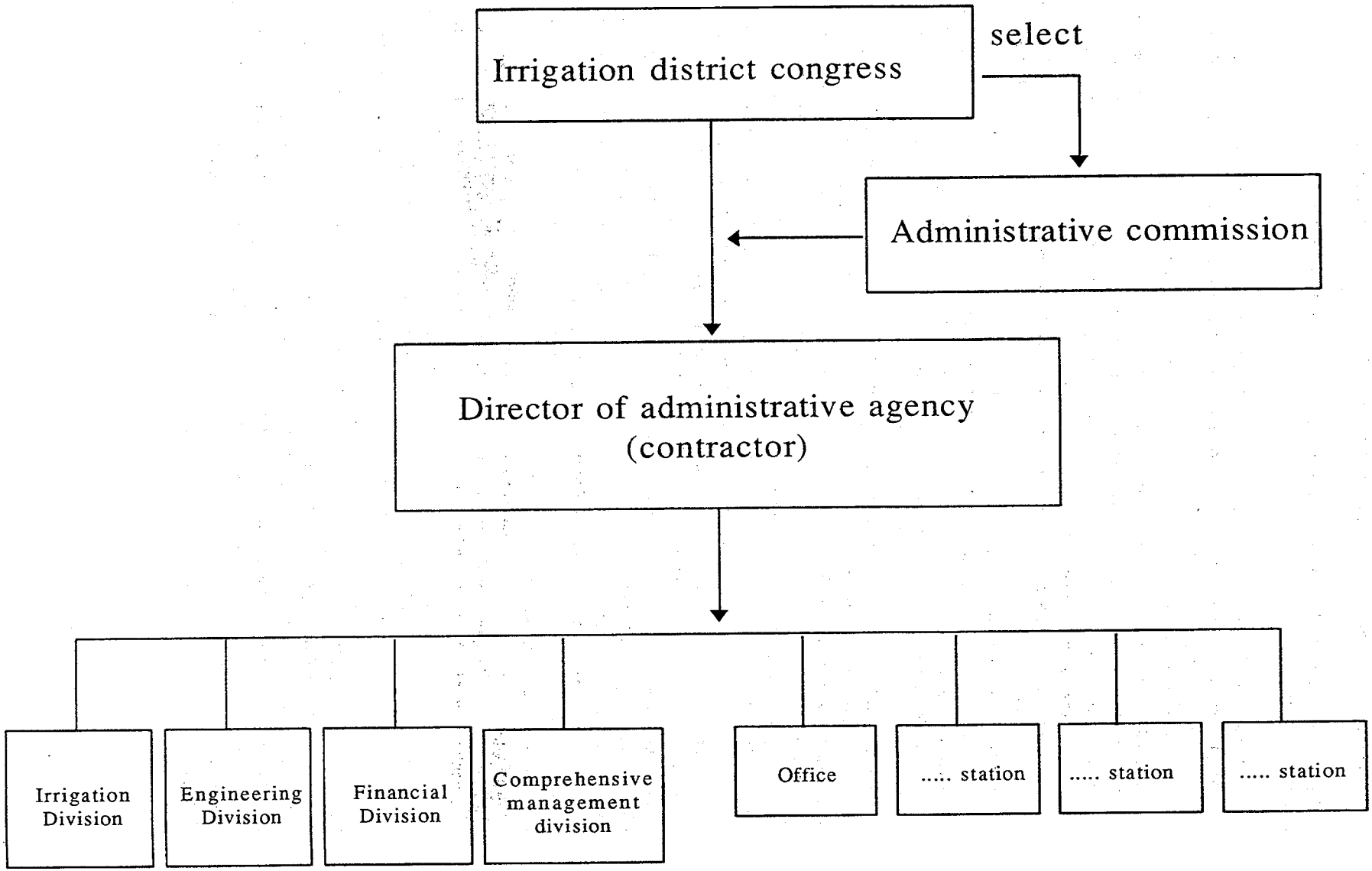
According to the principle of combining professional management with valley management, the Director of the Water Administrative Agency will take up the responsibility of the contract under the leadership of the irrigation district congress. The irrigation district congress will select an administrative commission as its standing institution. Under the commission, three township administrative stations, four divisions, and one office will be set up as shown in Figure 1.

The township administrative station, consisting of 2 to 5 persons, with [township's head acts as the station's head,] will be in charge of the below-sublateral canal projects, field canal system, drinking water engineering, pumping wells, low-pressure pipelines, farmland construction and organizing construction, etc. In order to inspect and protect the below-branch canal projects, we have set up 13 branch canal commissions consisting of 74 persons, 40 sublateral canal commissions consisting of 269 persons and 312 irrigation groups consisting of 250 persons, thus forming into a "from-top-to-bottom protective system."

EXISTING PROBLEMS AND DEVELOPMENT PREDICTION

After implementing contracted management for six years great achievements have been made. However, judging from the demand for reform, what we have done seems far from adequate. Thus far, we still have not realized self-sufficiency in funds; ageing and unrepaired projects are still present; some field projects have a lower completeness; the contract targets still remain to be perfected; most of the employees have a lower education level, etc. Therefore, there is a need to work out even higher targets; efforts must be made to ensure 220,000 mu of farmlands to be irrigated by the year 2000; unit water yield will reach up to 1.5 kilometers per cubic meter (km/m^3); water charge will be decided in accordance with the cost, reaching 2 million yuan per year; net income of comprehensive management will reach 300,000 yuan; per capita income will reach the well-to-do level (US$1,000), and per capita bonus will reach 3,000 yuan. By then, it would realize such objectives as self-sufficiency, self-management, self-accumulation, self-development, taking the responsibility for its own profits and losses, and thus striding forward towards the goal of implementing large-scale, scientific, systematic and enterprise-type management.

Figure 1. Administrative organizations of the irrigation district.



Research on Standard of Irrigation Service Fees

Wang Xiugui[1] and Qian Xulai[2]

ABSTRACT

A RATIONAL, STANDARD of irrigation service fees (ISF) is an issue which has caused concern both in the government and among the farmers in the irrigation districts. If the standard of ISF is too low, it will result in a shortage of funds for operation and maintenance of irrigation systems. This would require more subsidies from the government to the professional management agency. If the standard of ISF is too high, it will be difficult or unable for farmers to afford the fees. Thus, they will hesitate to participate in the management of irrigation systems. Consequently, collection of fees may be problematic. Therefore, it is necessary to work out a reasonable standard of ISF.

This paper presents the results of a study on ISF carried out in three irrigation districts in the Hunan and Hubei provinces. The present situation of collecting water fees and the actual cost of irrigation water are discussed. Based on the findings of the study, an improved formula for calculation of irrigation water fees is proposed.

INTRODUCTION

The amount of irrigation service fees (ISF) is an important issue which concerns the professional irrigation management organizations and the farmers in the irrigation areas. If the standard of ISF is too low, it would have an adverse effect on farmer's enthusiasm to participate in water management. Furthermore, it would be impossible to mobilize adequate funds for regular maintenance of the irrigation system. This would inevitably lead to the poor performance of irrigated agriculture and also increase the financial burden of the government. On the other hand, if the standard of ISF is too high, it may be beyond the farmers' ability to pay and may also increase their cost of production. It may also act as a disincentive for farmer participation in water management. Therefore, it is necessary to set up a reasonable standard of ISF which would guarantee enough funds for normal operation and maintenance of irrigation projects and also lessen the economic burden of the farmers.

In China, the standard of ISF at present is based on the National "Disciplines on Re-assessing, Collecting and Managing of Water Fees for Water Projects" issued by the Chinese State Council, in July 1985. The main provisions of the Disciplines are as follows:

1. The rate of water charge should be determined on the basis of the actual cost of supplying water.

2. The cost of irrigation services includes O&M costs, cost of heavy repairs and depreciation of fixed assets built by state funds (excluding assets created by the voluntary labor of farmers).

3. Irrigation water fees for grain crops were equal to the actual cost of supplying water. For cash crops, the rate may be a little higher than the actual expenditure.

The abovementioned Disciplines has been implemented for about 10 years. There is now a growing recognition amongst the irrigation fraternity that the present system of water charges is outdated. The present view is that water should be considered as a commodity and the cost of water should be determined on the basis of market prices. The level at which ISF is set should be equal to the cost of water supplying plus profit. This level of ISF would guarantee adequate funds not only for routine O&M expenditures of the irrigation project, but also for expanded reproduction.

Could this standard of ISF be carried out in practice? Would it promote farmers' enthusiasm for participation in irrigation water management? In order to gain a clear idea of these questions, a study on irrigation water fees and the paying ability of farmer was carried out in several reservoir irrigation areas in the Hunan and Hubei provinces.

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INVESTIGATION OF TYPICAL RESERVOIRS' IRRIGATION AREAS

Three projects were selected for detailed case studies, as given below:

No.	Province	Name of project	Characteristic
1.	Hubei	Zhanghe Irrigation System	large-sized
2.	Hunan	Songbai Irrigation System	medium-sized
3.	Hunan	Dating Irrigation System	small-sized

These projects are typical of the rice-producing area in the hill regions with annual rainfall ranging from 646 to 1,267 mm and where supplementary irrigation is required during the dry season or in a dry year.

Investigations focused on the following matters:

(1) The actual cost of supplied irrigation water (C_a).

According to Document No. 94, issued by Chinese State Council in 1985, the actual cost of irrigation service was calculated according to the following formula:

$$C_a = \frac{O+M+d+R}{W} \qquad (1)$$

where:

O + M = annual expenditures for operation and maintenance of professional managed facilities.

d = annual depreciation charge of fixed of State assets. It is usually set at the standard rate of 2-3 percent.

R = annual charge for heavy repair of professional fixed assets at the rate of 0.75-1.5 percent.

W = the amount of water supplied annually by the reservoir or upper diversion system.

(2) Standard of ISF for grain crops (C_g).

In accordance with the abovementioned Document, the standard of ISF for grain crops was calculated according to the following formula:

$$C_g = C_a - \frac{d_f}{W} \qquad (2)$$

where:

d_f = annual depreciation charge of fixed assets created by farmers' voluntary labor.

(3) Actual standard of water charges implemented by the local professional management agency (A_s).

(4) Actual revenue from irrigation fees (A^r) collected from water users (Yuan/cum).

The four indices indicated above were estimated in different reservoirs' irrigation areas. The results are listed in Table 1.

Table 1. Current water price (US cents/m³).*

Name of Reservoir	C_a	C_g	A_s	A_r	A_r/C_a
No.1	0.686	0.50	0.50	0.22	33%
No.2	1.27	1.09	0.49	0.25	20%
No.3	0.01	0.74	0.41	0.32	36%
Average	0.95	0.80	0.47	0.27	30%

* Currency equivalent (as of 1 July 1986): US$1.00=RMB ¥3.202.

As indicated in Table 1, both the standard of water charges (As) and the actual revenue (Ar) from ISF in the three irrigation areas are much lower than the actual cost of irrigation water (C_a) and the actual standard of ISF for grain crops (C_g) as determined in accordance with government regulations. The average value of collected water fees is only 30 percent of the actual cost.

As a result, these three irrigation projects were operated and managed with financial deficits every year.

From the above analysis we can see that the current actual standard of water charge determined by the local government is too low. The collection of irrigation fees from farmers has also been a problem. Therefore, it is very important to determine a reasonable standard of ISF. It should be determined on the basis of actual cost of supplied water by irrigation projects. On the other hand, the paying ability of farmers and also the acceptability of local governments should be considered.

PROPOSED STANDARD OF ISF

In order to understand the paying ability of farmers, we have investigated the economic situation of a sample of farmer households.

Table 2 gives the incomes and expenditures of the sampled households. From this table we can conclude that the average net income (ANI) of the 8 families is US$882. Annual ANI for each member is about US$157, which is lower than the average income per capita in the whole country. ISF levied from farmers is about 3.3 percent of the total agricultural cost of a family, and about 1.7 percent of the total net income of a family. Therefore, raising the ISF is not reasonable as it would place additional economic burdens on the farmers.

Table 2. Farmer's income and expenses [RMB ¥ (US$)].

Farmer	CL FM (m²)	Cost of Agriculture									
		AI		WF	Tax	Total	VO	NI	AIEM	Year	Reservoir
Zhao	4	9,330	640.0	11.9	79.0	731.1	1,334.9	603.8	150.9	1992	No.1
Xiao	7	10,530	986.9	12.9	54.7	1,054.5	2,046.3	991.8	141.7	1992	No.1
Liu	5	11,600	702.7	13.2	39.7	755.7	2,089.1	1,333.5	266.7	1992	No.1
Wu	5	5,330	139.6	10.3	19.2	170.6	642.3	812.9	162.6	1991	No.2
Yi-A	6	5,330	151.4	13.7	19.7	184.8	854.2	669.3	111.6	1991	No.2
Yi-B	6	5,000	136.7	13.1	18.7	171.0	809.2	638.2	106.4	1991	No.2
Yang-A	5	5,330	74.2	15.6	29.3	119.1	807.6	926.7	185.3	1991	No.3
Yang-B	7	10,530	124.3	22.5	31.9	178.6	1,257.3	1,078.7	154.1	1991	No.3
Average	5.6	7,873	69.5	14.1	36.5	420.7	1,230.1	881.9	156.8		

Notes: FM--family member; CL--cultivated land; AI--agricultural input, including seeds, fertilizer, pesticide and others, excluding WF; WF--water fees; VO--value of output; NI--net income; AIEM- average income for each member.

If the ISF is determined on the basis of actual cost of supplied water with a profit of 1.5 percent, the standard of ISF will be greatly increased. This is shown in Table 3.

On the basis of estimates given in Table 3 and Table 1, if ISF be collected according to the commodity price of irrigation water, the current ISF will be increased by 3 to 5 times of the actual standard of water charges. It is far beyond the farmers' ability to pay.

Table 3. Water prices for grain in typical reservoirs (US Cents).

Name of Reservoir	Zh.R	Sb.R	Dt.R	Average
Water Prices	1.09	1.72	1.12	1.31

For assessment of ISF in China, attention should be paid to the following conditions:

1. The headwork for storage/diversion of water, the water conveyance system comprising the main and sub-main canals, and the hydraulic structures are financed and constructed by the sponsoring government agency (state, province, prefecture or county).

2. The water distribution sub-system is constructed by the beneficiaries of the respective lateral or sub-lateral canals: usually through, voluntary labor with some financing assistance from the local government for purchasing construction materials or equipment.

3. The on-farm water distribution structures are normally constructed by farmers sharing the supplied water from a farm outlet.

4. The distribution sub-systems are partly operated and managed by farmers, and the on-farm irrigation systems are wholly operated and managed by beneficiaries.

Given the foregoing situation, we consider that the depreciation charge of fixed assets should be excluded in the assessment of irrigation cost as the permanent hydraulic structures, such as dam, earth canals and other concrete structures can serve quite a long time (more than 50 years) with normal maintenance, regular repair and occasional heavy repairs. The proposed formula for calculation of the cost of irrigation water fees is as follows:

$$C_0=(O+M+R)/W \qquad (3)$$

where :

C_0 = the cost of irrigation water fees. It is determined in terms of normal operation and maintenance expenditures, and heavy repair expenses. The other symbols are the same as in formula (1).

Table 4 shows the calculated results in the investigated irrigation areas: Comparing Table 4 with Table 1, it can be seen that the standard of ISF calculated with formula (3) will be almost double the increased actual amount levied from farmers and only a slight rise on the actual standard adopted by the local government.

Table 4. Cost of irrigation water (US Cents).

Reservoir	No.1	No.2	No.3	Average
C_0	0.51	0.57	0.55	0.54

We hold that the improved formula and its results are more reasonable and hence easily accepted by farmers and local governments of different levels.

CONCLUSIONS

1. The current rate of irrigation fee calculated by formula (1) is unreasonably high, and the actual fees collected are much more lower than the set standard of water charges.

2. A reasonable standard of irrigation water fees should be set on the basis of actual cost of supplied water by irrigation projects, paying ability of farmers and the acceptability of local officers.

3. In irrigation projects, only some of the facilities need to be replaced in the course of service. These include pumps, hoist machines and other equipment with short economic lives. Dam, earth canals and other concrete hydraulic structures can serve quite a long time with normal maintenance, regular repair and occasional heavy repairs. Moreover, the earth dam and canals were partly contributed by farmers in the form of a labor force.

   Therefore, it is unnecessary to include the depreciation of fixed assets as a part of irrigation cost.

4. The proposed formula provides a more reasonable basis for determining ISF and would be easily accepted by farmers and local governments of different levels.

ACKNOWLEDGEMENTS

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Development of a Diversified Economy to Increase Financial Revenue for Irrigation Management

Qian Xu-lai[1]

ABSTRACT

IN THE PAST, many irrigation projects were short of funds for normal operation and maintenance expenditure. This led to the deterioration of the irrigation facilities. The Chinese Government introduced a series of policies for improving water management, especially the financial situation of the professional management organizations. This paper presents the relevant policies adopted by the state, especially the policy relating to economic aspects which has been a great success in increasing revenue of management organizations. This paper also discusses the prevailing constraints for the development of a diversified economy which requires urgent attention.

INTRODUCTION

Since the founding of the New China, the government has invested substantially in developing irrigation works. Irrigation has contributed to the sustainable development of agricultural production and played an important role in countering hazards related to drought and waterlogging.

In China, the large- and medium-sized irrigation projects were constructed by the state. After the construction of the projects, professional management organizations were established with responsibility for the following:

(a) Operating and maintaining the conveyance irrigation system.

