Overview of Irrigation Management Transfer in China

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INTRODUCTION

IRRIGATION IN CHINA has a long history. Since the founding of the people's Republic of China, irrigation has been developing considerably. The total irrigation area has increased from 16 million hectares (ha) in 1949 to 48 million ha in 1992. Up to now, 5,363 large and medium irrigation districts (with over 667 ha of effective irrigation area each) have been constructed, with 21 million ha of irrigation area accounting for about 40 percent of the total irrigation area in China. Apart from providing irrigation services for local agricultural production, these irrigation districts also supply industrial and domestic water to cities and towns, and 70-80 percent of drinking water for people and livestock in rural areas. Sixty five percent food grains, 75 percent cash crops and 90 percent vegetables of the products in the whole country have been produced in irrigated areas, accounting for one half of the cultivated land area in China. Irrigated areas have become the national production base of grain, cotton and oil plants. Irrigation districts play a very important role both in local agricultural production and national economic development.

TWO DISTINCTIVE FEATURES OF IRRIGATION DEVELOPMENT IN CHINA

China needs to construct some giant irrigation projects. This has been decided on the basis of the large population in China, the unevenly distributed water resources, and the complicated geographic and geomorphic condition. With a very large population, food supply in China has always been the most crucial problem throughout history. Affected by monsoon climate, the annual precipitation in China declines from 1,600 millimeters (mm) in the southeastern coastal regions to less than 200 mm in the northwestern region. It concentrates mainly in the summer season, from June to September, and is unevenly distributed temporarily. China is also frequently hit by drought, waterlogging and flood disasters. The geographic condition of China is very complex, the usable area of plains and slopes or basins in mountain areas account for 12 percent and 29 percent, respectively, of the total land area.

China has a severe shortage of water resources. The average annual availability of water resources per capita is only 2,700 cubic meters (m^3), which is about 25 percent of the average availability in the world. The average water availability of water resources per unit area is only 1,888 m^3, which is 465 m^3 less than the average availability in the world, and is also quite unevenly distributed. Water resources are especially scarce in North China. There will be no agricultural production without irrigation in the northwest part of China. Thus, some key irrigation projects must be constructed in China, to fit the special requirements of the complex geographical background, and to provide a reliable environmental condition for agriculture and national economic development.

Most of the existing irrigation projects in China were constructed under special social conditions. Affected by long-term war, China was faced with poor industrial production conditions and an extremely weak national economic capacity at the founding of the People's Republic of China. Farmers struggled for basic food sufficiency. In this context, the Chinese Government clearly responded and paid spacial attention to the importance of water conservancy.

Based on the understanding that "agriculture is the foundation of the national economy," water conservancy is considered as the lifeblood of agriculture. It is also clear that they cannot solve all the water conservancy problems at [that stage], but they need to do their best to improve water conservancy development as far as possible. Based on the existing socioeconomic conditions, the Chinese Government organized millions of farmers to continuously undertake the construction of basic water conservancy projects, such as constructing reservoirs and canals, digging wells and ditches, [evening] lands, planting trees and building roads, to improve the living environment and production condition. A large number of irrigation districts have been built during this period, and the following stages have been experienced:

1. *A three-year rehabilitation period after the founding of the People's Republic of China:* The main objectives during this period were to heal war wounds, and to resume agricultural production. Almost all existing irrigation districts have been rehabilitated in this period, especially all the gravity irrigation districts, which reached their best performance level before 1949. Some extensions have also been obtained, such as the world famous

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Dujiangyan Irrigation District, the command area of which after three years of rehabilitation reached 0.2 million ha, while conditions for further development were founded.

2. *A High speed development period from the mid-1950s to the 1970s:* With the development of material industry and technology, the construction of some large irrigation projects were started. Almost all the existing medium- and large-scale irrigation projects in China were constructed during this period. With the development of the mechanical manufacturing industry and agricultural production, China began to construct pumping irrigation systems from the late 1950s. Examples are the Jiamakou Pumping irrigation districts in Gansu Province, and the Jangdu Pumping Irrigation and Drainage Project in Jiangsu Province. From the early 1970s, tubewell technology has been developed to exploit underground water resources. It developed rapidly: especially in the plains of North China, the exploitation of underground water resources has greatly developed to encompass the entire region.

3. *A new period of economic reform since 1980:* During this period, especially after the practicing of the rural economic contract responsibility system, the ownership system in rural areas changed rapidly. To follow this change, the focal point of irrigation was shifted to management, focussing on basic management work and management system transfer.

