WATER-SAVING IRRIGATION PRACTICE IN CHINA

-- Demands, Technical System, Current Situation, Development Objective, And Countermeasures

Gu Yuping[1]

Abstract

This paper analyzes a few major issues in the macro development of water-saving irrigation. Beginning with the balance between the supply and demand in agricultural water, it discusses how the water-saving irrigation relates to the sustained development of agriculture. It also puts forward the technical content, technical system, and standard system concerning the water-saving irrigation, as well as the major fields and modes for development of main regions. Finally it presents the objectives and countermeasures for the future.

The beginning of 90s witnessed the deepening of water crisis and the comprehensive development in the cause of water-saving irrigation, which had never been experienced before in China. However, it also brought about problems to the people's thinking and in technology. Several typical of them are chose to analyze here. Because so many fields are concerned in the water-saving irrigation, it cannot be guaranteed a healthy development unless its technical content, quality standard and evaluation indexes for its economic benefits are correctly understood and grasped, with further defined objectives for development, general layout plans and policies and measures.

1. Water-saving Irrigation, A Guarantee for Sustained Development in Agriculture

1.1 Water Demands in Agriculture for Sustained Development

The 21st Century will find China's economy in a fast overall development and China's modernization upon a new stage. Despite this, one cannot fail to see the serious challenges to be faced, that is, the water and soil resources has nearly been tapped to their utmost limit and China's population will hit 1.6 billion. The increase in population will place a heavy burden on the grain production as well as provide new requirements for irrigation. As foreseen by departments concerned, in China, the population will reach 1.46 billion by 2010 and 1.6 billion in 2030; if 400 kg of grains for one person, the total grain demand will be around 580 million t by 2010 and 640 million t by 2030. To meet this demand, the irrigation area should be increased. It should be up to 56.67 million hm^2 by 2010 (a net increase of 5.33 million hm^2 more than the current), and 60 million hm^2 by 2030 (a net increase of 8.67 million hm^2 more than the current). This will cause the agricultural water consumption to increase dramatically. Currently in China, about 400 billion m^3 of water is used by agriculture, in which 70 ~ 75 per cent, that is, about 300 billion m^3 is for the grain production. For the 450 million t of total grain production, 2/3 (about 300 million t of grain) is from the irrigation area; from the above,

[1] China Irrigation & Drainage Development Center, Ministry of Water Resources, P. R. China

the water productivity is calculated to be 1kg/m^3. According to this, the water demand in agriculture in China will be 580 billion m^3 by 2010, 640 billion m^3 by 2030, an increase of 180 billion m^3 and 240 billion m^3 respectively more than the current.

1.2 Serious Water Shortage Threatens the Sustained Development of Agriculture

Because the economic benefits resulted from industrial and drinking water supply in both cities and rural areas are apparently higher than those by agricultural water supply, it cannot be avoided that part of the agricultural water is seized for industrial or living usage. In fact, since the water crisis in 80s, a large amount of agricultural water has been used to supply industries and urban area. Take Sichuan of Central China as an example. Compared with that in 1980, in 1998 the city's total water supply was reduced by 2.7 billion m^3, in which the industrial and living water consumption increased by 3.3 billion m^3, while the agricultural industry gave up 6 billion m^3 of water.

According to the 2010 Plan for water conservation, the capacity of the current water supply projects under construction is about 45 billion m^3, and that of the water diversion projects from south to north is about 33 billion m^3. With the addition of a group of new diversion projects or retaining projects, such as the projects to deliver Songhuajiang River to Changchu and to deliver Yangtze River to Huaihe River, as well as newly drilled wells at Northeast, Yellow River and Huaihe and Haihe River area, the water supply capacity newly increased accumulates to be about 140 billion m^3. That is, by 2010, the total water supply of the whole nation will be 650 billion to 670 billion m^3. Moreover, as forecasted, by 2010 the water demand will be about 270 billion m^3 in the industrial and living sectors, that is, only about 400 billion m3 of water will remain with the agricultural sectors, which is generally equal to the current level. However, due to the newly increased irrigation areas, necessity to improve the conditions and guarantee rate in the existing irrigation areas, as well as water usage by fruits, pasturage and aquatic industry, a serious water crisis is looming for the sustained development of the agriculture.