(b) Collecting irrigation fees.

(c) Supervising the operation and maintenance of distribution systems, including on-farm application.

From the 1950s to the 1970s, it was a common practice to charge a low water fee rate in irrigation projects. In some cases, water was provided free of charge to farmers. The government paid the management staff salaries and all other administrative expenditures of the project management agencies. As a result, in many irrigation system, the shortage of funds for the maintenance of hydraulic structures resulted in serious deterioration of the operation and maintenance of irrigation facilities. Every year the government provided a large subsidy to the professional management organizations. However, in most cases this was very inadequate.

According to the investigation conducted by the Hubei Provincial Bureau of Water Resources before 1985, many irrigation agencies had experienced severe financial constraints (see Table 1).

In 1985, the State Council approved a proposal for the "reform of water management systems and development of a diversified economy." This program was implemented throughout the country.

In order to change the current situation, the water management system must be reformed. Water and land are the principal resources in irrigation projects. It is very important to make the most effective use of water to increase agricultural production during the drought years or seasons. At the same time, an effort must be made to promote a diversified economy to increase revenue for O&M expenditure and welfare of management staff.

The main provisions for reform were as follows:

1. Reform of water management system

   Each irrigation management office should carry out the "contract responsibility system" in relation to management and all operations. For example, a professional management organization might contract with a county or Prefectural Bureau of Water Resources for the operation and maintenance of an entire irrigation system with an approved budget. The production target must be fulfilled, while any surplus or deficit is accrued by the management organization.

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Table 1. Financial deficit in the management of irrigation projects.

Items	Number of project	Financial deficit (US$1,000)
Large-sized reservoir	42	1,228
Medium-sized reservoir	197	3,356
Pumping station	106	733
Diversion sluice	16	74
Total	361	5,391

2. Development of a diversified economy

Management and operation are the most important tasks for an irrigation management agency. At the same time, the management organizations are also encouraged to diversify their activities. This includes fishery, establishment of a small-sized hydropower station, forestry, water supply for domestic use, tourism, as well as the processing of agricultural and other sideline products for increasing the income to make up for the deficit of operation and maintenance costs.

3. For the promotion of the development of a diversified economy in the area of irrigation, the state will implement some favorable policies such as loans at low interest, reduced taxation for 2-3 years, etc.

In July 1985, the Chinese State Council issued a new national policy called "Disciplines on Re-assessing, Collecting and Managing of Water Fees for Water Projects." This stipulates the following:

(a) The water charge should be raised on the basis of the actual cost of water being supplied for different uses.

(b) The cost of water includes expenditures for O&M, heavy repairs and depreciation of fixed assets built from state funds.

Implementation of the above-mentioned provisions opened new prospects in the finance and economics of the irrigation districts. Many professional management organizations have achieved a balance in revenue and expenditure and have become financially self-sufficient with some surplus. The reform of the water rate system has been a remarkable success. Table 2 and Figure 1 show the annual value of collected water fees in the irrigation projects of the Hubei Province, from 1980 to 1990. Table 3 and Figure 2 show the annual value of collected water fees in the San Daohe Irrigation Project in the Hubei Province during the same period.

Table 2. Annual value of collected water fees of irrigation projects.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Collected water fees (US$ million)	1.6	2.5	2.6	2.7	3.0	3.8	5.7	6.2	7.8	8.1	9.1

Figure 1. Annual value of collected water fees in the irrigation projects in Hubei Province, 1980-90.

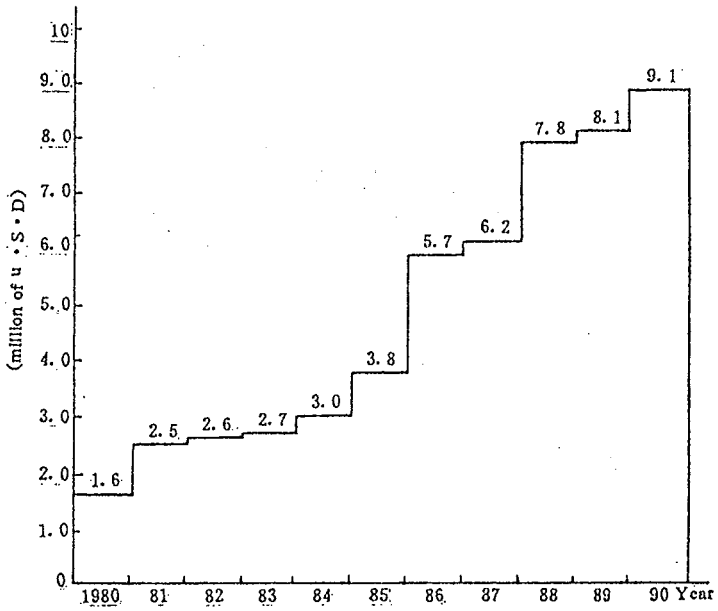

Figure 2. Annual value of collected water fees in the San Daohe Irrigation Project, Hubei Province, 1980-90.

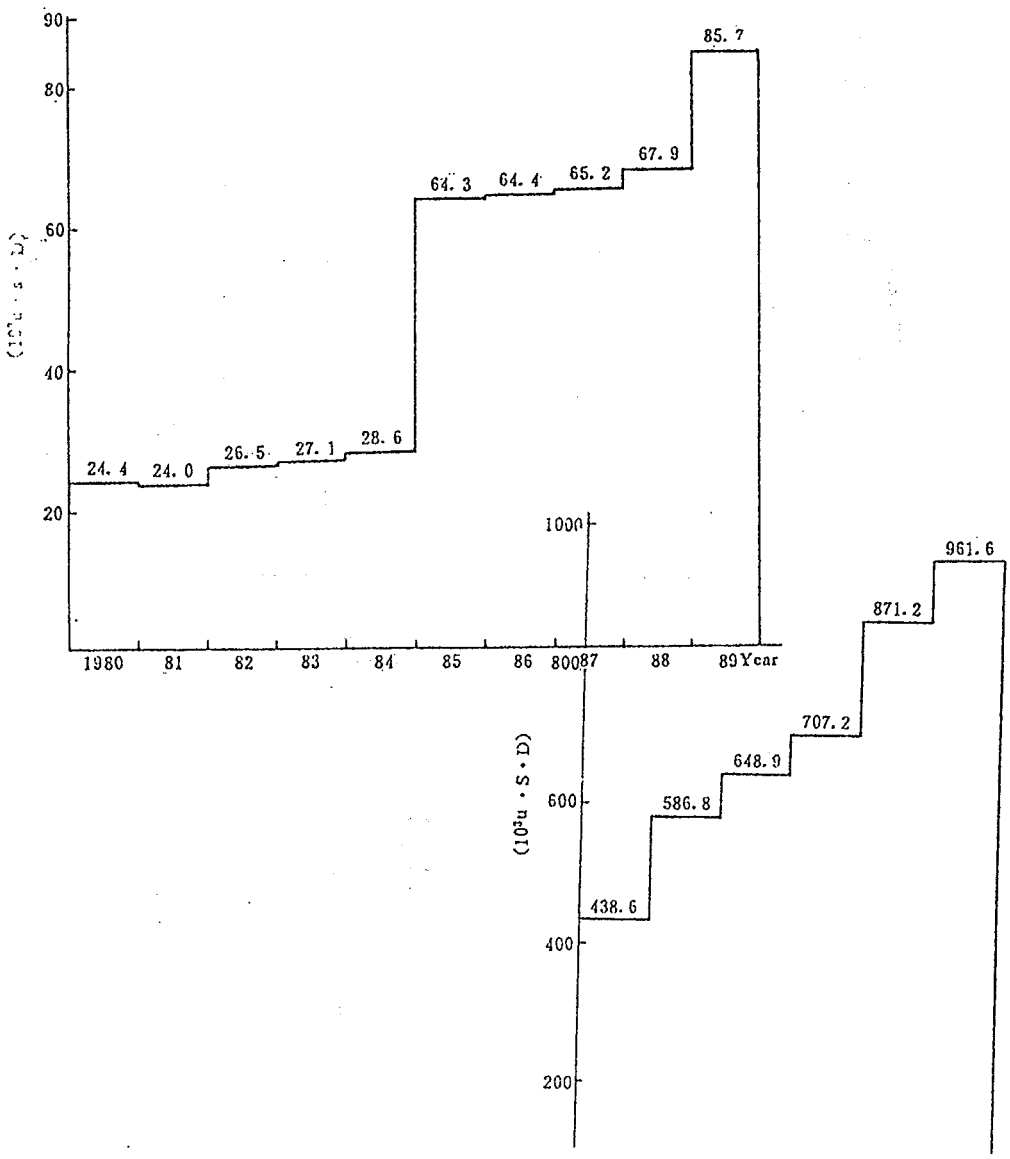

Table 3. Annual value of collected water fees of the San Daohe Irrigation Project.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Collected water fees (US$ thousand)	24.4	24.0	26.5	27.1	28.6	64.3	64.4	65.2	67.9	85.7

DEVELOPMENT OF A DIVERSIFIED ECONOMY

Reform of the water charges system is the key for increasing the income of professional management agencies. However, the financial self-sufficiency of most professional organizations are rather low to meet the normal requirement of O&M expenditures. This will cause the deterioration of irrigation facilities and lowering of the living and welfare standards of the professional staff. Therefore, the Chinese Government emphasized the development of a diversified economy with a view to making the institutions financially autonomous and to improving the welfare standard of the professional staff.

Development of a diversified economy in the irrigation district usually includes the following activities:

(a) *Fishery and aquaculture:* The total water surface area of the small-, medium-, and large-sized reservoirs over the country is about 2.0 million hectares (ha). This provides favorable conditions for fishery and aquaculture, such as artificial pearls, prawn culture, raising crabs ad turtles, etc. For example, in the Zhanghe Reservoirs the average annual income from fishery and aquatic products was about US$32,000 from 1987 to 1989.

(b) *Hydropower generation:* Along the canal or the dam site, the surplus water head may be used for small-sized hydropower generation perennially or seasonally. In the Zhanghe Reservoir, the annual income by small-sized hydropower generation is increasing yearly (Table 4).

Table 4. Annual income by hydropower generation.

Year	1987	1988	1989
Income (US$1,000)	61.8	90.7	155.5

(c) *Water supply for industry and domestic use:* With the rapid development of township enterprises and the increase in living standards of the population, the water demand of industry and domestic use has increased. The water charge for industry and domestic usages is much higher than that for agricultural usage. So, the irrigation management agencies should pay more attention to developing small-sized water supply projects to meet the water demand of rural industries and townships. At present, the sideline revenue from selling water for industrial or municipal use is the main income of the professional management agency of the Zhanghe Reservoir. This took up 26.3 percent of the total gross income from 1987 to 1989.

(d) *Forestry and agriculture:* There are a lot of uncultivated land, barren hills, and slope land, which can be reclaimed for afforested areas, tea plantations or orchards in the irrigation district. For example, in the Zhanghe Reservoir, 167 ha of citrus and 2.7 ha of tea have been planted in the wasteland along the river and in some high land.

(e) *Tourism:* The irrigation projects, especially the reservoirs, have the potential for tourism. The beautiful scenery provides favorable conditions for the development of tourism, water sports, canoeing, swimming, etc.

(f) *Other sideline enterprises:* According to the local conditions and resources, the irrigation management agency might initiate other sideline enterprises, such as [prefabricated members plant,] quarry, hydropower processing factories, transport, communication, and commercial works.

Table 5 Annual revenue of the Zhanghe Reservoir Irrigation Agency from various channels (US$1,000).

Revenue sources	1984	1985	1986	1987	1988	1989
Irrigation water fees	438.6	586.8	648.9	707.2	871.2	961.6
Industry water supply	114.2	183.2	251.2	238.0	249.5	143.6
Hydropower	116.3	142.7	151.7	176.0	230.7	261.8
Aquatics	97.6	123.1	61.4	61.9	90.7	155.5
Processing	24.5	34.6	29.0	29.9	27.3	38.6
Commerce	1.4	2.9	0.6	0.5	0.3	0.2
Plantation and others	5.4	7.8	19.1	21.5	27.4	11.0
Total	79.2	92.5	135.9	1709.9	245.3	350.9

Table 5 shows the annual revenue of the Zhanghe Reservoir Irrigation Agency from several channels: (a) irrigation water fees collected from agricultural use, (b) sideline revenue from industry and domestic water use (this constitutes the major portion of annual revenue), (c) revenue from selling electricity produced by hydropower plants, (d) profits from aquatic products, (e) profits of sideline enterprises and commerce run by the agency, and (f) revenue from plantation and other sideline enterprises.

DISCUSSION AND CONCLUSION

First, irrigation management offices should make major efforts to develop a diversified economy, including reform of the system of levying water fees and reduce of subsidy financed by the government budget. This will create a favorable condition towards financial autonomy or self-support from funds to be generated by the management agency itself.

The presupposition for the development of a diversified economy in the irrigation district first of all is to maintain irrigation facilities in good condition and make the most beneficial use of water to increase agricultural production. The management agency should take vigorous action to develop a diversified economy according to the local conditions and resources available.

Development of tourism and fisheries industries in the irrigation reservoir and the development of a domestic water supply should be done in such a way as to minimize any adverse effects on the environment, especially from water pollution.

Finally, in order to ensure a stable revenue from the diversified economy, it is very important to master the know-how of business operations and have access to market information. This is particularly important for hydraulic engineers and technicians.

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Irrigation Management Transfer in Yanguan Town of Zhejiang Province in China

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ABSTRACT

YANGUAN TOWN, UNDER the jurisdiction of Haining City of the Zhejiang Province, has a total cultivated area of about 1,000 hectares (ha). Irrigation and drainage are conducted fully by pumping stations. In this paper, the problems facing irrigation at this town and the methods and effects of irrigation management transfer are introduced. The tasks of irrigation management transfer in future are also put forward.

GENERAL FEATURES OF THE IRRIGATION AND DRAINAGE SYSTEMS IN YANGUAN TOWN

Yanguan Town is under the jurisdiction of Haining City, the Zhejiang Province. It is situated in the southern fringe of the Hangjiahu Plain, standing by the famous Qiantang River of China. Its terrain slopes gently, being high in the south and low in the north, and is featured by a crisscross network of rivers. With a subtropical climate, the four seasons vary distinctly. Although annual precipitation averages 1,300 millimeters (mm), droughts still occur frequently in autumn and winter because of the uneven distribution of rainfall. This town includes 12 villages and has a population of 22,200. The total cultivated land is 943.5 ha of which, 712.3 ha are planted with rice. The annual output of rice averages 12.9 tons per hectare (t/ha). The annual output value of cash crops is as high as 16,500 yuan*/ha (US$1,950/ha). In recent years, township enterprises have seen a rapid development. The gross output value of industry and agriculture of this town amounted to 250 million yuan (US$29.5 million) in 1992 of which, 225 million yuan (US$26.55 million) was from agriculture. The per capita income of farmers is 1,447 yuan/year (US$171/year). At Yanguan Town, irrigation is conducted mainly by lifting water from the Grand Canal and its tributaries. In this town, there are 28 pumping stations installed with 32 pumps, with their delivered horse-power totaling 423.5 kilowatts (Kw). The length of power transmission lines with a voltage of 10 kilovolts (kv) is 42 kilometers (km). The number of transformers with an electric power of 1,216 kilovoltampere (kva) is 27. The fixed assets of pumping stations in all are valued at 1.762 million yuan (US$208,000). The length of irrigation canals is 85 km, and that of drainage canals 16.2 km. Hydraulic structures to complete canal systems add up to 346 km. Their static head, averaging 3 meters (m), is suitable for both irrigation and drainage. Therefore, stable yields can be ensured in all of the cultivated lands despite drought or excessive rain. The assets in the form of irrigation projects are put under the collective ownership of the town level and village level. Within the town area, the irrigation management staff members number 76. Among them, 4 are specialized managers from the Irrigation and Drainage Management Station of Yanguan Town, a basically self-supporting institution which receives only a few subsidies from the government. The rest are village heads, who are assigned personal responsibilities for irrigation and drainage (normally there is one village head of this kind in each village), leaders and operators of pumping stations and weathermen. These people are generally under the dual leadership of the Irrigation and Drainage Management Station and the Villagers' Management Committee.

PROBLEMS OF IRRIGATION MANAGEMENT

In the past, a production team was taken as a business accounting unit in agriculture. Irrigation management followed the road of collectivization. Water charges were paid for by collectives. Management staff got their income the same way as other members of a production team did, i.e., making money by accumulating workpoints (a unit indicating the quantity and quality of labor performed, and the amount of payment earned, in rural people's communes). These practices were, by and large, appropriate at that time. However, with the introduction of the output-related system of contracted responsibilities and with the readjustment of cropping patterns, irrigation management has been facing the following problems:

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*Yuan is the Chines unit of currency; in 1994, 1 yuan = US$0.118.

Irrigation Regimes Do Not Match the New Farming System

In the past, irrigation was carried out on large blocks of farmland owned by production teams. Nowadays, it is done on small strips of farmland allocated to farmers. The area of these strips ranges from 0.1 ha to 0.2 ha. The busy season in farming is shortened. For instance, the time taken for sowing and harvesting wheat was 15 to 20 days in former years. However, it is now shortened to 5 to 7 days. Consequently, the irrigation period is also shortened, leading to a concentrated demand for water and irrigation disputes.