The construction of such a number of irrigation districts had provided an essential environmental condition for China's agricultural and economic development during the past years. But due to insufficient constructing and managing experience and the poor national and individual economic capacity at that stage, the constructing quality was not so good, and the conveyance systems were not completed. Added to poor management skills and unsuitable management systems, project deterioration and inadequate rehabilitation are universal after several decades of operation. Today, most of the projects are performing below their potential.

IRRIGATION MANAGEMENT SYSTEM

The Chinese Government has always paid special attention to the establishment and perfection of irrigation management systems. The general principal is that the donors will be the owners and the managers. Government departments are the main managers of projects funded mainly by the government. Collectives and farmers manage projects which are mainly self-funded. The command area of the state-managed irrigation districts accounts for 47 percent of the total national irrigation area. Some small reservoirs, ponds, and pumping irrigation projects (with less than 667 ha of command area) are mainly managed by collectives, with the command area accounting for 27 percent of the total national irrigation area. Other small sized irrigation projects, mainly tubewells, are mainly managed by farmers, with the command area accounting for 26 percent of total national irrigation area. The government water conservancy departments at each level are relevantly in charge of planning, technical supervising, science researching, policy making and fund allocating. They are also in charge of setting up special local management units for irrigation projects to formulate operation strategies, check and approve annual planning, coordinate water allocation, and project maintenance. According to the regulations formulated by The Ministry of Water Resources (MWR), the management units should be set up by MWR for the projects covering different provinces, and by provincial water conservancy departments for the projects covering different regions or municipalities, and so on.

Traditionally, irrigation projects are classified into two categories: canal systems and field facilities. Canal systems consist of reservoirs, water delivering or drifting constructions on the heads of main canals, and main-branch-tertiary canal systems; and are managed by professional management organizations. Field facilities are managed by mass management organizations. The professional management organizations should be set up by government water conservancy departments at suitable levels, according to the scale of each command area. This is called "management in levels." The actual irrigation management system is complicated, since the management models and systems are varied due to regional differences in economic condition; availability of water resources; investment systems for the construction of irrigation projects; project scale, type, construction quality and standard; and local customs, etc., In most regions, reservoirs, canal head constructions, and main canals of large-scale irrigation districts are managed by the same management organization, while branch and tertiary canals are managed by the organizations set up respectively by a lower level of the government water conservancy departments.

There is another kind of management model where the entire canal system and even within distribution blocks are all managed by the same management organization, which is set up by a suitable level of government water conservancy department. It is called the "uniform management model" in China, and is only practiced in a few provinces, such as the 9 large-scale irrigation districts in the Guanzhong Region of Shaanxi Province.

No matter what kind of irrigation model, democratic management systems exist at each level of management organization. The participants include the representatives of beneficiaries, local government officials, and irrigation management units; they are called democratic management committees or democratic representative conferences. One or two meetings will be held annually in these conferences or associations to make important decisions for project operation, such as water volume distribution, large-scale reparation and rehabilitation, calculation and levy of water charges, etc.

At the beginning of rural reform in the 1980s, irrigation management systems could not fit the requirements of reform, which once resulted directly in the decrease of irrigation area in China. In this case, the Chinese Government strengthened its water conservancy system. A series of policies, laws and regulations have been issued by the central government, such as the Water Law, the government policy for water conservancy management transfer, and water charge calculation and levying, etc. Further, water management offices were established in every township, and those found guilty of destroying water conservancy facilities severely dealt with.

After a ten-year effort, the declining trend in irrigation systems has been stalled, and the management work has been strengthened and consolidated. Since 1990, along with the establishment of the China Commercial Economic System, irrigation management systems transferred gradually. The government departments have begun to account property and check the financial status of irrigation districts; to identify property rights between farmers, collectives and government departments; to redivide duties and responsibilities between governments and irrigation management units; to establish contract responsibility management systems; to practice and improve a stocks sharing system and [an inner hire irrigation system]. In sum, with continuous practice, China's irrigation management transfer has come of age (begun in depth).

INPUTS FOR IRRIGATION DISTRICTS

The total input for irrigation projects in China can be divided into two parts: input for the construction of new irrigation projects (construction input) and input for system operation (operation input). Different policies have been formulated for these two different kinds of inputs.

The construction input mainly comes from the basic national construction funds. From the mid-1950s, China began to use its limited financial and material resources to construct a large-scale national economy, among which the basic water conservancy facilities is one of the important items. The construction input is mainly funded by the government, with the supplement of farmers' labor input. Before the 1980s, the central government was in charge of constructing important national irrigation projects. Also, the construction funds and material for main canals and higher-level key projects of large-scale irrigation districts were allocated to each province annually, according to the construction scale and macroscopic planning capacity of each province. Moreover, the Special Subsidy Funds for Small Rural Water Conservancy Projects (SSFSP), water soil conservation projects, and lower-level conveyance systems of large projects have been funded.