1.3 Water-saving Irrigation, an Important Measure for Agriculture to Realize Sustained Development

As the demand for the limited water resources continues to rise, the irrigation comes to be caught in the middle: on one side, with the development of the industry and agriculture and acceleration of the urbanization process, agriculture will have to give way for the industry and urban living; on the other side, in order to feed the increasing population, the new irrigation area must be expanded while the current irrigation area and guarantee rate are maintained, and more water will be needed. This determines that for a sustained development, China's agriculture must stick to economy and efficiency.

As the irrigation water-using efficiency in China is much lower than that in western countries, if the water-saving irrigation techniques are practiced generally, the potential to save water will be very prospective. To adopt canal lining or water pipes will increase the water delivery

efficiency in a canal system; the shallow-wet irrigation for paddy fields, or furrow and border irrigation for dry farmlands will improve the usage of field water; the sprinkling irrigation and micro irrigation will improve the usage of water at its delivery section and in the field, and improve the evaportransporation environment and reduce evaportransporation. The irrigation water using efficiency of irrigation water in China can be increased to 0.60 ~ 0.65, should it be realized that over 80 per cent of China's 22 million hm^2 of well irrigation area is sprinkling irrigated or equipped with low-pressure water pipes by the middle of 21^{st} century, over 80 per cent of main canals of 2933 hm^2 at the canal irrigation area is reconstructed, and all the paddy fields are shallow-wet irrigated and field infrastructure in dry farmlands are improved additionally with irrigation water schedule and water control measures. In this way, without increasing the water consumption in agriculture, it can be guaranteed that the increased population can be fed, the water resources can continue to be tapped, and agriculture can keep a sustained development.

2. Technical System for Water-saving Irrigation

2.1 Contents of Water-saving Irrigation

As a technical measure, the water-saving irrigation method is employed to make full use of irrigation water resources, improve water usage efficiency, and achieve high yield and efficiency in grain production. It is an integrated technical system, combining water-saving techniques concerning water resources, engineering, agriculture, management and other links. With it, the overall using rate of irrigation water resources will be improved, the grain production at unit area or total area will be heightened, and the sustained development of agriculture can be guaranteed.

2.2 Technical System of Water-saving Irrigation

2.2.1 Adjustment in Crop Pattern and Water Usage Structure

According to the bearing capacity of water resources, as well as natural, economic and social conditions, the water, soil and heat, and other agricultural resources, should be better configured, to reasonably modify the agricultural production pattern, crop pattern and water using pattern of farming, forestry, animal husbandry, and fishery. Water consuming crops should be limited at areas with water shortage and, it should be encouraged to grow crops with low consuming less water but with high added value.

2.2.2 Optimization of Water Resources Allocation

The natural precipitations should be made full use of. The runoff and ground water should be reasonably configured and used, to increase the efficiency in using water resources. At the canal irrigation area, both the wells and canals should be used in water channeling, impoundment and lifting, according to the local conditions. At the well irrigation area, mostly the shallow ground water should be exploited, and according to the local water resources, the

ground water exploitation, especially deep ground water exploitation, should be under strict control; under the precondition of flood control, the floods collected in the rainy season should be used to replenish the ground water manually. Bad quality waters, including sewage and slightly salt water, should be tapped appropriately. Where normal irrigational conditions are not provided, the rainwater should be harvested by various means, to properly use the locally dispersed water resources in seeding and seedlings to fight against drought.