The Policy of Water Charges and Ways to Pay Irrigation Managers Are in Contradiction with the Output-Related System of Contracted Responsibilities

Strictly speaking, water charges are still paid for by villages as a collective. Irrigation managers are paid for through fixed salaries. Under this situation, some problems, like water charges were the same regardless of water consumption, and the salaries of irrigation managers were the same regardless of their conduct at work. The fact that farmers only use water but do not undertake relevant responsibilities has led to the squandering of water and has dampened the enthusiasm of irrigation managers.

The Significant Increase in Farmers' Income Has Contrasted Sharply with the Low Income of Irrigation Managers

The fixed annual income of irrigation managers was lower than 1/3 of that of the farmers. As a result, irrigation managers were in low spirits. Many of them who were both young and competent gave up their posts to make a fresh start in township enterprises. Hence, the team of irrigation management has been unstable due to lack of successors.

METHODS OF IRRIGATION MANAGEMENT TRANSFER

For the purpose of adapting to the reform in the system of rural economy and to the development of an agriculture with high production, good quality and high benefit, a reform in the framework of irrigation management, or the adoption of irrigation management transfer, becomes a necessity. Otherwise, the sustainable development of irrigation cannot be ensured. The measures of reform taken by the Irrigation and Drainage Management Station in the past few years are as summarized below:

Carryout Technical Innovation by way of Rehabilitating Pumping Stations and Canal Systems

From 1987 to 1992, a total sum of money as much as 1.346 million yuan (US$158.8 thousand) was invested for technical innovation of which, 311,200 yuan (US$36.72 thousand) was paid for through government subsidies; 120,000 yuan (US$14.16 thousand) through depreciation funds; 342,000 yuan (US$40.4 thousand) through profits turned over by enterprises subordinate to the Irrigation and Drainage Management Station and 573,800 yuan (US$67.7 thousand) through funds raised by villagers. As many as 32 low-lift pumps, newly developed by relevant agencies of the province, were installed to replace all of the low-efficiency ones. Irrigation canals, as long as 65 km, were all lined with concrete. As a result, the average overall efficiency of pumping stations throughout the town was raised from 0.5 to 0.85. Both water and power consumption were reduced by a big margin.

Adopting Irrigation Management Transfer

The economic benefit-related system of contracted responsibilities, in which the authority over management is separated from the title, was put into effect as follows:

Formulating a Joint Pledge of Irrigation Water Use

In this pledge, responsibilities, authority and interests of farmers and managers of pumping stations are stipulated clearly. It guarantees the day-to-day operation of irrigation systems.

Implementing the Economic Benefit-Related System of Contracted Responsibilities

The Irrigation and Drainage Management Station of Yuanguan Town and each of the Villagers' Management Committees, that have the title to irrigation projects, put forward a base price (on the basis of accounting various costs,

such as the prime cost of electricity, cost of upkeep, cost of project and mechanical maintenance, management expenses and salaries of staff members) and contracted the system. The contractors took over the entire irrigation system and exercised their authority over management in light of contracted specifications. Moreover, the contractors kept separate accounts and assumed the sole responsibility for its profits and losses.

Implementing a System for Monitoring the Post-Responsibilities of Contractors

The central point is that each individual was assigned specific tasks and the income was determined on merit. The aim was to overcome the so-called "equalitarianism," that each individual gets the same pay as others irrespective of his or her performance.

Formulating Strict Rules for Irrigation Water Management, Project Management, Mechanical Management and Financial Management

There were guidelines for irrigation management in the locality.

Developing a Diversified Economy

In 1984, the Irrigation and Drainage Management Station began to develop a diversified economy by making full use of its technical superiority and financial resources accumulated in many years. By the year 1992, the assets of enterprises which had been set up by the station were valued at 10.14 million yuan (US$1.197 million). The gross output value and the sum of profit tax for this year amounted to 21.05 million yuan (US$2.48 million) and 1.15 million yuan (US$136 thousand), respectively.

EFFECTS OF IRRIGATION MANAGEMENT TRANSFER

Reliability of Irrigation System Has Been Raised while the Cost of Irrigation Has Been Reduced

Irrigation management has been improved so that water demand from farmers can be satisfied promptly. At the same time, escalation of the prime cost of water and power has been restrained. Annual power consumption for irrigating one hectare of irrigated land has been reduced. For instance, power consumption in irrigation which was 316.2 kwh/ha in 1984 dropped to 181.65 kwh/ha in 1991 (Power consumption in irrigation for the past 10 years is as shown in Table 1). The collection of water charges has averaged 100 percent.

Table 1. Power consumption per unit area in irrigation from 1984 to 1993.

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Power consumption (kwh/ha)	316.2	273	336	240.75	274.5	251.7	319.2	268	271.4	181.65

Staff Members of the Irrigation and Drainage Management Station and Village Cadres Are Able to Pay More Attentions to Irrigation Development

In the past, staff members of the station and village cadres were kept busy with sundry duties of irrigation districts. For example, they were preoccupied with administrative duties and resolving many irrigation disputes. After the adoption of irrigation management transfer, they were only responsible for the coordination and supervision of irrigation management, checking at the end of the year whether the signed contracts have been honored or not and superintending the signature of new contracts for the next year. As a result, they can spare more time and energy to concentrate on project management, water resources management and the development of a diversified economy.

The Economic Performance of Irrigation Management Agencies Has Been Improved and the Team of Irrigation Management Stabilized

Because of irrigation management transfer and the development of a diversified economy, the family members of irrigation managers could be provided with opportunities for employment by enterprises set up by the Irrigation and

Drainage Management Station. As a result, the family financial situation of irrigation managers has been improving. Besides, a welfare fund for retirement has been established, so that irrigation managers can enjoy an endowment insurance. Furthermore, some 60 of the irrigation managers have been given the chance to participate in various training classes. These measures have not only stabilized the team involved with irrigation management, but also raised the level of competence of irrigation managers.

To sum up, it has been proved in practice that the adoption of irrigation management transfer has achieved very positive results.

TASKS OF IRRIGATION MANAGEMENT TRANSFER IN FUTURE

With the establishment of the socialist market economy, irrigation management will be further improved in 3 aspects:

1. The title will be further separated from the authority over management. More specifically, pumping stations will be managed by lease or contracted out to individuals.

2. The system of water markets will be introduced. On the basis of unified water pricing, volumetric water rate will be charged, treating water as a commodity. In the meantime, the water-saving irrigation technique for rice will be popularized so as to promote farmers in the use of water more efficiently.

3. Apart from running its own enterprises, the Irrigation and Drainage Management Station of Yanguan Town will support pumping stations of each village to develop a diversified economy in accordance with local conditions. Thereby, the income of irrigation managers will continue to improve, the economic viability of pumping station will be further strengthened and irrigation management as a whole will be directed to the road of self-development.

Irrigation Management Transfer in Laofangqiao Town of Yuyao City in China

Yi Yongging[1]

NATURAL ENVIRONMENT AND CLIMATE

LAOFANGQIAO, ON THE longitude of 121°01' E and the latitude of 30°01 N, is a town of Yuyao City which is located in the northeast of Zhejiang Province. Its total area is 15 square kilometers (km^2). Topographically, Laofangqiao Town lies in a plain area at river network zones. The total cultivated area of this town is 1,008 hectares (ha) and the percentage of area occupied by water surface of river [surface] is 70 percent. The average yearly temperature is 16.2°C and the average yearly rainfall is 1,300 millimeters (mm). Approximately 70 percent of the annual rainfall is concentrated from June to September. However, annual rainfall varies a great deal between years. In dry years, annual rainfall is 800 mm while in a wet year, it is 1,500 mm. Within the boundaries of this town, water supply for irrigation is inadequate. Therefore, water from the Siminghu Reservoir, which is 20 kilometers (km) away, is imported through networks of rivers to serve local irrigation. The elevation of this town ranges from 1.63 meters (m) (taking the Yellow Sea as datums plane) to 3.13 meters. The irrigated areas with an elevation lower than 2.9 m account for 600 ha. Laofangqiao is also a town that is frequently threatened by natural disasters such as drought, flood and waterlogging.

DEVELOPMENT OF IRRIGATION

In Laofangqiao Town, rice is the only grain crop grown by farmers. Double cropping is practiced. Rice fields as a whole are under lift irrigation. Before 1949, irrigation was conducted by the use of manpower-driven or animal-power-driven lifting tools. Starting from 1956, diesel-driven pumps were installed. In 1966, electric pumping stations were constructed. The construction of flood control dykes was initiated in 1984 and the electric, drainage pumping station with a lift ranging from 0.5 m to 1.1 m was completed thereafter. [Beginning from 1991,] the U-shaped concrete-lined canals were constructed. A new irrigation method of "shallow submerging and moistening" of rice fields became locally popular in 1993. This method saved 20-30 percent of water, while rice yields increased by 7-13 percent.

In China, a town government is an organization with state power at the local level. The government of Laofangqiao Town administers 17 villages and dozens of township enterprises. The gross output value of industry in this town amounted to US$23.8 million in 1993. Each year, the town government takes a proportionate sum of money from the profits that are turned over by township enterprises to subsidize the construction and management of irrigation and drainage systems. The annual subsidies vary from US$10,000 to US$30,000. Since 1982, the investment in irrigation and drainage projects in Laofangqiao Town totaled US$130,000. Government subsidies accounted for 38 percent, agriculture allowances provided by township enterprises accounted for 50 percent, while the remaining 12 percent was collected from farmers. The main irrigation systems in Laofangqiao Town are listed in Table 1.

IRRIGATION MANAGEMENT REGIME AND ITS PROBLEM IN THE PAST

Individual Village Management of Pumping Stations and Canals

Specified persons were assigned as pumping stations operators. These operators are water users at the same time. Maintenance costs were borne by the villages. Electricity fees as well as the salaries of the operators were paid in three modes. Depending on the collective economic performance of each village they are:

1. Full payment by their villages (two villages).

2. Partial payment by both farmers and their villages. Farmers had to pay US$8.8 to US$10.6 per hectare. The remaining sum was paid by their villages (total of three villages).

3. Full payment is done by farmers (most of the villages).

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These different approaches of irrigation management led to many problems, such as serious seepage of earth canals, overgrowing of weeds, insufficient capacity of water delivery and high irrigation cost. Power consumption was as high as 563 kw·hour/ha on average. The cost of irrigation was US$17-26 per hectare.

Joint Villages Management of Irrigation and Drainage Systems

The facilities that had to be managed include drainage pumping stations and irrigation pumping stations that serve more than two villages, waterlogging control dykes and water gates. Before 1990, there were no specified persons in charge of irrigation management in each of these villages. As a result, responsibilities were shifted to other villages and irrigation management was neglected. Before 1990, a technician was assigned who was responsible for the communal management of irrigation and drainage projects in each village in Laofangqiao Town. However, there were neither irrigation management agencies nor management staff at the local level. Therefore, the technician could hardly do his duties. Irrigation projects could not meet their potentials.

IRRIGATION MANAGEMENT TRANSFER

The Irrigation Management Organization

The Irrigation and Drainage Management Station of Laofangqiao Town was established in 1990. Owing to the irrigation and drainage systems, villages boundaries were crossed and the town area was divided into 7-drainage sub-areas and 3 irrigation sub-areas. Ten management groups were formed. Each project got persons that were specifically in charge of water management (Table 2). Village cadres and farmers who are dedicated and who possess mechanical and electrical skills were chosen as managers. Eventually, 61 farmers took part in the irrigation organization.

Payment of Management Staffs

Depending on the type of work undertaken, management staff were paid in two modes. One was to pay fixed salaries. The other was to pay hourly wages (Table 3). At fixed times arrangement for labor protection were provided by the irrigation and drainage management station.

Maintenance Costs

Agriculture allowances cover the maintenance costs. These are turned over to the town government by local township enterprises. The costs of US$1.7 to US$3.5 per hectare for electricity and the salaries of management staffs were covered through irrigation and drainage service fees, which were collected by the Irrigation and Drainage Management Station. If the collected fees were not sufficient the town government would make up the balance.

DEVELOPMENT OF DIVERSIFIED ECONOMY IN IRRIGATION AND DRAINAGE MANAGEMENT STATIONS

The staff members of the Irrigation and Drainage Management Stations were responsible for managing irrigation and drainage systems in Laofangqiao Town. At the same time, they made an effort to develop a diversified economy. For example, they were actively engaged in the design, construction and management of small irrigation and drainage systems. They were also involved in the promotion of new irrigation technologies and supplying materials needed for irrigation and drainage. From there activities, they could make an income, mentioned as technical services and administrative fees. Their income from the above sources in 1993 are as shown in Table 4.

These sources of income were used to cover daily expenses of the station, such as administrative costs, and expenditures on meetings, to pay the salaries of management staffs and to make up for any deficiencies in irrigation and drainage costs.

RESULTS OF IRRIGATION MANAGEMENT TRANSFER

Improvement of Irrigation and Drainage Performance

The organization of irrigation and drainage management, with the Irrigation and Drainage Management Station as its main body and village cadres as its backbone, has taken shape. Each post has been assigned to specified persons. Damages to irrigation and drainage projects caused by human factors could be avoided. Damages could be identified

at an early stage and be looked after immediately. As a result, irrigation and drainage facilities that are in good shape will be around 95-98 percent.

The Initiative for Management Work Was Stimulated

Each member of the management organization was assigned with specified responsibilities. Their responsibility, authority and interests were stipulated clearly. This stimulated their sense of responsibility and initiatives in irrigation management and their exposure to farmers.

Management Staffs Could Keep Their Minds at Their Work

Owing to a regular income from diversified activities, staff could keep their minds at their work. Consequently, a stable team of irrigation management was developed by the Irrigation and Drainage Management Station of Laofangqiao Town. This situation improved the management of irrigation and drainage systems, which relieved farmers. Furthermore, leaders of the town governments and villages, as well as farmers were delighted to pay more attentions to irrigation management.

PROSPECTS OF IRRIGATION MANAGEMENT TRANSFER

Establishing Irrigation Cooperation

The Irrigation and Drainage Management Station planned to establish an irrigation cooperation in 1994. Of the farmers' own free will, the Station will steadily extend its management to the pumping stations of each village. They will also implement the contracting of irrigation to farmers.

Experiments with Irrigation Management Transfer and the Training of Operators and Farmers

In 1994, the Station will make further experiments on the adoption of irrigation management transfer. According to the actual costs of irrigation in the past 3 years, a base price of contract will be fixed. Operators will be invited through proficiency assessment. The operators and farmers will receive a training. The new irrigation method of "shallow submerging and moistening" of rice will be promoted in all rice areas in Laofangqiao Town. As a result, both rice yields and farmers' income will dramatically increase.

Forming a Management Regime of [Sound Circle] With Self-Development

Irrigation management transfer will result in the productivity of irrigation water. Consequently, irrigation water can be saved, power consumption can be cut down, cost of irrigation can be reduced and more profits will be made through contracts. In addition, new approaches to develop a diversified economy, which vitalize the framework of irrigation management, will be tried out. Hence, a management regime of [sound circle] with self-financing self-development will be formed. Ultimately the irrigation district will become more productive and contribute more to the society.

Table 1. Major irrigation systems in Laofangqiao Town, 1994.

Type	Quantity	Unit	Power (Kilowatt)	Size
Earth canals	60	km		Width:0.5-1.2 m
Concrete-lined canals	7	km		Width:0.3-0.6 m
Irrigation pumping stations	125	in No.	1,066	D*:100-300 mm
Drainage pumping stations	12	in No.	411	D*:300-950 mm
Flood control dykes	16.1	km		Height:0.8-2.0 m
Water gates	27	in No.		Width:2.8-3.0 m

* Diameter of pump intake.

Table 2. Irrigation facilities and number of management staff in each subarea.

No.	None	Name of sub-area	Area (ha)	Pumping stations		Water gates		Waterlogging control dykes		Total No. of managers
				Stations	Managers	Gates	Managers	Length (km)	Managers	
1	Drainage sub-areas	Chuanshan	104	4	4	2	2	2.4	2	8
2		Zhishan	105	1	1	3	3	0	0	4
3		Yujiachao	77	2	2	7	7	4.4	5	14
4		Dazhatou	81	1	1	3	3	2.6	5	9
5		Xiaoyiyan	106	2	2	5	4	2.7	5	11
6		Xijie	33	1	1	0	0	2.0	2	3
7		Hongqi	100	1	1	3	3	3.0	3	7
8	Irrigation sub-areas	Dongjie	17	1	1	1	part-time			1
9		Pengcheng	47	1	1	2	2			3
10		Xhishan	53	1	1	1	part-time			1
Total		10	723	15	15	27	24	17.1	22	61

Table 3. Management cost and staff salaries.

Type of work	Difference	Payment	
		By fixed salary (US$/year)	By the hour (US$/hour)
Operation of pumping station	with electric skills		0.1
	with mechanic skills		0.12
Management of water gates	gate leaf	6	5
	gate lift	4	2.6
Management of dykes		4	

Table 4. Income from a diversified economy at the Irrigation and Drainage Management Station in 1993.