Following the macroscopic planning of the central government, each lower-level government carried out its varied project constructions, according to its local economic capacity. From the 1950s to the 1980s, government input was mainly utilized on the construction of key projects. The soil digging work in the construction of reservoirs and canals was mainly finished through farmer labor input. According to studies, farmer labor input accounts for more than one-third of the total input to the existing irrigation projects. During construction, farmers performed at a very high level. From the 1960s to the 1970s, since the government could not provide enough funds, material subsidies and technical aids, a large number of medium and large projects were constructed by farmers themselves, at times even without initial planning. The small projects constructed by farmers are countless. The famous Hongqi Canal and Renming Shengli Canal irrigation projects in Henan Province were constructed in this manner.

Principally, the government will not provide any further funds for irrigation projects already constructed, except two kinds of subsidies: (1) operational subsidy for projects in conjunctive use of irrigation and drainage, mainly used as the subsidy of energy charge; and (2) some operating expenses allocated from the national finance fund, for the poor regions with limited fund sources, which indicates the protectivist policy of the government towards agriculture. For all constructed irrigation projects, the operation and maintenance (O&M) costs mainly come from the following channels: The day-to-day expenditures (including salaries, travelling and electricity charges, etc.), and maintenance costs come mainly from the water charges collected from farmers and other water users. Different regions have different measures of making up the difference between O&M costs and water charges. For example, for the soil digging cost, the most popular measure is for the local farmers to simply contribute some labor input or to pay a relevant amount of money. In some regions with better economic conditions, a proportion of the local industrial benefit can also be arranged as the subsidy fund to subserve agriculture.

Farmers should also take the responsibility of field facilities maintenance. Governments also provide some subsidies for project expanding or enhancing work by using the established SSFSP, such as for the lining work of small canal

systems. Twenty to forty percent of the material fee can be provided by using the SSFSP in local finance fund. Since the collected water charges cannot recover the irrigation costs, there is no fund source for the rehabilitation and large-scale repair of irrigation projects at this stage.

Since the 1980s, China has experienced a financial system transfer. The central government is only in charge of the construction and management of giant inter-provincial projects, the construction and management of projects within provinces and the arrangement of SSFSP were transferred to each provincial government. Also, the general trend of irrigation development is transferred from construction to adjusting and consolidating, with suitable [extending]. The existing irrigation projects have been developed in two directions: (1) to improve irrigation quality in conjunction with comprehensive agriculture development, and (2) to improve living and ecological conditions of poor regions.

Some specialized agriculture development projects have been founded by the government, such as the Food Grain Development Fund, the Comprehensive Agriculture Developing Fund, and the Special Fund for Commercial Food Production Bases. For old liberated regions, minority nationality regions and boundary regions, some Poor-Aid Funds were arranged to help in the infrastructure construction of these regions. Sometimes, instead of direct fund aid, Funds for Providing Work as a Form of Relief was arranged. Funds for Rehabilitation and Completion of Water Conservancy Infrastructures are also included in the above. China is still a developing country, and due to fund limitations, it is impossible to solve all the irrigation problems at this stage, especially when there is no fund source for the rehabilitation and large-scale reparation of irrigation projects as mentioned above. The government still adheres to the policy of letting the farmers contribute funds and labor input every year, on a voluntary basis, to carry out rural water conservancy construction, to improve the existing status of irrigation projects.

Today, the socioeconomic conditions of the rural areas of China are developing rapidly. Farmers' living conditions have undergone some big improvement. They have obtained a greater income, especially those who were already rich, have gained considerable investment capacity. In order to obtain a higher quality of irrigation service, they have begun to contribute their own money to rehabilitate irrigation projects. Along with the practicing and improving of the water conservancy stocks system and the investment transfer system, farmer consciousness of the construction and management of irrigation projects by themselves has heightened. Some very good results have been obtained in many regions, such as in the Laiyang City of Shandong Province, and the Jiaozhuo City of Henan Province. This has widened the fund source channel and opened up a new way for the improvement of irrigation engineering status.