2.2.3 Engineering Measures

Except the section where the water need be recharged to supply the source, all the canal sections with serious seepage should be specially treated. For a small water conveyance system, mostly the pipes should be used instead of earth canal. The land should be leveled and the size of canals and field borders should be adjusted reasonably; the surface irrigation technique should be improved and more walking irrigation machines and water-injection seeding technique, etc. should be adopted, to improve the efficiency of field irrigation. For areas with a developed economy, cash crops plantation or an intensified agriculture, such advanced irrigation methods as sprinkling irrigation and micro irrigation should be adopted. For hilly areas, the slope should be built into terraces and rainwater should be harvested. In an engineering project of water-saving irrigation, a general plan should be drafted concerning mountains, water, fields, woods and roads, with a reasonably laid out irrigational and drainage system, fully equipped with water conveyance and distribution and measurement facilities.

2.2.4 To Spread Agricultural Techniques and Biological Measures

According to the water resource conditions, the local cultivation or planting area should be reasonably arranged and drought resistant species should be selected and spread. The soil structure should be improved to enhance its water-saving capacity by means of deep ploughing, intertill weeding, and more usage of organic fertilizers. Protective tilling techniques should be spread, with no tilling or a little tilling, so as to lessen the water and soil erosion; to retain soil moisture by way of harrowing and suppressing, or to cover the land with straws or films. Biological drought-resistant agents and soil water preservation agents can be used, and the transpiration of crops can be contained appropriately to lessen their water consumption, to increase the soil’s capability to absorb and hold water.

2.2.5 To Perfect Control Measures

The water resources should be universally managed, to perfect the control and supervision over agricultural water usage. The total water consumption should be strictly controlled, to set up quota for irrigation water. Water-saving irrigation methods should be generalized actively, including the controlled water irrigation for paddy fields and insufficient irrigation for dry farmlands. Relevant laws and regulations as well as technical standards should be perfected, to establish a reasonable water price system and provide administrative methods for water charge calculation, collection and usage, to enable practicing water saving through

the economic leverage. To clarify the ownership rights and the responsibility for administration and maintenance concerning engineering facilities is a way to gradually establish a healthy system for agricultural water usage. A social service system can be established and more efforts should be put in the technical guidance and demonstration training for effective water usage in agriculture. Relevant knowledge and techniques should be generalized. Technical supervision should be strengthened and the market for water-saving materials and equipment should be regulated.

2.3 Standard System for Water-saving Irrigation

The irrigation water, passing from its source to the field and then absorbed by crops and finally enabling production, has been through many links, including water resources allocation, conveyance, distribution, irrigation, soil evaporation and plant transpiration, etc. So, corresponding measures should be taken at each of these links. In order to reflect the essence of water-saving irrigation in a comprehensive and objective way and make the issue less complicated, the irrigation water consumption, irrigation water using efficiency, and engineering and technical requirements, etc. have been selected as the key criteria on water saving checking in this paper.

2.3.1 Irrigation water Requirement

The irrigation of paddy fields should be made according to the controlled irrigational mode of being “thin, shallow, wet and sunny”; the water requirement of crops of dry farmlands, fruit trees and vegetables should be made according to their respective productivity; for areas of water shortage, water requirement should be made according to the sensitivity of crops at each of their physiological stage, and such irrigation methods as critical irrigation and insufficient irrigation should be determined.

2.3.2 Irrigation Water Use Efficiency

It is the ratio of inlet water at the canal head to total amount channeled deducted of the loss in the canal system and fields, which is an integrated index to centrally reflect the conditions of irrigational engineering and management level.

It should not be less than 0.50, 0.60, and 0.70 for large, medium and small irrigational areas respectively. It should not be less than 0.80, 0.85 and 0.90 at the well irrigation area, sprinkling irrigation area and micro irrigation area, and the trickling irrigation area respectively. Should this be realized nationally, the national average of irrigation water usage can be increased from the current 0.43 to 0.73?