Items	Scale	Income (US$)
Dealing in goods and materials needed in irrigation and drainage	US$2,000	388
Contract to construct concrete-lined canals	3,200 m	1,900
Construction of bank protection work	1,160 m	272
Administration of highway construction	US$3,400	130
Total		2,690

Self-Financing Irrigation Districts Under the Hubei Water Resources Project

Huang Zejun and Liu Houbin[1]

BACKGROUND

IN 1988, THE Water Resources Bureau (WRB) of the Hubei Province made extensive investigations into the institutions in the water resources sector. It was found that more than 95 percent of these institutions had deficits and that the irrigation facilities were old and seriously damaged. Because of this the provincial WRB started studying the possibility of transferring the management of irrigation and drainage projects, which was in accordance with the new World Bank policy on "Irrigation and Drainage Districts" (IDD). The Dongfeng Canal Irrigation District and the Zhanghe Main Canal No.3 Irrigation District were selected as pilot districts. Subsequently, with financial and technical assistance from the World Bank experiments were planned for implementing irrigation management transfer. The present state of the study is to identify in what ways the transfer can take place. A study group has been set up, basic data collected, ways of transfer studied, financial analysis carried out, an Interim Report made, and discussions made with experts from the World Bank and the FAO. National and international study tours are planned to collect related materials from other places. This should not only help us to determine how the experiments can be implemented but provide us with details on the way transfer can take place in China, especially in the Hubei Province.

The Zhanghe Main Canal No. 3 Irrigation District as mentioned earlier is one of the pilot districts. Water is diverted from the General Main Canal of the Zhanghe Reservoir and is used to irrigate 90,000 hectares (ha) of hilly area around the Jingmen City. The canals that run along the ridges of the hills are mainly used for irrigation. There are 8 medium reservoirs and 62 small reservoirs in the irrigation district. However, these reservoirs are not managed by the management unit of the Main Canal No. 3. Figures 1 and 2 show, respectively, the present institutional structure and flow chart of water charge collection of the Main Canal No.3. As the level of the water fee is low and mainly cut apart, the financial situation of the Management Unit of the Main Canal No.3 is poor. Moreover, there is little benefit from the diversified economy. For the year 1990, 1991 and 1992, the annual deference of income and expenditure was 433,000; 438,000 and - 1,262,000 thousand yuan RMB, respectively.[2]

The Dongfeng Canal Irrigation District is the second pilot irrigation district. Water is diverted from the Shangjiahe Reservoir, the third reservoir downstream of the Huangbohe River. The water is used to irrigate 73,000 ha of hilly and mountainous areas in the Yichang County, the Zhijiang County and the Dangyang City of Yichang. The diversion capacity of the main of the Dongfeng Canal is only 13.5 cubic meters per second. In order to meet the crop water requirements, water is diverted throughout the year to fill 12 medium reservoirs and 182 small reservoirs in the irrigation district . The irrigation system is a 'Long-Vane-with-Melons' system with high level of regulation. The area that is directly irrigated from the canal amounts to 1/6 of the total command area. The remaining part is indirectly irrigated by water from the smaller reservoirs: 39 percent from the Dongfeng Canal System, and 61 percent from the medium and small reservoirs. In accordance with the above infrastructure, the management has four levels (Figure 3): the Dongfeng Key Canal System, the medium reservoirs (which are managed by the counties), the small reservoirs (which are managed by the townships) and the mini reservoirs and farm canals (which are managed by the villages). Figure 4 shows the flow chart of water charge collection in the Dongfeng Area.

In addition to the facts that the portion of indirect irrigation is large and that the operation of the Long- Vane- with -Melons System is complicated, the management of the Dongfeng Canal is characterized by its dependency on authorities at different levels. From a financial point of view, the Dongfeng Canal Management Unit has favorable conditions to develop hydropower and domestic water systems. Except for overhaul and depreciation, water fees almost cover the daily operating expenses.

NECESSITY AND STRATEGY OF IRRIGATION MANAGEMENT TRANSFER

For four reasons it is necessary to carry out irrigation management transfer at the same time that the irrigation facilities are rehabilitated with a World Bank loan:

1. The facilities may deteriorate rapidly, which may induce new investment after a few years;

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[1]Senior Engineers, Water Resources Bureau of Hubei Province, People's Republic of China.

[2]US$1.00 = Yuan 5.7.

2. The financial burden will continue to be heavy;

3. It will not be possible to meet the farmers' demands, and hence their participation cannot be ensured; and

4. The management institutions and their personnel will continue to be poor.

The idea behind irrigation management transfer is to change the organizations that carry out plenary management of water resources works and key canals. Water Users' Associations (WUAs) have to become a self-financed economic cooperative that can carry out management of the lateral and smaller canals and that can participate in the management of the entire irrigation district. The problem of property rights has to be solved by the joint-stock system. The operating mechanism has to be changed and farmers' participation in policymaking and management be ensured. The water fee will be divided into two parts: one part is for the branch canals and the larger canals, while the other part is for the smaller canals. The latter part is the source of income of the WUAs. To supplement the lack of operating funds with the low water fee the amount of government subsidies have to be determined. The subsidy will be reduced with the development of the economy of the countryside and the increase in the level of the water fees. Ultimately, the management institutions have to become self-financing.

PLANS TO REORGANIZE WATER MANAGEMENT

Water Resources Bureaus are state-owned organizations that presently undergo a reform in the direction of state-owned and public-operated organizations with a stock system. Water Conservancy Bureaus are social public organizations that mainly serve farmers. Consequently, they do not make profits. That is why the reforms will be different from those in private enterprises. For instance, administrative interference has to be reduced and the nation's strength used to support the water conservancy management units. This is a problem that has to be studied. There is a difference between the two pilot regions in terms of their adjustment to the current situation and the level of understanding.

The Fist Plan of the Dongfeng Canal Irrigated Area

The first plan of decentralized management at four levels is as follows (Figure 5):

Level 1: The Dongfeng Water Management Bureau is subordinated to the Yichang City Water Resources Bureau. Under it there are seven Water Management Departments (including Shangjiahe Reservoir) and corporations dealing with township water supply and water-power supply. The management of the headworks, trunk canals, main canals, two medium-sized reservoirs, as well as of the unified release of water is carried out in the irrigated area.

Level 2: Under Yichang, Zhijiang and Dangyang Counties there are ten Water Management Departments managing their medium-sized reservoir and their main canals. The first and second levels deal with the adjustment of the accounting methods of measuring water costs of medium-sized reservoirs and distributing water fee in the promised proportion. Previously, measurement was done at the inlet of the reservoir so that all the reservoirs had to save water and could not use the full capacity. This is to prevent the water from being wasted.

Level 3: The former twenty-two township Water Resources stations will remain. These stations generally have jurisdiction over the branch canals, lateral canals and the small reservoirs within the townships. These stations are responsible for maintenance, the distribution and use of water, collecting water fees and resolving conflicts among villages. These stations are managed by the counties' Water Resources Bureaus. Financially, they depend on discount water charges and other income sources.

Level 4: Four hundred and sixty User's Associations will be established at the village level. The village committees are directly elected by the farmers, so that the associations represent the farmers' interests. The association generally assigns three persons to be charge of the canals, ponds and small reservoirs below the lateral canals. Water is distributed to groups as well as to households. The water fee is collected and handed over to the water resources stations.

The status quo of the property rights, financial relations and the participation of the farmers is basically maintained. The Yichang Municipal Water Resources Bureau owns the property right of the Dongfeng Canal. The counties' and cities' Water Resources Bureaus maintain the property right of the important medium-sized and small reservoirs and

the canal system. The Village User's Associations have the property rights of ponds and field channels. The farmers take part in the meetings held at different levels of the Water Management Bureau, departments, and stations. The flow of water charges between the Village Users' Association, Water Resources Stations, County Water Management Departments and the Dongfeng Management Bureau is the same as the present system. Water Resources Stations and Village Associations are dependent on the collection of water charges below the level of the branch canals.

From the evaluation of the first plan it is learnt that:

a. It is possible to release water in a unified way after changing the way water in a medium-sized reservoir in the Dongfeng Canal is checked.

b. The relationship between administrative subordination and the property right corresponds with the present situation; in practice, there will be little interference.

c. There are many levels of management. Water resources stations are independent, but their management is limited and the representation of the user is poor.

d. The associations are village-based. Therefore, their representation is strong, but their scale is too small and there is no independent and fixed organization. Therefore, it is hard to coordinate contradictory water uses. Farmers' participation in the management is limited.

The Second Plan: Management at Three Levels

The first and the second levels of the second plan are the same as those described in the first plan (Figure 5). At the third level, property rights and management of the canal, small reservoirs and ponds below the branch canal inlet belong to the Water Users' Associations (WUAs). The associations are formed out of one or several villages. This makes management easier. The association has a Board that is formed to lead and supervise the work carried out by the association. The village representatives form the main body. The Water Resources Stations, as well as district and farmers' representatives join the Board. The association has a manager with technicians, an accountant, a person in charge of water and workers working under him. Five to seven persons form the organizations' regular efficient body.

Property rights and financial matters are organized as follows. Property rights and financial relations at the first and second levels are the same as those in the first plan: no changes in the status quo. Property rights below the branch canal and the small reservoirs are with the WUAs. These rights are the farmers' reward for their labor contribution in the project. The WUAs collect water charges above and below the branch canal inlet and hand them over to the Dongfeng Irrigation District. The level of water charges below the branch canal inlet are decided separately and are used to cover the costs of operation and maintenance.

From the evaluation of this second plan it is learnt that it corresponds with the characteristic of the "Melons-on- Vine" Irrigation System, which maintains the management structure above the branch canals. The plan supports farmers' participation in management and it helps to reduce operation costs and to collect water charge. Still, it is rather difficult to deal with the relationship between Water Resources Stations and the Water User's Association. This plan may be seen as a transitional or temporary model of management.

The Third Plan: State Ownership and Private Management at Two Levels

The third plan comprises management at two levels (see Figure 5). At the first level, the owners include Yichang City, Yichang County, Zhijiang County and Dangyang City Water Resources Bureaus. The Deputies of these units are organized in a Board that manages the Dongfeng Irrigated District. They follow a system of joint responsibility for managing the canal system and reservoirs above the branch canal inlet in the Dongfeng Irrigated Area. The second level is the same as the third level of the second plan.

At present, property rights above the branch canal inlet remain unchanged, but accounting the capital and deciding the ownership of the property have become a joint responsibility, as in a stock company. Joint responsibilities include the provision of labor to create assets for existing as well as new and old projects. All the associations are also the shareholders and have the right to take part in the shareholders' meeting in policymaking and in management. Property rights below the branch canal, including small reservoirs are either transferred to the association or are commonly owned by the County Water Resource Bureaus and the WUAs. Water charges are divided into two levels : above and below the branch canal inlet and are collected by the associations. The owner's units of the corporation (Municipal and County WRBs) can keep some management cost in a certain proportion.

The third plan is beneficial to decentralized management. Since property rights are not transferred the plan embodies the principles of both state ownership and public management and the change of inner operation mechanism. Municipal and County Water Resources Bureaus are the main owners that control the Board and that have the right of policy decisionmaking and leadership. However, the Chief Manager is in charge of the daily operation. The plan reduces the number of administrative levels; it reduces the operation costs by recovering water charges. It stimulates self-support and bring about great changes in the administrative system. This is also the reason why it is difficult to put it into practice. People have no such habits or experiences and the interests in all aspects have to be adjusted. The user's associations are both shareholders and users and take part in policymaking and management. Responsibilities, rights and interests are all unified below the branch canal. The difficulty lies in the fact that there are no precedents but the problems of farmers' consciousness of participation and the status of water resources stations.

Below, the three alternative plans to change the management of the Dongfeng Canal Irrigated District are compared. The first plan, with four levels of management, is the most practicable one. The second plan supports users' participation and fits in with the status quo of the first and second level structure. The third plan, with only two levels of shared management is an ideal plan. The basic idea is all right, but there is no precedent for it in China and the plan needs to be further studied before it can be implemented.

The First Plan of the Zhanghe No. 3 Main Canal Irrigated Area

The first plan aims to maintain the management of the canals and medium reservoirs separately at two-levels. The management structure of the No. 3 Main Canal is basically the same as is shown in Figure 1. At the first level, the No. 3 Main Canal Water Management Department maintains its present jurisdiction, which goes down to the diversion points of the branch canals. At the second level, the distribution groups below the former management section are transferred down to the user's association. Generally, one branch canal forms one association, including one or several villages. There would be seventy five WUAs. The structure of the WUAs would be the same as the ones mentioned in the second and third plans of the Dongfeng Irrigation District.

Property rights above the branch canal belong to the Jingmen Municipal Water Resources Bureau, whereas those below the branch canal will be transferred to WUAs as assets in turn for their labor contribution. Water charges consist of two parts: one part is above the branch canal inlet and it is handed over to the Water Management Departments by the associations to pay for the operation costs, water source fee to the Zhanghe Reservoir as well as other costs; the other is below the branch canal inlet and is collected on the legal norm to be used to maintain engineering management and the expenditures of the associations. The association makes a contract with the Water Management Department and takes part in the meetings, management and policymaking activities.

This plan is not beneficial to unified release water in the No. 3 Main Canal and the reservoirs. The structure of the associations has a good foundation (because of earlier experiments) and [its goals] can be realized. Property rights are completely clear in this kind of two-level management. Water charge can be directly collected. And the plan is strong in economically managing operational costs.

The Second Plan: Management of Unified Canals and Reservoirs at Two Levels

At the first level the medium- sized reservoirs and the Dabiwan pumping station that are now under the municipal jurisdiction are put under the administration of the No. 3 Main Canal Irrigated District. The aim is to carry on unified release of water. Under the district there are twenty management sections (including four central sections, five medium-sized reservoirs and the Dabiwan Pumping Station) that manage the canals and reservoirs above the branch canal inlet. The second level is the same as described in the first plan.

Property rights, financial matters and farmers' conditions are the same as described in the first plan.

This plan is more beneficial to the unified dispatch of water resources than the first plan. It can ensure water supply and reduce the waste of water. It is beneficial in making full use of water and soil resources to develop diversified activities.

From comparing the two plans it is learnt that the second plan is better than the first one. Property rights of canals, reservoirs and stations belong to the Municipal Water Resources Bureau, so that it is not difficult to put the plan into practice. Besides, the water user's association of the No. 3 Main Canal has good foundations for putting the plan into practice (water supply, power generation, industry and trade).

SELF-SUPPORT AND SELF-FINANCING

The idea behind self-support is that three different maintenance grades (A,B, and C) are used and that water charges are collected to recover the expenses of the following facilities and services:

A. The costs of the regular management, maintenance and annual repairs.

B. Overhaul costs.

C. Basic depreciation.

No matter what standards are used, the net income from each of the diversified water use sources (irrigation, industry and trade) can only be partly used to improve the financial situation and the welfare of the staff in the management units. Income and expenditures of water user's association depend on the collection of water charges.

The outline of the financial plan looks as follows:

1. The companies in the irrigated area collect water charge for agricultural irrigation according to the standard of Grade A. The norms and the way of counting and collecting the water fee [for] below the branch canal inlet are explicitly mentioned to [foresee] in the income for the water user's association.

2. The state will cover the cost of overhauls in the irrigated area in the annual investment in the capital construction of water conservancy or in other special funds in order to reach the level of Grade B.

3. The management units will not take care of the depreciation of fixed assets, while the state will be responsible for the renewal and reform costs of the irrigated district according to the plan so that self-support of the irrigated district may reach the level of Grade C.

4. The management reduces the number in administrative levels in order to increase the income by increasing the output and by making full use of water, soil and man power. If the above three conditions are satisfactory met, efforts will be made to surpass the level of Grade C (to make proper profit) of self-support.

5. The water user's association has its standing agency, fixed assets and water charges to ensure regular operation of the projects and reasonable distribution of water, so as to lessen the farmers' burden (to avoid the misappropriation by the townships, conflicts over water, extra expenses and so on).

6. The owner units: the Municipal and County Water Resources Bureaus have the advantage of making macroscopic control. Besides, they can draw the legal management fee and divide profits according to the rules and regulations.

IMPLEMENTATION DIFFICULTIES

It is difficult to formulate and subsequently implement a new financing policy under the present situation. Presently the government subsidizes the supply of water, and, consequently, the level of water charges are low. In the future, the fees will be determined by the actual cost of water. Local Departments of Finance and Water Resources Departments [of the governments] need to reform their investment policies.

One of the difficulties with establishing and managing self-financing irrigation districts is that the administrative system (in which only the administration at village level are administered by farmers themselves) is extended to branch and lateral canals which cut the irrigation system into different sectors. If the branch canals and smaller canals are to be run by WUAs, the position and functions of townships and the Water Resources stations of the townships will be the key problem.

The following difficulties of the collection and direct use of water fees remain:

1. At present, the Water Resources Bureaus at the various levels as well as the Water Resources stations of the townships use the basic water fee to fill the gap in the operation funds.

2. Water Resources stations of the townships, as well as Finance Departments and Agricultural Economy Stations, might object the reform because they do not receive anything of the collected water fees.

3. The existing Irrigation Management Units will worry about losing support from government departments to collect water fees [and to the living of staff and laborers].

Other difficult issues with the institutional reforms concern the reduction of staff and the transfer of expenses to be made. The current irrigation management institutions are financial burdens, and the institutional reforms mean that these burdens will be transferred. Furthermore, possibilities to make staff redundant and to 'socialize' relevant functions depend on the progress of the reform of the entire society.

The policy law and decree do not mention anything about the setting of water fees for canals below the branch canals. Therefore, it is necessary that the Central Committee, as well as the Water Resources Department and the Price Departments make investigations into this and come up with a policy.