MANAGEMENT OF FIXED ASSETS

The fixed water conservancy assets (FWCA) in China are formed by the investment of governments on different levels and collectives, and the labor input of farmers during the past more than thirty years. The management and operation of these assets have an important bearing on national fundamental interests and farmers' vital interests. The Chinese Government has always paid special attention to this problem. Three nationwide special investigations have been made in the 1960s, 1970s and 1980s, respectively, to identify and classify the scale, type, and ownership of FWCA, which established a foundation for enhancing management work. Based on sufficient assessment, analysis and investigation, the Ministry of Water Resources and the Ministry of Finance issued the calculation method for nationally owned FWCA and the Finance Management Regulation for Water Conservancy Project Management Units. In the 1990s, China issued its Water Law, which stipulating that the nationally owned FWCA should be managed by government departments. [The management jurisdiction of government specialized irrigation management units towards the nationally owned FWCA is legally protected.] Similar to nationally owned medium and large enterprises, the management of the Chinese-owned FWCA is affected by the former planning economic system, which resulted in two big problems: First, the value assessment of FWCA is based on the original value at the time of construction, which subsequently cannot fit the market price calculated by dynamic calculating methods. Second, the management of value forms for nationally owned FWCA has not been brought under the normal management course of nationally owned fixed assets, which makes it difficult to formulate national macro-management policies and to complete cost and value form management in management units. This is especially so after China decided to establish a socialist commercial economic system. In this case, following the national uniform planning process, the Ministry of Water Resources is going deeply into this reform. The suitable catalogue for fixed assets-type classifying, and the proper method for value forming and calculating are being formulating. A nationwide assets accounting and property checking project is being undertaken, to make records and establish an account book. From the central government to local governments and management units, the value management of FWCA is being brought under the normal finance management category.

To fit the requirements of a socialist commercial economy, a new management system for values and items will be established as well. Similar to the revised finance management regulations, apart from normal finance management rules, a number of new items will be included. These could include account book headings for finance management which can reflect the value forms; special rules for financial handlings; rules for FWCA value ensuring, increasing and canceling, etc., in order to [proof] the loss of nationally owned FWCA in day-to-day management, and to bring the

management work onto the right course. Moreover, a monitoring and controlling system for government activities will be established to make clear the property rights, identify the ownership of the nation and the user right of the management unit, and regulate measures for the investment of nationally owned FWCA.

DELIMITING OF PROTECTION AND MANAGEMENT AREAS

The delimiting of protection and management areas around irrigation projects (DPMAAIP) is a basic task of irrigation management. It is also a relatively new task due to the practicing of reforming and opening policies and the ownership changes of the system. There are two objectives to this task: First is the delimiting of a protection area for irrigation projects, to provide a clear jurisdiction evident for legality management. For a long time, the townships, villages, farmers, and industrial or mining enterprises in many regions damaged and encroached upon irrigation projects for their own benefits, such as planting trees, digging soil, building graves or houses on the canal dikes and hills, or even damaging the projects. Once the DPMAAIP work was implemented, protection limits were clear, and the management organizations can stop or sue the above activities, according to the Water Law and other relevant laws and regulations. Second is the making of the jurisdiction areas of irrigation districts clear and decided, to let the irrigation management units make good use of the water and soil resources within the jurisdiction, and develop the economy in irrigation districts. Third is making a good preparation for assets accounting, property checking and ownership identification.

To improve the completion of DPMAAIP, an overall strategy has been proposed by the Ministry of Water Resources, and the government policy on the range, procedure and regulation of DPMAAIP has been issued by the Ministry of Water Resources, in conjunction with the National Land Administrative Agency. The detailed local PMADAIP standards have also been issued by the local governments in different regions, according to their local situation. As for canals, a prohibition area for grave building and social digging, etc., should be delimited, according to their soil digging and filling background. For natural canals, a prohibition area for well digging should be delimited according to their percolation radium. For reservoirs, a jurisdiction area for vegetation and water quality protection should be delimited, according to the limit of watershed. Up to now, apart from city areas, every region has issued its local DPMAAIP standards. The DPMAAIP work has gained momentum, and has already been finished in some provinces. But some are still in the process of completion, since the measurement and legislation of national territory are still being perfected. Some complicated problems still need further study, such as land area measurement, identification of land ownership and user right, and the problems left over by history.