2.3.2 Technical Requirements in Engineering

(1) Canal Protection Ratio: it is the ratio of existing seepage-controlled area to the water passage area. It should not be less than 40 percent for large irrigation areas, no less than

50 percent for medium irrigation areas, and no less than 70 per cent for small irrigation areas; the well irrigation area should be set with fixed water pipes.

(2) For water pipes in the well irrigation area, the consumption of field fixed pipelines should not be less than 90m/hm^2. The branch pipes, when laid in a single direction, should have intervals of no more than 75m; if in double directions, should have intervals of no more than 150m. The water outlet (hydrant) should be arranged at intervals of no more than 100m and connected with soft pipes.

(3) The sprinkling irrigation should meet requirements for evenness and atomization; the pipe sprinkling irrigation system should have control, metering and safety protection devices; central fulcrum, translational and windlass sprinkling irrigational machinery set should be safe and reliable; for the light or small translational sprinkling irrigational machinery set, its stand-alone control area should be 3 hm^2 and 6 hm^2 respectively.

(4) For micro irrigation engineering, the water source should be strictly filtered and purified; the requirement on evenness should be met; relevant control, metering and safety protection devices should be installed; in the translational trickling irrigational system for drill crops, the usage of shells should be no less than 900m/hm2.

3. Solutions on Water-saving Irrigation Development

3.1 Guidelines & Principles

3.1.1 To Broaden the Source of Water and Reduce Water Consumption, with Priority Given to the Latter

In order to fundamentally solve the problem of the pressing water crisis in China, we must stick to a principle to increase the water resources and reduce water consumption. With nearly half a century of development, it has now become more and more difficult to exploit and use China's water resources. However, it is easier to reduce water consumption with lower costs involved. At a time when the irrigation water-use efficiency is low generally, it is reasonable to reduce the consumption first. On the basis of the overall water consumption reduction, new engineering projects of water resources can be started, and the water can be diverted through several river systems.

3.1.2 Attention Paid to Local Conditions and Substantial Results

China is a country covering a large area of land, with each part quite different from the other in terms of natural and geographical conditions, the speed of social economic development, the economic conditions, and the level of agriculture development. Therefore, the water-saving irrigation must be carried out according to specific local conditions. We should grasp the critical links obstructing agricultural water using efficiency and resulted benefits, and adopt the appropriate water saving measures, with a view to their economic, social and ecological benefits. We should pay our attention to all the small, medium and large-sized

engineering projects, the engineering and non-engineering measures, and advanced and conventional techniques.

3.1.3 Supported by the Government, Participated by Peasants, with Guiding Policies and Perfected Systems

To generalize the water-saving irrigation, the macro control function of the government should be brought into full play and the whole society, especially the vast number of peasants, should be instigated to participate into this cause. We should employ the economic, scientific and technological, administrative, political and legal means, etc. to carry out savings on water by force or guide it with economic benefits.

3.2 Emphasis and Mode of Development in Each Region

3.2.1 Northeast Region

It covers Heilongjiang, Jilin and Liaoning Province and eastern Inner Mongolia Autonomous Region. In the western part of this region, if feasible, the ground water can be exploited appropriately, aided with deep ploughing and scarification and other agricultural measures; the walking irrigation devices and drought-resistant water-injection seeding technique should be spread mostly. For areas with degenerated grasslands or desertification, the stock carrying capacity should be strictly controlled and measures should be taken, such as to raise animals in a fenced area, rotation grazing and even stop grazing in the grassland area; to build a man-made feed base of water saving and help reduce the pressure on natural grasslands; to improve the grassland conditions depending on the recovery ability of the grassland ecosystem. For areas short of water, the area for paddy fields should be reduced and controlled irrigation should be practiced; for the water logging and saline areas where the paddy fields are build to treat floods or alkaline, the water used to wash alkaline or salt should be limited reasonably to a certain amount. It should be noted that enough ecological water should be reserved for the swamp. Where only a small part of the runoff water is exploited or used, new water resources should be developed and water-saving irrigation be practiced.