Changing the management of water management bureaus, implementing joint-stock systems, establishing WUAs and getting their participation in the management are new things to cadres, management staff and farmers. A lot of work needs to be done. Property rights in the joint-stock system need to be determined. The stock distribution, the operating mechanism and the details of management regulations of irrigation districts should be studied carefully. Farmers need to be encouraged to take part in irrigation management. Propaganda to get support for the reforms from government cadres and irrigation staff need to be carried out.

TRANSFER POSSIBILITIES

The Central Committee's reform policy has created a good environment for irrigation management transfer. This policy includes programs like "setting up of modern enterprises," "transfer of government functions" and "deepening the reform of rural economies." Some of the 50 items concerned with the development of a socialist market economy support reforms that are similar to the transfer of irrigation management. This is clearly demonstrated by the present reforms taking place in many provinces and cities.

The "Water Law" and various decrees and policies provide a basic legal framework.

Studies show that farmers like to manage sub-canals and want to take part in the management of larger canals. The irrigation management institutions also want to improve their financial positions and maintain the canals properly with the direct cooperation of water users.

The pilot districts provide a good base for management experiments. Studies on reforming the Irrigation Districts have been carried out, and implementation of the World bank financed project will strengthen the material base.

AN IMPLEMENTATION PROPOSAL

Irrigation management transfer has to [be started within the five years of the is to be] started during the five-year period of the implementation of the project by using the World Bank loan and has to be continued for several years. This has to be a step by step procedure that requires careful planning. The proposed procedure is as follows :

1. Accomplishing the study on institutional reforms of the two pilot districts, with the technical and financial support from the WB.

2. Presenting the reform proposal to the provincial government and related prefectures and cities for support and approval when the appraisal by the World Bank is passed. Legal problems will be examined by relevant People's Congress.

3. Reform is to be started during the implementation period of the Project:

   A. Training of staff of related water resources bureaus and management institutions, discussion on the selected proposal.

   B. Selection and training of organizers of WUAs.

   C. Checking of the assets of the management institutions; determination of property rights; developing detailed operating mechanisms, regulations and financial rules.

   D. Transferring existing management units to new ones.

   E. Training of farmer water users; organization of WUAs; transfer of property rights of small canals;entrusting WUAs with their own rights to collect water fees, expenses and management of irrigation works.

F Transition to a state in which the new irrigation management units collect water fee directly from water users and use it for the operation and maintenance of the irrigation facilities.

G Reduction of social functions and staff in the new management units in order to reduce expenditures. This depends on the progress of the reform within the entire society.

4. Monitoring of the new operating mechanism, evaluation at proper time (by the World Bank and domestic-related departments), evaluating experiences, determination of ways for institutional reform, developing detailed implementation guidelines, and step by step carrying out of the implementation in other irrigation areas.

Figure 1. The present institutional structure of Zhanghe 3 Main Canal.

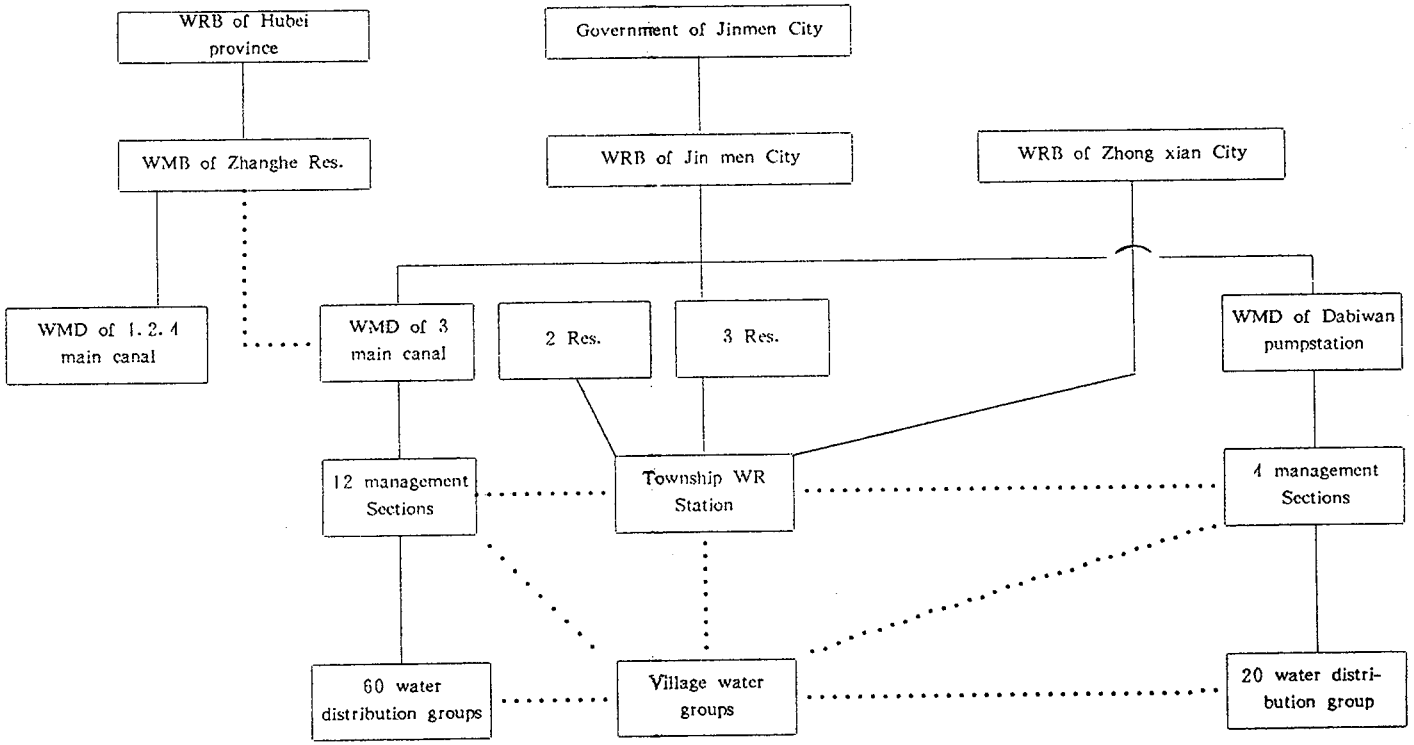


Figure 2. Flow chart of water charge collection in Zhanghe 3 Main Canal.

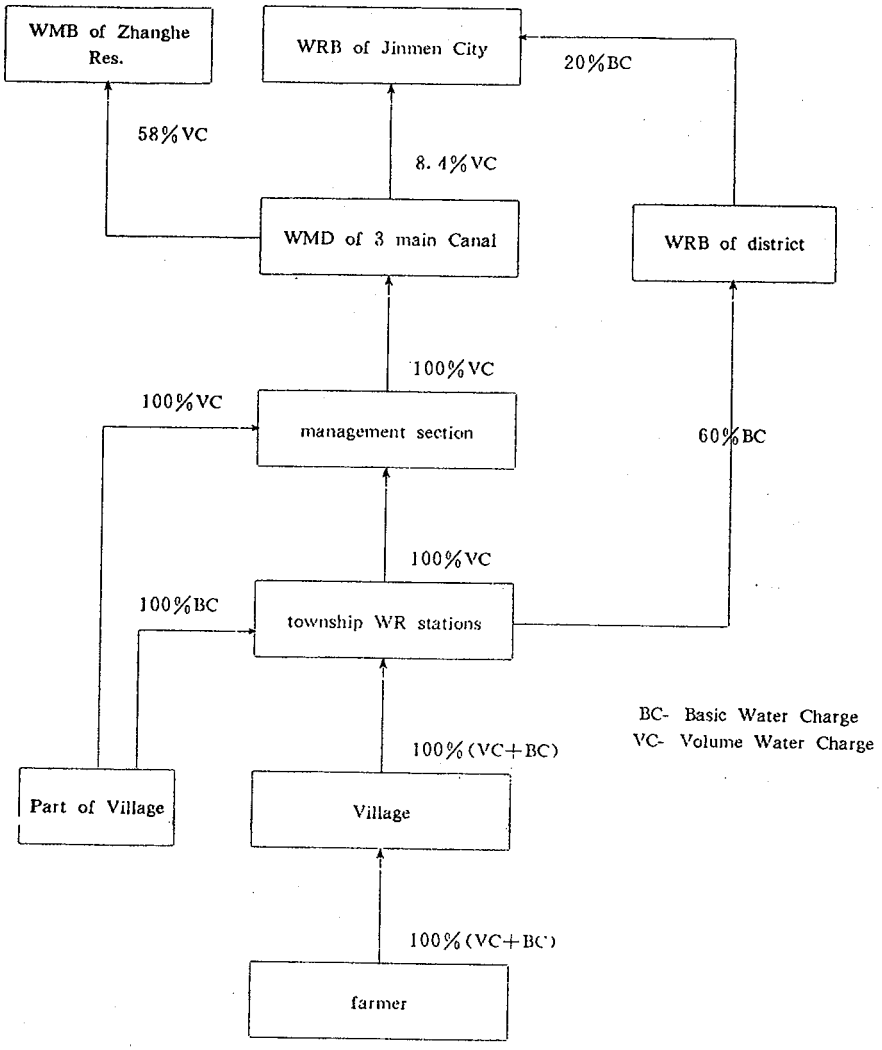


Figure 3. The present institutional structure of Dongfeng Area.

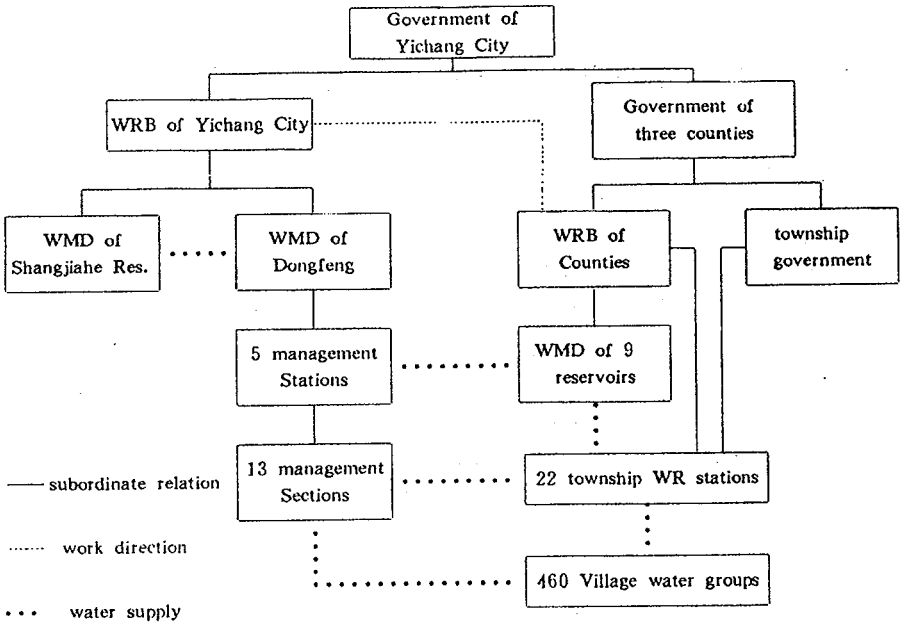
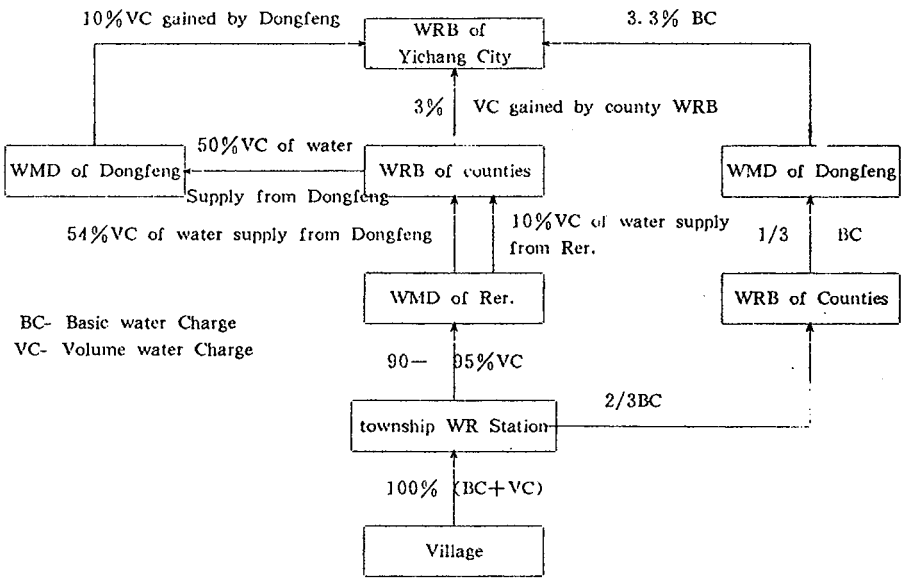


Figure 4. Flow chart of water charge collection in Dongfeng Area.



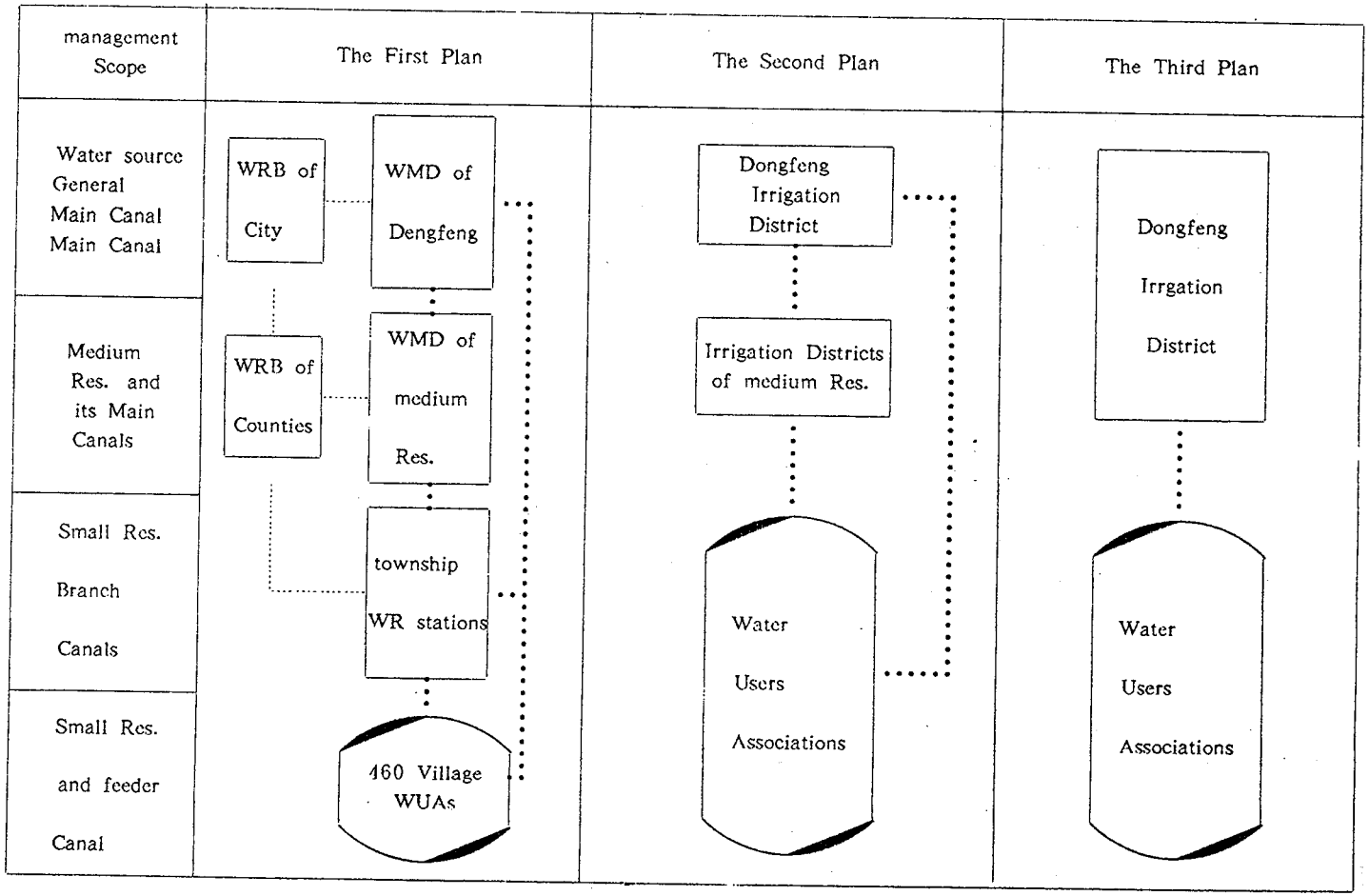
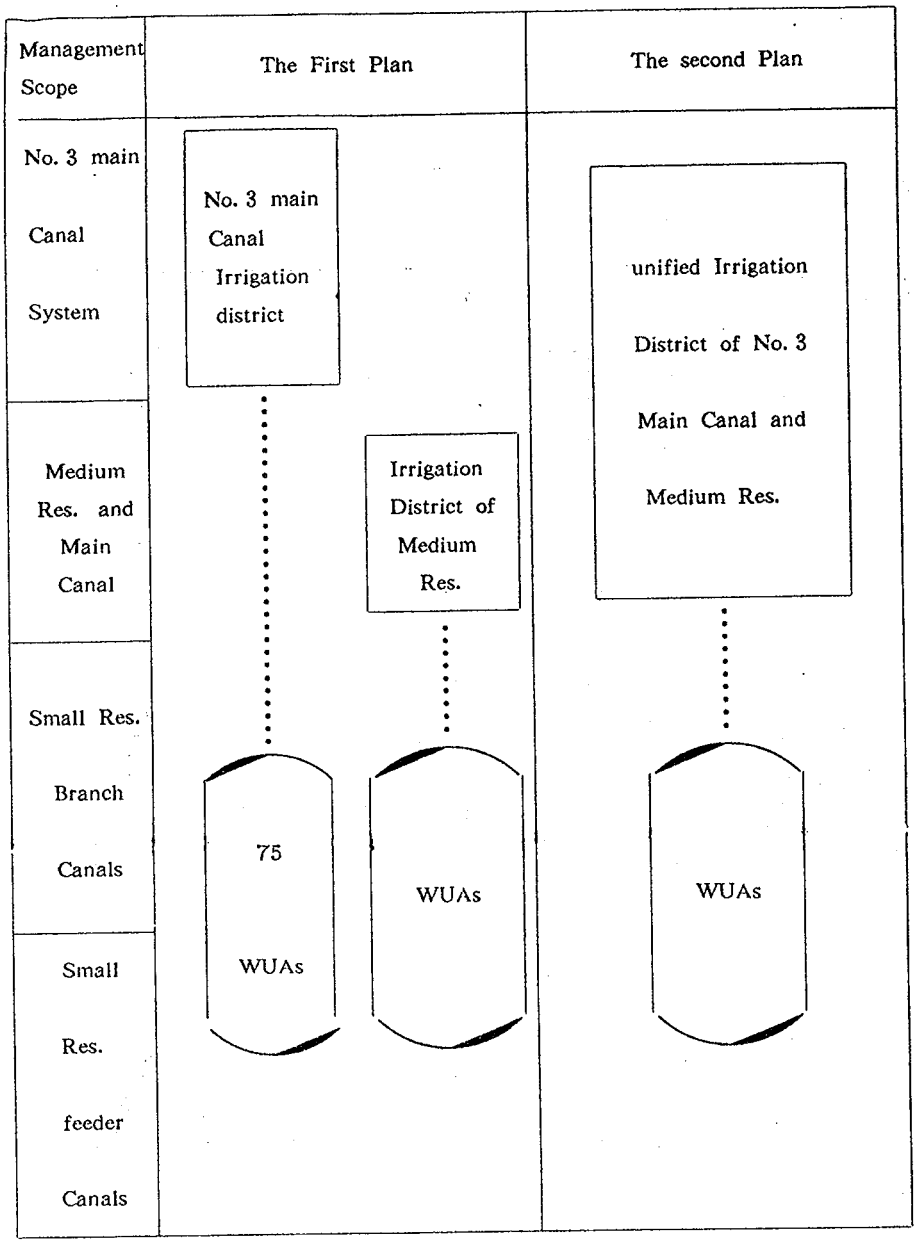