DETERIORATION OF IRRIGATION PROJECTS

The deterioration of irrigation projects (DIP) in China appeared from the mid-1970s, and reached its peak in the early 1980s. It has become one of the two crises in China's water conservancy (another one is the shortage of water resources). The research program, "The Deterioration Assessment and Investigation Methods for Irrigation Projects" has been proposed by The Ministry of Water Resources in 1990, to get a clear view on DIP, find a suitable measure, and establish a foundation for improving irrigation management and go deeply into irrigation transfer. In this program, the method of "analyzing by levels" has been adopted to formulate a standard for DIP assessment and classification. A nationwide DIP investigation has been made in large-scale irrigation projects, which is based mainly on each provincial association. Targets of this investigation are key constructions at the heads of large-scale irrigation projects, canals with over 1 [cut meter] per second of water diversion capacity, and the constructions along those canals. Results of computer analyses indicate that 53.8 percent of total key constructions dropped into deterioration in varying extent. The deteriorated canal length accounts for 28.6 percent of total investigated canal length. The damaging ration of lining canals accounts for 32.4 percent, while the deteriorating ration of constructions along the canals accounts for 40 percent. There are many reasons for DIP as indicated below:

1. *Natural ageing:* Over 50 percent of total large-scale irrigation districts having been constructed before 1960, most of them have by now reached their rehabilitation or reconstruction age. Thus natural ageing is the main reason for DIP. According to the study, about 67 percent of DIP is caused by ageing.

2. *Lower construction quality:* This is because a large number of irrigation projects is constructed within a short period, and the economic conditions and the technical skills of construction groups are limited during that time. Many project constructions are completed with whatever facilities available. As a result, the construction quality is low and cannot meet the designed requirements. This situation causes [congenitally deficient irrigation projects], reduces their effective operation time limit, and accelerates deterioration. The investigation results indicate that 12 percent of deterioration is due to this reason.

3. *Unsuitable planning and design:* Due to limitations in technical capacity and construction standards during the early period, large numbers of irrigation projects were constructed while surveying and designing, without sufficient evaluation and examination. It caused a lot of planning and designing problems, such as unsuitable canal bed slopes and unsuitable aqueduct inlet and outlet allocation, etc.

4. *Ineffective management, and damage caused by humans:* Many management units have no perfect setup, and the educational background of management staff is low; subsequently the management work is ineffective. Unsuitable operation has resulted in artificial damage upon the irrigation projects. On the other hand, as a developing country, the legal system is still imperfect; people have an indistinct legal consciousness; thus frequent harm (destruction) was caused to irrigation projects by humans.

5. *Other reasons:* Includes factors such as insufficient maintenance funds which has resulted in insufficient project maintenance, change of water resources, etc.

In this case, governments, water conservancy administrative departments at each level, and project management units have paid special attention to DIP. With the help of government finance at each level, a large amount of funds has been put into the reparation and rehabilitation of deteriorated irrigation projects. But since there are too many problems left over by history, the fund deficits are too big, and the fund sources are limited. The problem has not been solved satisfactorily to date.

WATER CHARGE REFORM

Water charge collection has a long history in China. Many famous ancient irrigation projects had the custom of water charge collection throughout history. For example, the Dujiangyan Irrigation Project in Sichuan Province, in its 2,250-year operational experience never stopped water charge collection. Since the founding of the People's Republic of China, many exorbitant taxes and levies of the old government have been abrogated. But water charge collection has remained, and the regulation of water charge calculation and levying for water conservancy projects has been reissued. Limited by the socioeconomic conditions during that time, the water supply was simply a requirement-supply activity directly under the administration of a government department. The market economic relationship between water supply and water charge collection has not been established. Also, considering the economic capacity of farmers and their large amount of labor input for project construction, the standards of collected water charge were always low. Subsequently, irrigation projects could only sustain their basic operation at a lower level.

From the late 1970s to the early 1980s, the Chinese Government practiced reforming and opening policies. The pure centralized planning economic system of the former period has been changed, and the contract responsibility system is being practiced in rural areas. The consumer of irrigation projects has changed from collective to thousands and ten thousands of individual farmhouses. This improved the transfer of irrigation management systems and the reform of water charge calculation and levying systems. After sufficient investigation, the new calculation and levying regulation for water charges was issued in 1985. Some clear and decided reforms included in this regulation are as follows:

First, all water conservancy projects "should be paid," instead of "could be paid" in the former time, for their water supply services. Second, the objective of water charge reform has been made clear, i.e., to meet the project operation and maintenance costs, which include salaries of staff, travelling fees, meeting expenditure, office expenditure, large-scale repair charges, rehabilitation and reconstruction charges, etc. A standard for water charge collection should be formulated according to the water supply costs. Different regions were asked to formulate different kinds of water charge collecting standards for different kinds of water supply services, respectively, according to their local water resource availability and economic condition. [In the case of agricultural water supply, it is regulated that the water charge collecting standards for food grain water supply should be formulated according to the costs of water supply.] The standard for commercial plants could be higher than for food grain. The standard for industrial water supply would be the water supply cost plus 4-6 percent of investment profit. In water shortage areas, all water charge standards can be promoted to a higher level. There are also clear and decided regulations for water supply to domestic, hydropower, environment promotion, public health, planting and/or breeding. Third, the regulation for water charge collection, use, and management is also included. Principally, water could be collected according to the supplied amount of water. The supplied amount of water should be measured following hydrology standards. The management units can stop water supply to any user who does not want to pay the water charges. The collected water charges are duty free, and belong to the management units. There are also limits for the use of water charges, and some regulations have been formulated to supervise the use of water charges. Fourth, the duties and responsibilities of the central government and local governments at each level are identified: The central government is in charge of formulating the standard of water charge collection, the regulation of water charge collection, and use or management for the projects directly under the

central government. The local governments at each level will be in charge of the above duties for the projects under their supervision.

After the efforts of the 1980s, a big improvement has been obtained in water charge reform. First, from the central government to lower level governments, this policy has gained universal understanding, especially among lower level governments and farmers. A prejudice existed among staff of the local government departments and farmers, that farmers should not pay any water charges, since they have already contributed some money and labor input to the construction of these projects. Moreover, there are always differences that exist between the industry and agriculture, in developing countries. Farmers have already contributed a lot towards original accumulation, so that the government must use national funds to sustain the operation, maintenance and rehabilitation of irrigation projects. This kind of lack of understanding formed the main constraint at the beginning to reform, but after many years of propaganda and discussion, the situation has been reversed. Also, the policy system has been perfected. For the past 20 years, there have been no clear and decided government regulations on water charge collection, such as the principal and method for calculation and formulation of water charge collection, the use and management of water charges, etc. Subsequently, the water charge collection standards in different regions became varied; in some regions, water charge collection went on very well, while there was no water charge collection in some other regions. In this reform, the government departments at each level, supervised the completion of the water policy charge. Further, the water charge collection linking network between management units and farmers has also been established. In the earlier period, the management units collected water charges from collectives. After the rural economic system reform, water use expanded to thousands and ten thousands of farmhouses. In this context, a large amount of work has been done in different regions, and some rich experiences and effective methods of water charge collection have been established. For example, charging by goods, collecting through food grain purchasing stations, and transferring bills through banks, etc., have reduced collecting staff and cost.

But there are also some problems which have appeared in water charge reform. The first is how to supervise water charge collection while theoretically following the requirements of commercial economic laws. (Is it suitable for rural water supply where 80 percent of water is supplied to food grain plants?) It is still a problem whether water charge collection should be handed over as public benefit charge collection, or whether it should be brought under the national price management system for commercial products. Especially after China began to establish a socialist commercial economic system, the problem became more acute. The second is that after ten years of water charge reform, the actual collected water charges can only cover project operation, management, and normal maintenance, while there is no capacity for irrigation management units to complete large-scale repatriation, rehabilitation and reconstruction. As a result, the deterioration of projects is becoming more and more serious. The third is that the economic laws and regulations in water charge collection are still not perfect, such as price formulation, cost examination and calculation, and accounting management systems, etc. Especially, assets management is not perfect, which has resulted in deficits of original value evidence, and incorrect cost calculation. The fourth is that the economic development in China is unevenly distributed, in poor regions, the collected water charge standards are very low, and water charge collection is very difficult.

To counter these problem existing in water charge collection, the Ministry of Water Resources started an indepth study of the reforms from 1994. According to the theory of the socialist commercial economic system, these reforms will focus on the following four stages. (1) To establish the management system for the value form of assets. Now the nationwide assets accounting and property checking work is underway, to identify the ownership, investigate the value amount, establish a basic account book management system, and to bring it into the normal course of the nationally owned assets management system. (2) To formulate new price management regulations for water supply. The basic idea is that the water charge standards for food grain water supply should be formulated according to water supply cost, and the standards for other kinds of water supply should be brought under a uniform macro prices management system. (3) To formulate a new examination and calculation method for water supply charges, finance management regulations and accounting rules, and to provide conditions for further water charge reform. (4) To formulate controlling and management regulations for nationally owned assets, and a compensating method for assets values, to ensure their sustainability and increase.