3.2.2 Yellow River-Huaihe River-Haihe River Region

This region covers Beijing City, Tianjin City, Hebei Province, Henan Province, Shandong Province and part of Shanxi, Jiangsu, Anhu and other provinces. It is very short of water and the water resource amount per person or per mu is far below the national average. The water resources have been exploited and used far beyond its bearing capacity. It is one of major regions to practice savings on agricultural water. The adjustment of crop pattern should be accelerated by reducing the area for crops of high water consumption (like winter wheat) and expanding the area for water-saving highly effective crops; measures should be taken, such as straw coverings, to keep the soil moisture or hold water, to improve the usage of natural

precipitation and generalize insufficient irrigation. In the well irrigation area, the exploitation of ground water should be strictly controlled, and slightly salty water and other bad quality water can be used; if possible, the water should be backfilled to keep the balance in ground water exploitation; the low-pressure pipes should be used to convey water and soft pipes be used in field irrigation. In the canal irrigation area, the well and canal should be combined used and the scale of irrigation area should be under strict control according to the amount of usable agricultural water; through canal lining and land leveling and other measures, to improve the surface irrigation techniques and water usage efficiency. In mountainous and hilly areas, while to keep the soil and water from being eroded on the one side, it should be generalized to save and use the rainwater on the other side, to increase the water resources and develop dry farming. At the suburb of medium and large-sized cities and coastal areas, advanced water-saving techniques, including sprinkling irrigation and micro irrigation, should be adopted to develop a water-saving and highly effective agriculture.

3.2.3 Northwest Region

This region covers west of Shanxi Province, Shaanxi Province, the central and western part of Inner Mongolia Autonomous Region, Ningxia Hui Nationality Autonomous Region, Gansu Province, Qinghai Province and Xinjiang Uygur Autonomous Region. It is with scarce rain with strong transpiration, serious water and soil erosion. The ecological environment is very weak and in great need of water resources. All the irrigation area should be limited to a certain scale and the quota of water usage should be strictly enforced; the canal system should be rearranged appropriately and seepage treatment should be made for main canals; the field should be leveled, the size of plots be reduced, and the canal and border irrigation techniques improved, to gradually reduce the total water consumption in irrigation; the water saved can be used to improve the ecological environment. If feasible, both the well and the canal can be used and the depth of ground water should be controlled, to prevent secondary salinization of the soil and the degeneration of natural vegetation. Efforts should be made to return the land for farming to forestry, to adjust the structure of farming, forestry, animal husbandry and the cultivation structure, to keep the soil moisture by covering and spread drought resistant crop species of high quality and production. Where the ground water is excessively exploited it should be controlled, especially for the deep-layer ground water; the floods at the rainy season should be collected and backfilled to the ground water. At Loess Plateau, work should be done to keep the soil and water from being eroded, and basic farmland construction should be well done, to develop most vigorously the dry farming, spread resisting species of top quality and high production and the agricultural techniques, such as those to keep the soil moisture by covering and protective cultivation, etc; if feasible, it should be generalized to use the rainwater for seeding; to develop courtyard economy and to get the peasants out the poverty soon. At the basin of the inland river, any agricultural water usage should be in accordance with the general plan and unified management of the river system resources; under the precondition to maintain the necessary water supply for ecological purposes, the potential should be tapped by means of saving on water, to provide water for the agriculture at the upper, middle and down reaches and for the balanced development of the rural economy; the water supply for the protection forest of the farmland

and other woodlands and grasslands should be guaranteed; it should be prohibited to use the saved water blindly in wasteland development or expansion of the irrigation area.