management Scope
The First Plan
The Second Plan
The Third Plan
Water source General Main Canal Main Canal
Medium Res. and its Main Canals
Small Res. Branch Canals
Small Res. and feeder Canal
WRB of City
WMD of Dengfeng
WRB of Counties
WMD of medium Res.
township WR stations
460 Village WUAs
Dongfeng Irrigation District
Irrigation Districts of medium Res.
Water Users Associations
Dongfeng Irrgation District
Water Users Associations

Figure 6. The proposal of institution for Zhanghe No. 3 Main Canal District.



Yellow River Irrigation Management Organization Transfer and Results Analysis in ShouzhangJi Township

Zhou Zhenmin

ABSTRACT

THE PRESENT PAPER is, firstly, to introduce the basic situation and problems existing in irrigation management organization of ShouzhangJi Irrigated District of Liangshan County, Shandong Province. Belonging to gravity irrigation, the district covers a total area of 41.32 square kilometers (km^2), and has 2,693 hectares (ha) of arable farmland, 2,334 ha of effectively irrigated farmland, 48 villages and a population of 30,920. Since the realization of the production contract system in 1980, the investments from both local and state governments became more and more limited. The state-funded irrigation management organizations were not able to take on all of the irrigation project construction and necessary management jobs. The function of irrigation projects and agriculture output went down. The farmer incomes decreased seriously. Therefore, it is urgently necessary to improve irrigation facilities and find the best irrigation management forms. Secondly, the paper deals with the present irrigation management organization system as well as on how it was transferred from the old system to the present one. The paper studies the obligations and the source of funds related to present irrigation management organizations, as well as how the irrigation management organizations mobilize funds which are necessary for irrigation system rehabilitation and operation and maintenance (O&M).

Considering the construction, rehabilitation and planning of transferred irrigation management systems are more difficult than before, the paper introduces the principle and method of irrigation project construction after irrigation management organization transferred. The quality supervision methods of irrigation projects have also been studied in the presentation.

Finally, the benefits resulting from transferred irrigation management organizations have been analysed. The paper also summarizes the experiences related to how the irrigation management organizations are transferred more effectively. The present study shows that the irrigation management organization transfer of ShouzhangJi Township has resulted in desirable effects.

BACKGROUND

Situated in Liangshan County of Shandong Province, the ShouzhangJi Yellow River Irrigation System covers 48 villages with a total population of 30,920, a total area of 41.32 km^2, a total arable farmland of 2,693 ha, and a total effective irrigation area of 2,334 ha. Belonging to gravity irrigation, the district gets its water source from the main canal of ChanGai Irrigation Area. Since the establishment of an irrigation system invested by the state in 1965, the construction, rehabilitation and O&M in ShouzhangJi irrigation system have been undertaken by the state and local governments with large irrigation project investment, low management level, project function deterioration as well as seriously wasted water resources. What is worst is that since the realization of the rural production contract in 1980, due to the less project investment from both state and local governments, the construction and O&M were at a standstill. [According to statistics, three-level irrigation project equipment were less than 10 percent of the total area.] The irrigation project intact rate was less than 50 percent. Some irrigation projects were not able to function. The average water utilization rate was less than 40 percent. In 1980, the average irrigation duty was 18,000 cubic meters per hectare (m^3/ha) the grain output was only 5,925 kilograms per hectare (kg/ha). The living standard of the farmers was very low. The annual average grain production was only 360 kg/man. The benefits of the irrigation system had decreased. The effectively irrigated area decreased from 1,724 ha in 1980 to 1,347 ha in 1982. The irrigated area decreased by 21.9 percent. Therefore, in order to raise irrigation benefits and increase farmer incomes, it should be in accordance with the development features of the social situation, to transfer the old irrigation management system and establish desirable irrigation system management organizations.

PRESENT IRRIGATION MANAGEMENT ORGANIZATION SYSTEM

In 1985, according to the development of the rural production situation and Yellow River irrigation characteristics, the county and township governments made the decision to transfer the old irrigation management system. The old irrigation management system where everything was dependent on the government has been changed in three steps. The first was to set up a Farmers' Irrigation Management Committee under the leadership of the local government. The second was to set up Irrigation Management Sections according to physical, irrigation project, and water use conditions as well as agricultural crop pattern. The third was to establish Village Irrigation Management Groups based on villages. The forms of different organizations and relevant obligations are as follows:

Farmers' Irrigation Management Committee

Under the leadership of township government, the Farmers' Irrigation Management Committee (FIMC) was set up in 1985, with one chairman, two deputy chairmen, several committee members elected. They were a township chief and responsible persons in public security, judicial, agricultural, and water resources departments. The chiefs of all irrigation management sections were elected as committee members. One irrigation management group chief and one active irrigation management farmer in every village were elected as the representatives of FIMC. The FIMC chairman summarizes the annual work and delivers the next year's working schedule as well as answers the questions on irrigation project construction and O&M from the farmers. The main obligations of the FIMC are to study and make out irrigation planning and irrigation regulations, carry out decisions from the representative conference as well as to solve and coordinate the [water contradictions] among the different irrigation sections, etc. All the members of FIMC work for the FIMC on a part-time basis. The FIMC, established and participated in both representatives of the local government and farmers, has played important roles in exchanging information, mutual coordination, and in the unified irrigation system planning, [unified standard] as well as in jointly developing the scope of the irrigation district.

Irrigation Management Sections (IMS)

In order to take full advantage of farmer management and according to the physical condition, irrigation project distribution, project structure management and water resources utilization level of the irrigation district, the covering area of the main and branch canals in the irrigation district has been divided into 5 irrigated sections. Each section controls 8 to 10 villages and about 500 ha of irrigated farmland. Each irrigation section has established the relevant section-level irrigation management organization with 1-2 section chiefs, and 2-3 section members. All the staff in the irrigation management organizations consist of farmers who are recommended by village committees, approved by the township FIMC and registered in the county FIMC. The obligations of IMS are: to be responsible for the project structure management and water use management [in the scope of section], to lead the village level irrigation management organizations, to coordinate the [water use contradiction] among the villages, to organize project construction, to levy water charges, supervise project construction quality, etc. The pay is 45-60 Yuan RMB (about US$5.2-6.9) per man-month which is covered by the water charge.

Village-Level Irrigation Management Groups

The village-level irrigation management group generally consists of 3 persons, in which the village committee chief is appointed as the group chief, and two group members are elected by villagers. Generally speaking, the group members are enthusiastic about irrigation management, rich in irrigation experience and are held in high esteem by farmers. According to irrigation facilities in the area, the village irrigation management groups employ [2 to 4] management staff members who are responsible for different canal sections and for the management of the relevant canals, ditches, roads, trees and irrigation facilities in their duty section and get 30 Yuan RMB pay (about US$3.5) per man-month which is paid from the water charge.

THE SOURCE AND MANAGEMENT OF FUNDS

In order to carry out irrigation project construction successfully, the established irrigation management organizations have taken many steps to mobilize funds needed for water resources development. The main steps are as follows.

Water Charge

Based on water supply cost, state economic policy, and water resources situation, the standard of water charge has been made out according to actual irrigated area. The annual average water charge is 120 Yuan RMB/ha (US$13.79 ha). The total amount of water charge in the whole township is about 300,000 Yuan RMB (US$34,480) yearly.

Duty Labor System

Each farmer is asked to contribute 41 duty labor days in irrigation structure construction. The duty labor account has been set up in the township. The labor allocation information should be sent to the villages in the form of a notice paper. The villages have the labor allocation account. The farmers have their own labor allocation handbook. The duty labor allocation is based on the principle of unification and concentration, harnessing in sections, reasonableness and equity. For main facilities with a great number of projects and requiring a great deal of labor, the FIMC will mobilize

labor at a township-wide range in order to complete the task within a short time. The project construction will be allocated in accordance with benefitted area to harness section by section; the labor used in the project construction will be calculated and balanced at the end of every year. By doing so, both project schedule and quality are guaranteed. A reasonable labor burden is realized.

Mobilization of Funds

For important projects at the local points, the FIMC will mobilize funds from beneficiaries according to the principle that "the people who are benefitted should be burdened." In recent years, 2,700,000 Yuan RMB (about US$310,300) have been mobilized from farmers and the problem of fund shortage has been solved successfully.

Adjustment of Crossing Land Plots

In order to solve the problem of farmland area used in project construction and due to uneven distribution of ditches, roads, and canals in the range of different villages, the FIMC has adjusted the crossing land plots among villages. The problem of inequity land levy has been solved and successful water conservancy on farm is guaranteed.

Fund Management and Utilization

The principle of "coming from farmers and going to farmers" as well as unified management are realized in fund management and utilization. The farmers who constructed or set up desirable irrigation facilities will be rewarded. According to the regulations made by FIMC, desirable canal lining will get a prize of 30-50 Yuan RMB per 100 meters (m) (US$3.5-5.7), desirable underground water supply concrete tube will get a prize of 50-70 Yuan RMB per 100 m (US$5.7-8.1), which motivated the farmer activity in building irrigation projects.

THE PRINCIPLE AND METHOD OF IRRIGATION PROJECT CONSTRUCTION

Under the leadership of the County Water Resources Bureau and considering the present and the future, the "Five Year Irrigation Project Schedule of ShouzhangJi Township" has been made. Based on the principles of "small scale, project equipment and benefit within a year, "the canals, ditches, roads and trees have been planned systematically. Drought, waterlogging and salinity have been harnessed conjunctively. The best results have been achieved in the reasonable distribution of irrigation facilities, parallel importance of construction, management and utilization. The following measures have been taken in the process of construction.

Harness Sections according to Different Conditions

Different project measures have been taken according to the status of different irrigated areas in the range of overall township. For example, [water] rivalry among the villages at the northern part of the township is serious, and irrigation is very difficult. For a long period, the farmers' requirements for rehabilitating irrigation facilities were very strong. Having been set up, the new irrigation management organizations have mobilized 3,200 laborers for irrigation project rehabilitation for 20 days, [which completed an earth project of 86 thousands m^3, 18 irrigation equipment facilities, and cost 132.100 Yuan RMB (US$15,200) mobilized from farmers.] The Tangfang Secondary Main Canal with a length of 11.5 km and undredged for a long period, has been dredged and the irrigation problem of 346.7 ha of 13 villages in the north part of the township has been solved. Situated in the lower reach of the irrigation district, the east part of the township covers 318.7 ha of farmland with a high land altitude. During the irrigation season, water use is very difficult. The FIMC mobilized 204,000 Yuan RMB (US$23.5) from farmers, and stone projects of 33,500 m^3 each were completed; and 5 pumping stations were built, which solved the difficult irrigation problem successfully.

Development of Project Construction

In order to facilitate project equipment construction on farm, the FIMC selected 4 villages covering 266.7 ha of arable farmland, where the farmers are very active in irrigation project construction as the demonstration model of project equipment. The FIMC called on farmers to mobilize funds for farmland project construction. Fifteen canals, ditches and roads have been built. Hundred and seventy five irrigation structures, a total amount of 80,000 m^3 earth stone projects, have been completed. Irrigation project equipment in five levels have been realized, the project benefit has been fully played, the water saving rate amounts to 30 percent, which facilitated the development of irrigation project construction in the township.

Promoting Production with Science and Technology

In order to solve the problems of high silt content in the diverted Yellow River water and canal silting, since 1986, with the cooperation of the Yellow River Irrigation Test and Research Station (which is under the leadership of the Ministry of Water Resources of PRC), mechanized concrete canal lining in branch and lateral canals as well as reasonable project distribution demonstration on-farm have been carried out. The canal lining demonstration area has been built. Two concrete lined branch canals with a total length of 2,320 m, two concrete lined lateral canals with a total length of 900 m, 5 new lateral canals with a total length of 2,520 m, 36 branch structures, and 38 lateral structures have been completed in the demonstration area of 140 ha. The finished demonstration projects increased water supply and silt transportation abilities and prevented the canal from silting up. The irrigation efficiency has been raised to 43 percent.

Strengthen Construction Management and Guarantee Project Quality

In order to guarantee project quality and in accordance with the tasks, the FIMC and IMS organize special construction teams to undertake project construction under the supervision of professional engineers. The project construction may be contracted to groups. Fixed points, fixed maps, fixed standards, fixed project material, fixed time, fixed rewards and punishments (which can be called "six fixations") have been realized. The management network has been formed with the measures that "the FIMC leads sections—the section leads villages—the villages manage canals—the canal is related to persons—the person has obligations." The contract system has been implemented. Each type of irrigation structure has been registered and contracted to farmers. The duty, rights and benefits are joined together. The pay is fluctuated. Inspection every month, appraisal every season, preliminary summary at the middle of the year, general appraisal and summary at the end of the year are realized. Duty and rights are clear and definite; management is concrete; steps are strong. This has enhanced irrigation benefits greatly.

ANALYSIS OF RESULTS

Since the establishment of farmer irrigation management organizations in 1985, great changes have been taking place in irrigation system management and agriculture production of the ShouzhangJi Township. At present, the number of irrigation canals and ditches in the township amount to 2,764 with a total length of 760 km, the irrigation structures amount to 2,196, the area equipped with five level irrigation structures (that are main, branch, lateral, tertiary and sub-tertiary equipment) amount to 1,533 ha. The effective irrigation area has increased from 1,347 ha to 2,334 ha a raise of 73.3 percent. The intact rate of facilities along the main canal is raised from 85 percent to 90 percent. The intact rate of branch and lateral structures has increased from 78 percent to 83 percent. The irrigation duty decreased from 9,148.6 m^3/ha in 1985 to 6,090 m^3/ha which has saved water by 33.4 percent. The irrigation water use rate is raised from 40 percent to 66.7 percent. The irrigation rotation is decreased from 25 days to 12 days. The grain output is raised from 5,925 kg/ha in 1985 to 9,517.5 kg/ha in 1990, which means that the grain output has increased by 60.6 percent. Annual average grain production is increased from 360 kg/man to 829 kg/man. Therefore, it can be concluded that the irrigation management organization transfer of ShouzhangJi Township has brought about huge social and economic benefits to the farmers.

The Management of Village Irrigation Systems in the Shandong Province

Yan Zhenyuan[1] and Ma Shusheng[2]

INTRODUCTION

THE TERM VILLAGE irrigation systems refer to irrigation systems paid, constructed and managed by either village collectives or individuals. The characteristics of these systems are as follows.

Most of them are small-scale systems which mainly consist of small lift stations with motor-pumped wells (installed capacity less than 100 kw), small reservoirs and dams (with a storage capacity of less than 100,000 m^3), and irrigation canals.

A great number of these irrigation systems are scattered over an extensive area. According to an estimation of the Shandong Province, the area under village irrigation systems accounts for 55 percent of the total irrigated area of the province. The fixed assets of the village irrigation systems account for almost 12 percent of the total fixed assets of hydraulic systems all over the province.