WATER MEASUREMENT IN IRRIGATION DISTRICTS

Water measurement is an important aspect of irrigation management in China. It is indicated mainly in the following three sections. (1) It can provide accurate information for planned water use. Since China has a water shortage problem, specially in the northern region, in order to save water and get the maximum benefit from limited water resources, both the agricultural and industrial water supply should follow a planned structure. Even in the southern part of China, where water resources are comparatively richer, a planned water supply should be adopted during the dry season and peak water use periods. (2) It can provide evidence for water charge collection based on the supplied

water volume. In most regions in China, the practice is to collect water charges according to the supplied water volume, and this is also the general trend with the ongoing reforms in irrigation management. This process will be intractable without water measurement facilities and technologies. (3) Water measurement is also needed for the improvement of scientific irrigation methods and the accumulation of irrigation technical information.

Water measurement started in the late 1950s in irrigation districts in China. With the adoption of the planned water supply system in the whole country, especially in northern China, a major improvement in water measurement technologies and equipment has been obtained. In many large irrigation districts, water measurement technologies and equipment have developed from nothing to traditional equipment, and to automatic or semi-automatic technology and equipment of today.

Today, a greater part of water management in China is still being conducted with traditional technology and equipment. There are three kinds of methods used. (1) Weirs and flumes, such as Parshall flumes, long (short) flumes without (with) throat, thin (thick) triangular or trapezoidal weirs, v-shape weirs and measuring sills, etc. (2) Measurement constructions, such as standard aqueducts, gates, canals and water drops. Based on the measurement mechanism of weirs and flumes, and according to the relationship between water level and discharge, the water discharge and value can be calculated by the measurement results of water level. It is a simple and cheap method. (3) Flowmeter--since it was constructed in China in the 1960s, the flowmeter has been developed very quickly. It is simple to operate, and can be used to complete moveable and fixed point measurement, it can also be used to check other measurement equipment. For the application of new technology, some automatic and semi-automatic technology has been developed based on the above mentioned traditional technology, such as automatic water level recorders, supersonic meters, automatic gate controlling, computer technologies applied in water-level measuring and discharge calculation, measuring and warning systems going around and electra-magnetic flowmeter.

In the formulation of technical standards and regulations, and in technology development of water measurement, a lot of work has been carried out by irrigation management units, water conservancy administrative departments and governments at each level. First, the "regulation for water measurement by means of weirs and aqueducts" and some other menus have been published according to international standards. Second, some specialized organizations have been established for examination, testing, supervising and controlling of new instruments and equipment, with the authorizing of technology supervising departments. Third, the allocation and installation of water measurement equipment have been brought under the basic construction content. The basic construction regulation issued by the Ministry of Water Resources has made it clear that all water measurement equipment required by project management must be fulfilled in new project constructions, or it cannot be accepted and operated. Fourth, some demonstration pilot projects have been built to complete technical training and communication, such as the Nanguan Irrigation District in Gaoyou County, Jiangsu Province and the Hetao Irrigation District in Inner Moggonner. There is frequent technical communication and demonstration between these two water measurement demonstrative bases. Five, in order to improve the academic exchange and coordination of water measurement technologies, the water measurement academic office has been set up in the China Academy of Water Conservancy. Sixth, a large amount of funds has been continuously put into the construction and installation of water measurement facilities by government water conservancy departments and irrigation management units. Especially in the units which supply industries and domestic water to city areas, even greater funds have been used in order to purchase new, advanced water measurement equipment and thus improve water measurement accuracy.

Detailed objectives of water measurement development in the future have been proposed by the Ministry of Water Resources. (1) To research, develop or introduce more advanced instruments and equipment which must also be cheap, of high quality, and able to meet the management requirements of irrigation projects. (2) The error component of water measurement in irrigation districts should be limited to 5 percent in the near future. (3) By the end of the 20th century, [pre-latter canals] and higher-level canals must have water measurement equipment installed.

DIVERSE SIDELINE ENTERPRISES

Diverse sideline enterprises (DSE) practiced in irrigation districts in China have a distinctly Chinese character to them. For a long time, a large amount of funds has been put into the construction of irrigation projects by the government, and a large number of irrigation projects has been constructed, forming about 6,000 million in fixed assets. This has contributed a lot towards flood and draught disaster protection and national economic development in China. But since the management is ineffective, most of the projects are performing below their potential. Especially, in the former period, the managerial units relied purely on government subsidy, and the management was inactive. The water charges actually collected can only cover the operation and management fees, and part of large-scale reparation and depreciation charges in a few districts. The living conditions and the work environment of the management staff cannot be improved. Moreover, most of the management units are located far from city and town areas, with inconvenient transportation and insufficient welfare facilities, where the living conditions were very poor. In the past several decades,