3.2.4 Southern Region

It covers the area on both sides of Yangtze River and provinces, autonomous regions and municipalities to the south. It is with much rain and the water resources are rich. Despite this, however, the seasonal drought constitutes a serious threat to the agricultural production in the region. In the west, limited by natural geographical and engineering conditions, the agriculture is poorly supplied with water. For irrigation areas mostly of paddy fields, the canal section with serious seepage should be treated and the pipe should be used in water conveyance. The water-saving irrigation techniques for paddy fields should be generalized, to reduce the surface pollution caused by over irrigation. Advanced techniques should be popularized, like sprinkling irrigation and micro irrigation, at the plantation area of cash crops including fruits, tea, vegetables and medicinal materials. At hilly areas, the erosion of water and soil should be attended, to spread the comprehensive treatment technique of slope farmlands, to thicken the soil layer and enhance the capability of the soil to keep moisture and water by covering; small reservoirs, water ponds or water tanks, as well as other small or mini-type water conservation works can be built, to collect more rainwater and spread the dry seeding technique. For the coastal areas with a fairly developed economy, requirements should be met for efficient use of water and modern agriculture, to develop the accompanying irrigation and drainage engineering works, to guarantee successful irrigation and improve the standard for the flood control and drainage, to accelerate the crop plantation landscaping process, so as to create conditions for water-saving efficient agriculture and agricultural modernization.

3.3 Current Situation and Objectives

3.3.1 Current Situation

Since 90s Chinese government has attached much importance to the water-saving irrigation work. Particularly, the period of “Ninth-Five-Year” plan witnessed a quick development of water-saving irrigation, due to rehabilitation of large irrigation areas for water saving, and the emergence of 300 major water-saving and effective-production counties and exemplary areas with production increase after adopting water-saving techniques. In the five years, 7.7 million hm^2 of irrigation areas were improved with water saving techniques nationally in China, with which, the national irrigation area meeting the water-saving standard reached 16.7 million hm^2, accounting for 31 per cent of the effective irrigation area; the area adopting water-injection seeding technique, walking irrigation machinery and controlled irrigation for paddy fields, and other non-engineering facilities reached 16.7 million hm^2; the irrigated water for unit area on the national average dropped from 7140 m^3 / hm^2 in 1995 to 6585m^3/hm^2 in 2000, and the water consumption for agricultural production valued at RMB 10,000 dropped from 1917 m^3 in 1996 to 1591 m^3 in 2000. Under the condition that the total irrigation water cannot be increased, the potential is tapped in water saving measures. In this

way, the newly-added 4.3 million hm^2 of irrigation area was provided with water, and 6.7 million hm^2 of farmlands found its water source for dry seeding. But for the above water-saving measures, the agricultural water demand would have been increased by 25 billion m^3 according to the original water usage. So, 25 billion m^3 of water has been saved during the "Ninth-Five-Year" period.

3.3.2 Objective

Analysis has been done on the water demand involved according to the national policies on food safety and adjustment of agricultural structure, in order to increase the income of the peasants and build the agricultural ecological environment. It is estimated that the demand of agricultural water will be increased by 59 billion m^3 by 2010, in which, the irrigation area to be newly increased will need 20 billion m3, to rebuild the existing irrigation area into farmlands of low or medium production and to increase the irrigation guarantee ratio and multiple-crop index will require another 28 billion m^3, the irrigation for new woods, fruit trees and grasslands and dry land water supply will need 8 billion m^3, to support the ecological environment will be 3 billion m^3. But, limited by external factors, the total water consumption by agriculture cannot be increased. So, the above issue has to be dealt with by means of water saving. Therefore, by 2010, the irrigation area meeting the water-saving standard in the nation should be increased from 16.7 million hm^2 at the end of the "Ninth-Fiver-Year" Plan (2000) to 43.3 million hm^2, and at the area with serious water shortage, rebuilding of the irrigated farmland should be completed to save on water; the controlled irrigation should be generally applied in areas of paddy fields; the inland river basin of Northwest and the area with over exploitation of ground water at Huang-Huai-Hai Plateau should be comprehensively treated, with emphasis on water saving and ecological protection. In this way, the water consumption for unit area irrigation in the nation can be decreased from 6600m^3 / hm^2 to 6000 m^3 / hm^2, to increase the use ratio of irrigation water from 43 per cent to 50 per cent. While the total agricultural water consumption remains the same, through water saving, the agricultural production conditions should be improved further, the newly-added 50 million mu should be provided with water source, with improved guarantee ratio and service functions of the original irrigation facilities, and improve the ecological system in the rural area.