The village irrigation systems with motor-pumped wells have the following advantages: The water conveyance distances are short, the irrigation water use efficiencies are high, the irrigation rotation periods are short and system maintenance is easy.

System ownership is determined by construction history and the sources of investment. There are three categories of ownership: systems owned by village collective, systems owned by a group of farmers, and systems owned by individuals. In the Shandong Province, the first category of ownership system accounts for roughly 95 percent.

Before 1970, ownership of systems was integrated with the management authority of the system. The village administration had overall responsibility for the construction and management of all the irrigation systems. With the reform of the rural economic system that took place after 1980 the management of system maintenance and system operation has also changed. In some regions, the ownership of systems is separated from the management authority. Other new types of management system are practiced. The main forms of irrigation management in the Shandong Province are given below.

MANAGEMENT BY PROFESSIONAL HYDRAULIC VILLAGE TEAMS

The main characteristic of this type of management is that the professional hydraulic team of a village is an economic entity that possesses management authority of all the irrigation systems in the village. It has the following responsibilities:

a) To define the boundary of the infrastructures and land-use rights.

b) To check and register the fixed assets, current capital, credit, and debt together with the Village Committee.

c) To keep accounts and to carry out independent accounting.

d) To collect water fees on the basis of the actual cost of water supply, as well as O&M expenditures and annual depreciation charge of fixed assets.

These professional hydraulic teams collect irrigation fees from farmers. The collected depreciation charges are deposited into a village fund to be used for rehabilitation of irrigation facilities. This solves the problem of repairing and replacing damaged irrigation structures.

Experience shows that this management system has been effective. For example, in Li Ji town, Peng Lai city, the Shandong Province, 36 administrative villages have collected US$34,000 of depreciation and overhaul charges in three years. Studies show that 95 percent of the hydraulic structures is in good condition, compared to 50 percent in the past. Water use efficiencies did also increase. The rotation period of irrigation has been shortened from 12 days to

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9 days. The electricity and oil consumption of the irrigation systems have been decreased by 30 percent and, consequently, much energy is saved. In the entire area, crop yields have gone up.

MANAGEMENT BY CONTRACTED PROFESSIONAL SYSTEM MANAGERS

In this management system, the Village Committee contracts the irrigation system to professional system managers. The contract period is 15 to 20 years. The contract is granted after the fixed assets of the irrigation system have been checked. During the contract period, the Village Committee (which is the first party) has the authority to supervise the system managers. The system managers (the second party) have the right to manage the irrigation systems on a commercial basis and to collect the water charges from the users. Part of these water charges is used to cover depreciation cost of the irrigation facilities. This part should be turned over to the Village Committee funds. The remaining part is the gross income for the system managers. In Yang Lan Gou Village of Tai An City of the Shandong Province, more than 50 dams, motor-pumped wells and water diverting projects have been contracted to 7 professional system managers. All of them have got good results. Some villages have only contracted the irrigation structures to the professional system mangers, whereas machines and electric equipments have to be provided by the system managers themselves. In some other villages, professional households constructed motor-pumped wells with their own funds. An example can be found in Shou Guang County of the Shandong Province where there are 200 wells built by the professional system managers themselves. They could freely sell water to the users.

DIRECT MANAGEMENT BY VILLAGE COMMITTEES

In this management, Village Committees take direct responsibility for the construction, operation and maintenance of irrigation systems and other works. This also includes the collection of water charges and financial management. All the irrigation systems have adopted the Contract Responsibility System in the operation and maintenance of irrigation canals, structures and equipment. The contract for operation and maintenance of irrigation systems is signed between the Village Committee and the invited managers. The contract also lays down the method of performance evaluation and makes provisions for reward and punishment. In some villages, the overall operation costs for motor-pumped wells are contracted to mechanics. If the irrigation targets are achieved and operation costs can be saved, the remaining would be the income of the mechanic. In case of a deficit, the mechanic himself has to make up the balance. For example, Liu Jia Tuan Village of Tai An City of the Shandong Province owns a total of 39 motor-pumped wells. In 1992, the collected water charges were US$3,800 of which 15 percent was contracted to the mechanics for maintenance. After paying energy costs and other expenditures US$1,753 were saved. It can thus be concluded that the Contract Responsibility System has proved to be effective in terms of maintaining village irrigation systems. However, in the case of some small reservoirs, Village Committees had to hire temporary laborers to look after the reservoirs and the allocation of irrigation water without any management rules or contract-responsibility systems.

IRRIGATION FACILITIES OWNED BY COLLECTIVES BUT MANAGED BY INDIVIDUAL FARMERS

This management can mainly be found in areas with shallow wells. These wells belong to the collective, but the pumps and pipes are provided by the water users. During the irrigation season, there could be five or six farmers pumping water from one well at the same time. Farmers who cannot afford to buy motor pumps can hire pumps from others. The rent of a pump ranges from US$0.3 to US$1.1 per pumping hour. As a result, water resources cannot be fully utilized. A large number of motor pumps have been purchased, but the efficiency of water use is very low and, therefore, it leads to an enormous waste.

ANALYSIS AND EVALUATION

The above four management types have their own specific historical and economic backgrounds, management levels and guidelines from higher-level authorities within the Water Resources Department. These management types follow different management transfer processes and have their own strengths and shortcomings.

The advantage of the first type is that the ownership is separated from the management authority. The hydraulic village team is an economic entity with full rights to make independent decisions. Therefore, the management results are good. It is an advanced management system with great vitality. However, it needs an economic basis, higher skilled managers and the support from higher authorities. This type of management system accounts for about 5 percent of the systems in Shandong Province.

The second management type, in which irrigation systems are contracted to professional water managers, is basically the same as the first one. But it gives less rights to independent decisionmaking. This causes some

limitations. On the other hand, it has the advantage of having greater flexibility and being easier to practice. It could be a transition form of management types.

The third management type did not support the separation of ownership from management authority, which is the key of current reforms. It basically continues to be a centralized management form. Although this type is practiced with the idea of contract responsibility, management arrangements cannot really be transferred in accordance with the economic rules. Consequently, the results are poor. Owing to historical reasons, this type of management system is still practiced in some districts. Anyway, the partial contract responsibility system is better than the centralized system that was practiced before.

The fourth management type, in which irrigation wells are owned by collectives but pumping facilities are used by individuals separately, is an outdated management system which should be abandoned.

DISCUSSION

The ownership of the most small irrigation systems is with villages. With the deepening of rural economic reform, the function of the Village Committees has changed accordingly. Direct engagement in economic activities by administrative organizations is not permitted. The administrative authority and the operation and management of enterprises should be separated. Managing an irrigation system is like managing an enterprise. Therefore, the separation of management authority from system ownership is imperative.

After 1979, the Chinese Government moved to restructure the agriculture system in order to boost food production. The major characteristic of the reforms is that of "the production responsibility system." The basic concept of this system is to allow farmers greater individual flexibility in how they can manage their operations. So the basic production unit is now the "household" in rural areas. However, water resources and the irrigation systems should follow communal management and operation. The contract responsibility operations in no way mean that water is used without a plan or that land and irrigation systems are divided. Neither does it mean that communal management and operations are like doing every thing under centralized planning. Communal management and contract responsibility operations are dependent upon each other. At the same time they complement and support each other. So the contract responsibility management and operations of small irrigation systems will be adopted gradually into all small irrigation systems and eventually also to medium and large systems.

In Lai Wu, De Zhou district of the Shandong Province, a share system for handling the village irrigation systems was developed during recent years. During the construction of motor-pumps wells, small lift stations and other structures, capital is raised by floating shares. Farmers contribute with construction materials and labor, rather than with money. After the construction of the system has been completed, shareholders have the right to supervise the management and enjoy priority in using the system. In case a profit is made, a bonus is shared by the shareholders according to the quantity of shares they owned. The share system not only raised funds for the construction of irrigation systems, but also integrated construction with management and operations. It is an effective way for transforming management mechanisms and solving the problem of separate ownership from management authority. This practice is welcomed by farmers. On the basis of information provided by Lai Wu City, the status is as follows. At present 2,500 wells, 4,600 motor pumps and 860 small reservoirs have been constructed and are managed through the share system. The number of farmer shareholders is 38,000. They raised funds that amount to more than US$3.4 million. We can expect that in the future this share system will be further developed for the construction of irrigation systems.

At present, water charges that are collected from the village irrigation systems are much lower than the actual cost of the water that is supplied. According to statistics, the collected water charges were less than one fourth of the actual cost. Therefore, the water charge system should be reformed and the rate of water charge should be determined on the basis of the actual cost of supplying water. Only if this problem is dealt with seriously, can the reform of irrigation management systems and management transfer be successful.

Strategic Water Resources Management and Decentralised Local Water Management Organisations: Institutional Implications and Issues

Hugh Turral

INTRODUCTION

THE DEVELOPING WORLD is faced with continued dramatic increases in population and a striking shift in the balance of rural and urban settlement. 50 percent of the expected world population of 6.1 billion will reside in cities by the year 2000.

Water is becoming an increasingly scarce resource at both national and more localised scales, as competition increases to satisfy demand for domestic supply, sanitation and industry. The dramatic expansion of irrigated area that has occurred in the twentieth century is reaching a plateau but the next round of food security needs is expected to be met largely from irrigated agriculture. Irrigation is the dominant user of water resources in most developing countries (typically accounting for 90 percent of current use in Asia) and will have to conserve water to satisfy urban and environmental demand. At the same time, considerable improvements in water use efficiency are required to improve agricultural productivity under irrigation and maintain rural livelihoods.

A number of initiatives, such as IMT, seek to improve local management and productivity of irrigation at a time when the state is withdrawing from service provision. Water markets are a topical initiative to manage allocation and re-allocation water resources, but many complexities and market imperfections limit their place and potential (Livingstone 1993)

At a time when it is increasingly evident that strategic planning and transparency in water resources management are critical issues, there are a number of apparently opposing forces:

1. There are increasing numbers of autonomous water user groups with varying degrees of established legal or customary rights. Satisfying the rights and needs of diffuse users and matching strategic goals presents many institutional difficulties.

2. Water use by the state is usually highly sectoralised and co-ordinated planning, at catchment, national and river-basin levels, is rare. Incorporation of low level water users into this process is rarer still.

3. Market liberalisation has frequently led to over-exploitation of groundwater resources, especially in coastal and urban settings. Existing water law is increasingly ignored and the interdependency of surface and groundwater is rarely explicitly recognised by users.

4. Transferable water rights (at more than localised scales) require a sound institutional and physical framework in addition to an informed and participatory market. Water legislation is often criticised as being inflexible and also irrelevant to specific environments or regions (viz. forthcoming national legislation to upland Peru).

5. External pressures for environmental responsibility imply conservation rather than resource development and use.

INSTITUTIONAL FRAMEWORK IN WATER RESOURCES MANAGEMENT

Irrigation development takes place within distinct geographical and political contexts (see Figure 1) and is well known for its complex nature, influenced by food policy, land capability, water availability and socio-economic factors. The institutions of water resources management comprise processes, entities (irrigation departments, river basin authorities, urban supply utilities, water user associations, individuals and so on) and mechanisms (statutes, codes of practice, legal frameworks). The key relationships between the institutional components are either structural (responsibility, authority, power and accountability) or motivational (interests of entities, and incentives - such as tariffs, subsidies and productivity awards).

PROCESSES IN WATER RESOURCES MANAGEMENT

The processes involved in the management of water resources are outlined in Figure 2, and the aspects that particularly relate to irrigation water user associations are printed under each process heading. In an ideal world, all the processes should involve some two way interaction between all the entities involved.

NATURE OF COMPETITION FOR WATER AFFECTING WATER USER ASSOCIATIONS

The literature on the institutional aspects of irrigation water management and decentralisation concentrates on the institutional rules and development of water user associations, encompassing the direct linkages in a hierarchy between the irrigation department and the users. The relationship of multiple independent user groups to the broader water resources management, macro economic and agricultural policy environments is rarely discussed. Equity, rule development and insights from game theory are generally applied within the boundary of the WUA.

Competition for water allocation from urban and industrial demand will affect individual water user associations, either by direct negotiation to re-allocate the water rights of an association (or of some of its members) or indirectly, by regulation and negotiation with an irrigation department or water resource management agency. Other forms of competition include:

Formal (*de jure*) irrigation organisations versus customary (*de facto*) irrigators.
WUA: WUA within a large system, catchment or river basin.
WUA: Environmental Allocation
WUA: Other water user groups (eg., aquaculture, wetland farmers, upland conservation groups, rural water supply and rural industry)

A key water management problem that emerges concerns the level of use and the allocation of rights to use. Good quality data on actual use, as well as the resource available, are required: the customary and *de jure* rights of other users must be accounted for in determination of the extent of rights allocated to registered water user associations. Collection, processing and timely availability of data are therefore crucial elements in the institutional framework, and are (ironically) often neglected or rationalised in the process of corporatisation and privatisation, as has happened in the process of regionalising the Rural Water Corporation in Victoria, Australia. In conditions of extreme scarcity, where all rights have been allocated and recognised, re-allocation of water to urban use requires renegotiation of entitlements or, as is frequently suggested, a market for transferable water rights.

Water user associations are often formed with the implicit idea that they are a semi-autonomous extension of the existing irrigation bureaucracy. Most writing on the subject concentrates on the development of the membership, rights, responsibilities, representation and operational activities the WUA. Ostrom (1991) and Tang (1992) have clearly established the case for farmer's role in the collective choice rules of irrigation associations; in practical terms that means that they have the right to decide how to arrange and modify the local institutions of collective action. This may not happen in practice if blueprints of water user associations are "imposed," as in the Punjab in Pakistan, where functionality has declined within a few years of an initial enthusiastic active participation to improve water courses. The irrigation bureaucracy is far from comfortable with the idea that individual water user associations might negotiate binding contracts to supply water, or have a role to play in allocating the size and timing of those contracts between different associations within a water course and between water courses. Ostrom (1992) and Tang (1992) also emphasise the complexity of irrigation/water resources institutions and the need for multiple layers of collective choice rules and representation. The notion of higher levels of farmer representation rarely goes beyond the formation of federations of water user associations, and if these are imposed, as with the well documented case of the Super Subaks, the fabric of the component institutions may be damaged.

Scales of Water Use Efficiency

An important assumption in IMT is that farm-scale water management will improve and hence so will water use efficiency, lading to improved crop productivity and livelihoods of farmers. However, a good hydrological understanding is required, since water loss from one constituent irrigation system may provide recharge or even surface water for other users further down the system: the water use efficiency of the Nile Basin is well documented to be about 70 percent (Stoner 1994), even though individual watercourses may operate at less than 40 percent. The level of infrastructure improvement often associated with IMT can be planned and implemented in accordance with its impact on basin and catchment water use efficiency. Currently, the basic hydrological understanding of groundwater-surface water linkages and supporting data are rarely available, even in developed countries, and is compounded by the use of data hungry

and sophisticated management models (Nathan and Earl 1993). The critical factor is whether inefficiency in water use results in a degradation of water/land quality (usually through salinisation and water logging) or whether it is unconditionally available for beneficial use elsewhere and is in fact another entity's water allocation or right. The motivational relationships of water charges and subsidies and the form of regulatory policy and enforcement are quite different for these two cases.

Legal Reform, Rights and Responsibilities

Many authors (*inter alia* Livingstone 1993; Ostrom 1993; Freeman 1990) have noted that secure but flexible *de jure* recognition of the right to use water is an essential attribute of sustainable water user associations. Problems arise when long established *de facto* rights to use water are declared without legal foundation so that a new development can be constructed, a recent noteworthy example being in Northern Tanzania (Burton 1994). Upstream (catchment) rights to use water are customary and are often discounted in irrigation development (Bottrall 1992 and in preparation).

Inadequate performance of systems with explicit *de jure* organisation often leads to individual or group efforts to organise water and tend to be dominated by an influential minority (see Water Management Synthesis Project 1988).

Many government interventions to decentralise and establish functional water user associations do so with explicit intention to divest themselves of operation and maintenance expenses and improve the collection of irrigation service fees (Korten and Siy 1989). Responsibilities of the associations are usually well defined, but the attention to formal constitutional rights of association, ownership of water delivery infrastructure and *de jure* rights to use water are variable and rarely as well provided for as in the Philippines. A characteristic of the wider scope of institutional reform employed in Mexico and the Philippines has been the presence of a stock market or securities exchange with sufficient scope to register water user associations with defined charters (see also Palacios-Velez 1991).

Thangpet (1994) details how traditional Muang Faai, in the environs of Chiang Mai, have broken down as land is removed from cultivation by building and urban expansion. The ad hoc sale of individual water allocations to urban water sellers and the disinterest in maintenance activities resulted in the reformation of a new association under the auspices of the Royal Irrigation Department; the RID asserts the state's primacy in the ownership of water and has attempted to stifle transfers to other uses. This has also led to problems for higher value horticultural producers who have traditionally relied on informal transfers of water within the Muang Faai. Rights to use water are undeclared in Thailand and appropriation can be usurped easily by those with access to technology and influence, particularly where industrial use is concerned (Livingstone 1993).

One right that has been pursued by irrigation departments is that the canal infrastructure should be in acceptable condition for turnover. In Indonesia, many traditional schemes were registered under the irrigation management turnover programme, which has enabled the departments to undertake a sizeable rehabilitation programme. A number of larger schemes have also been reclassified to fit within the 500 Ha limit for the turnover programme, by sub-dividing previously aggregated small schemes.