irrigation management units concentrated purely on closed water supply service and did not pay adequate attention to input-output benefit analysis. The ideals of waiting for national subsidy, relying on government investment and asking for government funds are popular among farmers. Also, commercial awareness is weak, while the management experts are not sufficiently experienced. With the reforms and opening policies being practiced in China since the 1980s, the economic conditions in rural areas are gradually improving. The most important problem in irrigation districts is how to stabilize management staff and awaken their enthusiasm. To solve this problem, apart from continuous fund supports from the government departments, the management units must go deeply into reform, in order to improve district management and widen sources of income. It is a seminal measure and can meet the requirements of socialist commercial economic development, to develop DSE in irrigation districts. Among the large number of irrigation districts, there are many different scales of reservoirs scattered all over the country, and many waste hills and canal slopes around irrigation projects. There are also considerable hydro-power resources within irrigation districts. This provides ideal conditions for DSE development in irrigation districts, such as for planting, breeding, tourism, power production, etc.

The development of DSE in irrigation management units has received the support of the government and relevant departments. As early as 1985, The State Council issued a special regulation for the development of DSE in the water conservancy sector. Some professional policies have been formulated, such as the duty free policy for planting, breeding and processing of agricultural production and subsidy production developed by irrigation management units. To support the development of DSE, some special funds and loans have been provided by the national finance department. In the 1980s, The Ministry of Water Resources suggested that water charges and DSE could be the two supporting poles in irrigation management. After ten years practice, the DSE has greatly improved. In the beginning, there were only a few small-scale planting, breeding and agriculture product processing businesses. Nowadays, not only have the former planting and breeding businesses been extended, a lot of new businesses have also been developed such as tourism, processing of rural material, construction and designing, trade, hotels and services, light industry, medicine production, etc. The development of DSE in irrigation districts provided benefits for the entire society, moreover it increased the economic income of irrigation management units. It also contributed a lot towards staff welfare promotion, housing, provision of employment, proofing of qualified personnel loss, and towards the overall development of irrigation districts.

DISPOSITION OF ESTABLISHMENT AND PERSONNEL

Nowadays, irrigation management organizations in China are identified as public welfare institutions. Most of them are faced with the following problems: too large an organization size, too many persons not engaged in management work, low work efficiency, high management costs, poor staff living conditions, etc. Since the 1980s, a lot of work has been done by The Ministry of Water Resources, and the water conservancy administrative departments at each level, and the management units. "The regulation for disposition of establishment and personnel in management units of water conservancy projects" has been issued by The Ministry of Water Resources. It regulates the standards of establishment and personnel disposition for management units of all types of water conservancy projects. The general limits for disposition of establishment levels and management staff numbers in different kinds of management units have been set, each position and its responsibilities in the unit have been stated clearly. According to the amount of work of each post, the number of staff members for each post can be decided, and the personnel can be allocated according to their responsibilities. Then expenditures such as salaries, office expenses and travelling fees can be controlled according to the total number of staff members disposed. This can save unwanted expenses and cut down costs.

There are three problems existing among the staff of management units: (1) Ageing and insufficient knowledge renewal. Older, senior managers have greater management and technical skills and experience, but they are at the threshold of retirement and lack computer literacy. In contrast, the younger staff members do not have sufficient experience. (2) Insufficient qualified personnel for comprehensive management, especially those with an economic and legal background. Since the management units have been engaging in project and irrigation management for a long period, when they transfer to commercial economy, they need these specially qualified personnel. (3) Loss of qualified technical staff, caused by the professional income difference. With economic system reforms, the differences in the income levels of personnel in different professions are becoming bigger and bigger. The income level of irrigation management staff is becoming comparatively low, which results in the loss of personnel. The government has paid attention to this problem, and some measures have been taken to increase the income levels of management staff in order to solve it. Personnel training should be regularized and systemized, and measures must be taken to see that the personnel who hold a particular post must meet the required level of knowledge, technical skill and capacity.

For this purpose, some experts have been organized by The Ministry of Water Resources to draw up regulations and standards for different kinds of posts in irrigation management units. Also, many training books have been published, which have provided favorable conditions for the completion of post training in different areas of China. Some location

specific training books are also published by each management unit. Based on the above criteria, many kinds of training courses have been opened frequently, such as training on irrigation scheduling, monitoring and maintenance of projects, irrigation tests, water measurement, financial systems, economic management, examination and calculation of water charges for water supply, application of computer skills, etc. Each management unit usually holds one or two training courses during off-season or before the completion of some special task, to promote the technical quality of staff. In some management units with better economic conditions, the technical personnel are also sent to universities or colleges regularly every year, to complete long-term training, and strengthen the backbone of the management units.