3.3.3 Major Engineering Projects

To meet the above objective, the state should further grasp major projects on the basis of the achievements made in the "Ninth-Five-Year" Plan, to push forward the generalization of the water-saving irrigation techniques.

(1) To Improve the Medium and Large Irrigation Areas

By 2010, the improving of 200 large irrigation areas for water saving should be basically completed, with the water use efficiency reaching 50 per cent, and the water productivity of grain crops reaching 1.4 kg/m^3; with the comprehensive development of

agriculture, part of medium-sized irrigation area should be improved, to apparently improve the agricultural production conditions and enhance the agricultural productivity. Priority should be given to areas in serious lack of water, with deteriorating ecological environment, and the irrigation areas as production bases of grains, cotton and oil. Outstanding problems should be dealt with emphatically, including dangerous engineering works, unsuitable facilities, degraded infrastructure, serious seepage loss, or incomplete measurement devices. The reform on the administrative system and operational system at the irrigation area should be done side by side with the infrastructure improvement work.

(2) Comprehensive Treatment Project for Water-saving Agriculture and Ecological Protection at Major Regions

At the inland river basin and the Yellow River-Huaihe River- Haihe River region in the northwestern region where are seriously short of water with a worsened ecological environment, the comprehensive treatment projects should be carried out for water saving and ecological protection. Water supply and demand should be determined according to the bearing capacity of water resources, to make reasonable decisions on agricultural structure and development scale concerning those prominent questions in the development of soil and water resources and the rural economy; with a view to improve the overall ecological environment, to consider water demands at the upper, middle and lower reaches of rivers, to strengthen centralized management over water resources, control groundwater exploitation, and build backfilling projects; for inland river basin, the canal lining should be built, some plain reservoirs with high evaporation loss be abandoned, and water outlets be merged; to take comprehensive measures for water-saving reconstruction and improve using of and benefits from irrigation water and natural precipitation on a large scale. We should try our best to get preliminary success in stopping the ecological environment from deteriorating in 10 years.

(3) Examples of Water-saving Irrigation Projects

Based on the Ninth-Five-Year Plan, water-saving projects will be completed by 2010 in about 600 major counties where is in lack of water resources, together with a group of exemplary projects or parks of efficient agriculture for water-saving irrigation, rainwater collection with better economic results. They should be carried out according to the local soil and water conditions, with the total agricultural water consumption under strict control and the water quota verified; upon the requirement placed by adjustment of crop pattern and development of efficient agriculture, the agricultural production conditions should be improved, to explore and summarize suitable water-saving modes, management system and developing mechanism; to train key members and strengthen propagation, let one unit guide a whole area, give full scope to the leading role. The project to collect rainwater for irrigation will not only provide water for man and livestock, but also help to fight drought, which will create conditions to increase the income of the peasants and change part of farmlands to grow trees. At

the same time, for efficient water-saving demonstration parks, attention should be paid to importing advanced and practical techniques from other countries, in order to integrate, improve and enhance the technical content in agricultural water-saving projects.