An Example of Financial Rights and Responsibilities

In Indonesia, despite the passage of local pilot laws (Ambler personal communication) and a national policy on irrigation turnover (see *inter alia* Bruns 1991), even the right to operate a bank account is often not in evidence. In Madura, functional groundwater user associations operate and maintain their pump sets and water courses, determine and collect water charges and pay water managers, in some cases 7-8 years after official handover. However, the level of financial reserves held by even the most successful wells has declined and there is considerable doubt that replacement pump sets will be afforded when the original ones reach the end of their 15-20 year working life (Agus personal communication 1994). The right to a bank account is not recognised and farmers still have a healthy suspicion of holding assets in cash, which can easily be lost in dramatic devaluations as has happened in the past: a preferred method of savings is in the form of livestock, owned by the WUA. Attempts to organise revolving joint funds for groups of tubewells have also failed (GDC 1992) and audit procedures (for both cash and in-kind assets) have not been implemented which would have enhanced the propriety of financial management both within associations and also protect them from levies and extra legal payments to local government or its officials. The formal ownership of the pumps and supply channels has been transferred to local government but not to the user groups which therefore have no collateral against loans from banks.

The possession of financial assets and capital is considerably less clear in gravity supplied irrigation, particularly on water courses which are part of a large bureaucratic irrigation system. A.K. Mitra (1992) notes that the Japanese model of post-war irrigation development has taken place within the framework of farmer owned, but usually professionally managed, Land Improvement Districts. These multi-function organisations arose out of traditional water user associations and funding has been obtained at prefecture level by both the issue of bonds and from internal

revenue across a range of local infrastructure development projects. Mitra asserts that the LID's have heavily influenced Korea, Philippines and Taiwan.

GROUNDWATER DEPLETION—AN INTRACTABLE INSTITUTIONAL PROBLEM?

The revolution in groundwater use in the last decade in India, Bangladesh, China and to a lesser extent, Indonesia, has been welcomed on equity, efficiency and community action grounds and because it is self organising and self maintaining. Where groundwater recharge is high and water quality is good (in Bangladesh and Eastern Gangetic Plain due to flood recharge; in Haryana and Punjab due to canal seepage), almost unlimited conjunctive use is possible and is indeed beneficial in stabilising or mitigating high water tables (Dhawan 1989). In the North China Plain, water tables have recently declined an average of 1.5 meters per year (IPTRID 1992) and similar problems are found elsewhere, such as Maharasthra and Gujurat (where saline intrusion is a problem). This range of situations can occur in distinct locations within a country or river basin, or may occur in a very localised fashion, within the administrative boundary of one irrigation scheme: a single set of groundwater rules obviously have little meaning and regulatory frameworks must address the range of existing and potential problems.

Dhawan notes that the hydrological community has for a long time pressed for enactment of existing groundwater legislation in India, as well as for its overhaul: in 1989 he reasoned that even if this happened, regulation, monitoring and applying sanctions is not administratively feasible or financially possible given the enormous numbers of individual operators involved. He observes that indirect attempts to control groundwater use by electricity metering and raising electricity and fuel charges were easily circumvented and had not proven successful where introduced. Metering discharges (or total volume discharged) is similarly difficult and involves very high costs to the regulating agency. In centrally controlled, state-sponsored groundwater development (deep tubewells in Indonesia and Thailand), the density of drilling is closely regulated and water table monitoring is built into the groundwater development programme: typical ceilings for groundwater extraction are 30 percent of average annual recharge (GDC 1987). Dhawan notes that minimum spacings between tubewells are often stipulated (as in Bangladesh), but almost impossible to control in deregulated situations, or where shallow groundwater is exploited by multitudes of very small portable pumps, working in open or shallow cased wells.

The institutional lesson is that a clear technical understanding of the water resource and quality issues is needed before groundwater exploitation is liberalised, and licensing arrangements must be agreed accordingly, before stimulatory policy instruments are invoked, such as derestriction of imports of pumping equipment, energy subsidies and unregulated drilling programmes. However, licensing arrangements are equally subject to the abuses documented in the management of surface irrigation (see Repetto 1986). These points are of little relevance to already well established over-exploitation of groundwater.

The well known "prisoner's dilemma" (which shows that in competitive situations, individuals will all seek to maximise their own benefits with the result that all are worse off than they would be if all restricted their benefits to a degree) is a feature of all common property resource use. In Australia, the irrigation community was reluctant to accept the existence of rising water tables and the inevitable salinisation that results: individuals are sure that it is a consequence of *other* farmers' poor water management practice (even to the point of being a phenomenon restricted to a badly managed land holding) or canal seepage (the "government's" fault). The national Land Care initiative has included a community programme called "water table watch," to monitor deep and shallow (perched) aquifer levels on farm. This has had a fundamental effect on the attitudes towards, and acceptance of, the water table problem in areas where it is not already totally self-evident. The situation is analogous to groundwater mining: education is needed in the from of a broad community understanding of the problem before regulatory frameworks can even be discussed. Dhawan was uncertain that participatory approaches had anything to offer: the Australian experience has shown that forming and "educating" land care groups at a relevant administrative and hydrologic scale, stimulates community responsibility. Whilst the number of players is evidently much greater in developing country settings, one hope for mitigating severe inequities that are the ultimate consequence of groundwater depletion, lies with self-regulation and participation at a scale that is administratively feasible for enforcement and application of sanctions to "rule-breakers."

Poor balance between development of low level community groups and institutional re-orientation and reform, in the wider water resources context, results in functional organisations operating in a dysfunctional institutional environment, which cannot be sustained. Either the organisations break down, or adapt to the realities of the institutional setting, or the setting is belatedly modified.

REFORM AND REALIGNMENT OF IRRIGATION BUREAUCRACIES—A WATER RESOURCES PERSPECTIVE

The Dublin Declaration and Agenda 21 have coincided with a wider awareness, among consultants and public water agencies, of the importance of broader-based water resources planning and management. Water Resources

Departments have sprung out of irrigation or Public Works Departments (viz Bihar and Tamil Nadu) with a marginal change in institutional culture and perspective. Bottrall (1992) suggests that substantial reform of attitude and structure is required if public works agencies of this nature are to make a successful transition to management and service oriented functions, and points out that commitment in terms of funds, allocation of skilled personnel and in-service training are among the essentials.

A strong resistance to the privatisation of irrigation management as well as ownership was uncovered by farmer surveys in New South Wales, Australia (Pigram and Mulligan 1991). Farmers expressed a general level of satisfaction with delivery of water, but were apprehensive about the level of deferred maintenance required and the likelihood of increased water charges under self or private management. A continuing stumbling block has been agreement on standards of asset maintenance, legal liability for negligence and responsibility for environmental protection. Existing management boards (with extensive farmer representation) have been restructured in three states to increase their control over day to day operation; over a 12-18 month period they have produced business plans, which has allowed a broader community understanding of the financial and organisation requirements of self management.

The corporatisation and then regionalisation of the Rural Water Corporation in Victoria has shown that performance of public agencies can improve significantly and that the basis of performance testing of service delivery begins with the development of a business plan incorporating well defined management objectives. Many are aware that despite the deregulation of the economic and financial system and a commitment to decentralisation and self management, attitudes within large technocracies can exhibit inertia. Time, targeted training and strong motivational forces are needed to make the transition to a culture of service provision.

Easter (1993) notes that substantial internal reform of irrigation administrations in the Philippines and Maharasthra has gone a long way to providing external assurance to irrigators in terms of service delivery, operation and maintenance. He suggests that this assurance needs to extend through the institutional system to supporting government policy on agricultural commodity prices and trade. Livingstone (1993) adds that despite formalisation of irrigators rights, the information base on actual use is very far from complete in the Philippines.

The River Basin Development Authorities in Nigeria were developed as water resource management entities from inception, but the priority accorded to irrigation development quickly absorbed the skill and financial capacity of the units, with a resulting bias towards construction and large scale irrigation scheme operation. Severe neglect of important wetland farming systems is well documented (*inter alia*, Thompson 1993), but there is evidence that a number of the RBDA's are making the transition to a broader perspective to equitably manage both up and downstream portions of the River Basin, despite a widespread decline in hydrometric data collection (personal communication; Thompson 1994).

CONCLUSIONS

The preceding discussion suggests a number of institutional pre-requisites integrating local water management into a more strategic framework.

1. Existence of co-ordinating water planning groups, within or apart from local government, which provide a planning structure with defined goals, measurable missions and are subject to reviews of their performance.

2. A legislative framework and agencies with authority and willingness to implement it, concerning common property resource issues like groundwater use and direct competition for surface water. The framework must be flexible enough to allow local adaptation where required.

3. Compatible macro-economic environment.

4. A core of multi-disciplinary expertise to advise planning groups, or failing that, an integrated training programme for key players.

5. Institutional cultures within state sectoral water agencies that are adaptable to change, and are motivated to embrace participatory planning.

6. An institutional structure which allows discussion and swift exchange of priorities between the centre and local water user groups.

7. Information and data collection are an indispensable foundation of rational water resources management, which must be valued as a basic cost of any management system: market based systems have a greater

requirement for the provision and dissemination of information, although ironically, cost control imperatives in public and private agencies mean that it is often seen as an expendable luxury.

8. Good technical control over water distribution and allocation is highly desirable for sustainable self-management of irrigation.

9. There needs to be a social and cultural willingness to accept the economic value of water, whatever strategic policy pronouncements are made by development agencies and national governments. Increasing participation in day to day management and development of water resource projects plays a significant role in shaping users attitudes and perceptions.

10. Macro-economic and food policy should be congruent with decentralisation, participation and cost recovery initiatives, in providing incentives to beneficial allocation of water.

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Figure 1. Context, technology and institutions of water resources management.

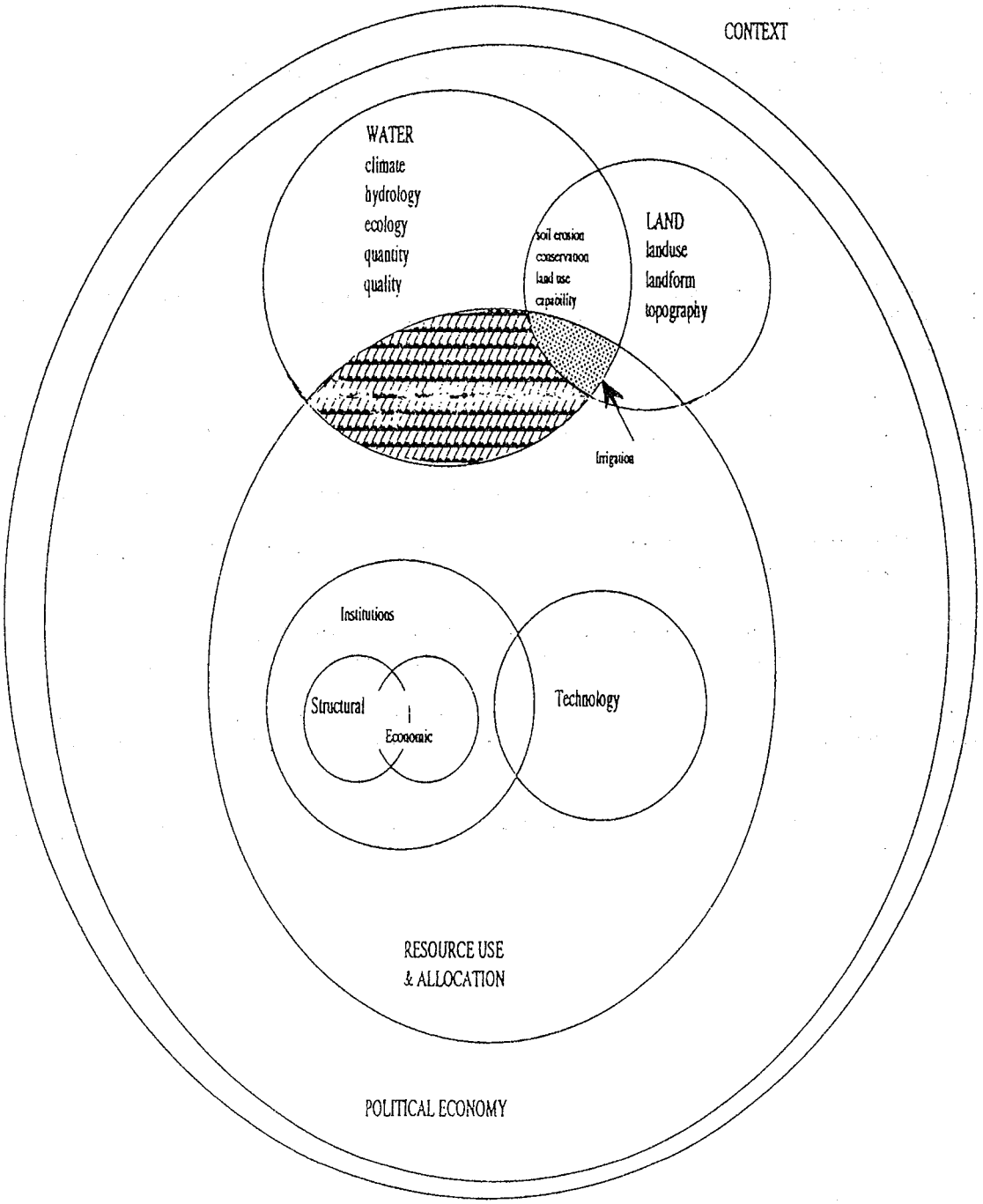
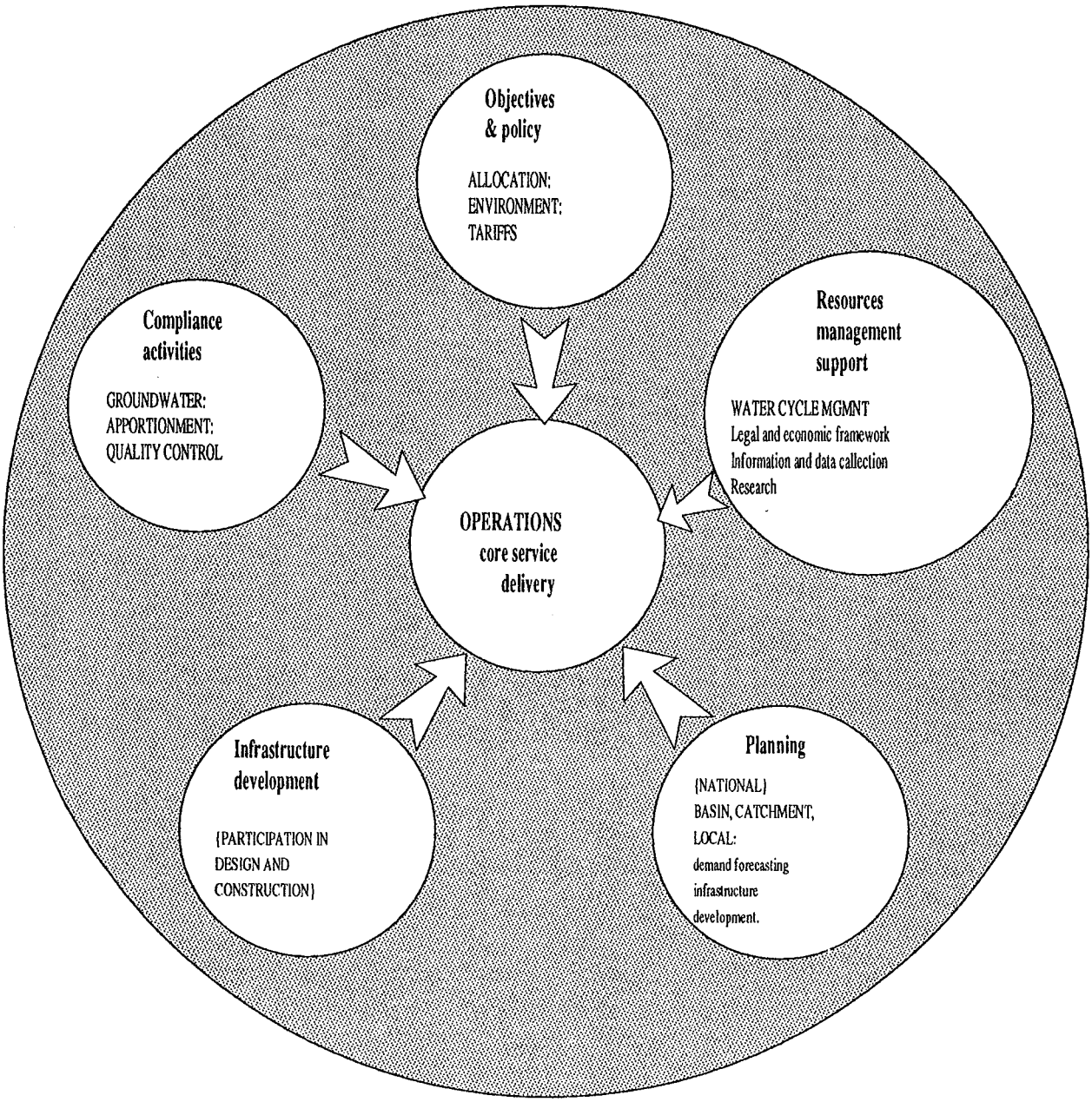
Figure 2. Processes in water resources management (Coopers and Lybrand, 1992 with modification).