3.4 Policy Support

3.4.1 To Built up a Rigorous Agricultural Water Management System

Macro control and quota management should be practiced in agricultural water usage. On the premise of centralized control over water sources, take into consideration all factors in drinking, production and ecological water, and clarify two control indexes, namely gross agricultural water usage and irrigation water quota, for each region and main water users, which will be used as a basis for management of agricultural water or water saving. This can be made a basis for agricultural water and water saving management. The organs concerned of the State Council should be responsible for the distribution of water among provinces, autonomous regions and municipalities; the local government should, on the basis of the water index allocated, delegate the responsibility to each water-consuming unit level after level where it is performed, and also stipulate the quota for irrigation of major crops according to specific conditions. All the Areas and consumers should practice saving on water effectively under the water using index. Cumulative price markup will be practiced in case of extra water consumption, and the saved water can be paid transferred. Water management department should conduct tests at different areas as soon as possible and spread experience in nation.

3.4.2 To Promote Agricultural Water Price Reform

To establish a scientific and reasonable volumetric price system for agricultural water, we should take into consideration the extent affordable to the peasants before justify the water supply cost in steps. The system of extra-ration accumulatively increasing price should be practiced, to enable water saving with the economic leverage. Strengthen the price setting and metering management of agricultural water. To hold hearing meeting on setting water price, enhance transparency, and prohibit any intermediate charge and defalcation. If higher cost is incurred due to natural conditions, like high lift, the water price should be heightened but with more subsidies, to solve the problem that the charge drops away from the supply cost. To adjust agricultural structure, develop water-saving efficient production structure, and enhance the peasants' ability to fit water price reform. Set up and perfect agricultural volumetric price measurement system and accelerate the reform to charge according per cubic meter of water or each household. In this way, "Big Pot Water" or equalitarianism should be prevented.

3.4.3 To Establish a System for Development of Agricultural Water Saving Projects Supported by the Government and Attended by Peasants

A water saving system for the agriculture should be established, with governmental support, participated in by water users, to enable water saving by force and by economic results. Through policy guidance, subsidies, technical guidance and supervision and management, the government should try to arouse the enthusiasm in of the water users in water saving. It should encourage peasants to organize water user cooperatives of various forms, letting the peasants join the cause of water saving construction and management in a wide range. In case of any important issues in water saving, democratic discussions should be made, to form a decision by the water user themselves. Pay attention to the comprehensive benefits and increase of the economic benefits brought by water saving. Let the peasants feel touchable economic benefits in the cause.

4. Conclusion

Agriculture is the basis for the national economy, providing necessary agricultural products and industrial raw materials for the living of 1.6 billion people. Because of the special topographic characteristics and climate of China, its agriculture production mostly depends on irrigation, and appropriate irrigation measures will result in a stable and high yield. Due to the serious lack of water resources, the traditional irrigation methods cannot catch up. Hence, to practice water saving is a prerequisite for the sustained development of the national agriculture and national economy.

REFERENCE

1. *Technical Code for Water-saving Irrigation*, Water Irrigation Research Institute, May 1998. Dept. of Irrigation, Drainage and Rural Water Supply, Ministry of Water Resources, published by China Water Resources and Hydropower Publishing House.

2. *On Rural Water Saving*, 2000, Dept. of Irrigation, Drainage and Rural Water Supply, Ministry of Water Resources.

3. *The Tenth-Five-Year Plan and 2010 Program for National Irrigation Development*, 2000. Dept. of Planning & Dept. of Irrigation, Drainage and Rural Water Supply, Ministry of Water Resources.

4. *Tenth-Five-Year Plan and 2010 Program for National Water-saving Irrigation Development*, 2000. Dept. of Planning & Dept. of Irrigation, Drainage and Rural Water Supply, Ministry of Water Resources.

5. Sun Jingsheng & Kang Shaozhong, 2000 (2). *Current Water Resource Usage and Measures to Develop Water-saving Irrigation in China*, *Agricultural Engineering Journal.*

6. Xu Di & Cai Lingen, 2000, *Research on Soil and Water for Sustained Development of Agriculture*, published by China Water Resources & Hydropower Publishing House.

7. Huang Xiuqiao 1998 (6), 26-28. *Features and Framework for Technical Code of Water-saving Irrigation.*