

A Study on Water Utilization in Chinese Rural Areas

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Abstract

In China, because rural population is great and agriculture is very important in national economy, rural areas have become a main sphere of water consume. There exist the problems of water shortage and water waste in the countryside. The conflicts of water resource supply and demand between industry and agriculture are very conspicuous. Various factors that include ideology, finance, technology, management and policy restrict the rational and effective use of water resource. The survey on the villages of Jiagezhuang and Yaobaizhuang in Ji County, Tianjin reflects these problems. The government tries to solve the problems by making laws and policies, as well as affording financial and technology support to towns and villages. At the same time, it is necessary for the government to make officials and farmers realize the importance of rational water usage and saving by doing propaganda, coordinating the inter-governments relations, and defining the departments' duties. For realizing the objective of rational water usage, it is necessary to take measures to construct and perfect irrigation installations by both superior and local governments' investment and farmers' labor force.

Key Words: *Chinese Rural Areas; Water Resource; Rational Use; Farmland; Irrigation System*

Preface

In 1994, the Chinese central government promulgated the "China's Agenda 21". In this agenda, the Chinese government shows its determination in establishing a general strategy under which economy, society, population, resource and environment could be mutually corresponded to realize sustainable development. Within this stratagem, efficient water usage is a critical factor. It has straight influence on whether or not sustainable development could be established.

Water is one of the most important irreproducible natural resources to the mankind. It is closely bound up with social development and people's living. In China, because of the huge rural population and rural economy's prominent position in national economy, rural areas have become the principal water-consuming part (see Table 1). With the population's increasing and development of economics, the amount of water resources per capita in China would persistent decrease, even gets close to the lacking water warning line in several areas. With the prediction, the Chinese population will increase to 1.6 billion in 2030, 0.7 billion tons of grain will be needed,

and the amount of water that can be supplied to agriculture will reach 400 billion cubic meters.¹ The crisis of water resources will be so serious. Thus how to make good use of water resources in rural areas deserves high attention.

In July 2006, under the help of Tianjin Environmental Protection Bureau and the Environmental Protection Agency of Ji County, the authors made an investigation on water usage condition in Jiagezhuang village, Guanzhuang Township and Yaobaizhuang village, Chuanfangyu Township of Ji County, Tianjin city. Based on these facts, we consulted other correlative data and made an analysis on current water usage condition in Chinese rural areas.

Table 1. Water Consuming Condition in Towns and Rural Areas (1980~2006)²
(Unit: one hundred million cu. metre)

Year category	1980	1993	1995	1997	1998	2000	2001	2002	2003	2004	2005	2006
Gross water consumption	4439	5198	5350	5566	5435	5497.6	5567.4	5497.3	5320.4	5547.8	5633.0	5795.0
Agriculture	3912	4055	-	4199	4068	3783.5	3825.7	3736.2	3432.8	3585.7	3580.0	3664.4
Industry	457	906	-	1121	1126	1139.1	1141.8	1142.4	1177.2	1228.9	1285.2	1343.8

□. Investigation on Jiagezhuang Village and Yaobaizhuang Village

Background Information of the two Villages and Interviewees

Two villages: Jiagezhuang Village, Guanzhuang Township and Yaobaizhuang Village, Chuanfangyu Township of Ji County, Tianjin city were selected. Their water usage condition was investigated by interview. We selected 54 rural households among these 2 villages and interviewed the peasants at their homes. 24 households of Jiagezhuang Village were selected and 36 households of Yaobaizhuang Village were selected. Questions like the interviewees' education level, income level, planting structure, irrigation method, their understandings of current water resources condition, and their knowledge and attitude about water saving technology were asked during the interview.

¹ Lin, Maosen, "The Discussion about Approaches and Methods of Agricultural Droughting and Saving Water", Gansu Science and Technology, 2007, Issue 5.

² Resource: From water conservancy database: "The distribution trend of water resources since the People's Republic of China was founded", <http://www.hwcc.com.cn>; "Gross Water Consumption Amount and Living Water", from National Bureau of Statistic of China: Chinese Statistic Yearbook 2003, Beijing: Chinese Statistic Publishing House, 2003, p.10; Chinese Statistic Yearbook 2007, www.stats.gov.cn/tjsj/ndsj/2007/html/L1203C.htm

The percentage of the interviewees' education level were as follows: illiteracy, 10%; elementary school graduates, 45%; junior school graduates, 35%; senior high school graduates (technical secondary school included) and above, 10%. The interviewees' lower education level (see Table 2) Rural Residents' Education Level in Tianjin Area) was pertinent with the fact that the interviewees were 35 to 70 years old. Most of those who were under 35 and had received 9-year compulsory education were either out of home to earn a living or receiving higher education then. Few of them would stay home to do farm work. Based on the interviewees' knowledge structure, most of them answered our questions by their perceptual knowledge.

Table 2. Rural Residents' Average Net Income and Education Level in Tianjin Area¹

Rural Residents' Average Net Income in Tianjin Area (¥)							
Year	2000	2001	2002	2003	2004	2005	2006
Average Net Income	3622.39	3947.72	4278.71	4566.01	5019.53	5579.87	6227.94
Rural Residents' Education Level in Tianjin Area (sample result unit: person)							
6 years old and above	Illiterate and semiliterate		Elementary school graduates	Junior high school graduates	Senior high school graduates	Junior college graduates and above	
9296 (sample size ; 100 %)	392 (4.2%)		1984 (21.3%)	3387 (36.4%)	2118 (22.8%)	1415 (15.2%)	

Background Information of Jiagezhuang Village²

Jiagezhuang Village is located at the west side of Ji County, which is a plain area. Because it is near the Ji County exit of Jin Ji highway, it has very convenient traffic. There are 570 rural households in the village, which accounts to a 2176 population. The annual average net income is 4000 to 5000 yuan. The village owns 1300 mu farmland all together, which is less than 0.5 mu per person. Among these lands, 800 mu is planted with wheat and corn, 500 mu is planted with fruit trees like apple, pear and peach. The farmlands' irrigation mostly relies on groundwater. There are 15 deep wells in the village for rural irrigation. The deepest one, from water surface to ground surface is 240 meters.

At present time, 1/2 of the farmland irrigation is by plastic pipeline

¹ Resource: "The Average Net Income per Person of Rural Households in Different Areas" and "Population Plotted by Gender and Education Level in Different Areas", National Bureau of Statistic of China: Chinese Statistic Yearbook 2004, Beijing: Chinese Statistic Publishing House, 2004, p.382; p.107; Chinese Statistic Yearbook 2007, www.stats.gov.cn/tjsj/ndsj/2007/indexch.htm .

² From the interview with the village committee of Jiagezhuang Village.

transportation, the other half is by traditional ground trench transportation. Flooding is the predominant irrigation method. Sprinkling irrigation was tried several years ago, but was aborted due to improper planning and lack of funds. Breeding industry is fairly developed in Jiagezhuang Village. Hogs, cows and sheep are bred in almost every household. The number of household that breeds more than 10 cows is about 10; more than 10 sheep is above 10; more than 50 hogs is above 10. Breeding is second to irrigation in water consumption. Besides, Jiagezhuang Village owns a collective chemical corporation, which is also a big water consumer. The village committee installed pipeline for each household and pumped water from the deep wells for people's daily use.

Background Information of Yaobaizhuang Village¹

Yaobaizhuang Village is located at the east side of Ji County, about 20 km to the downtown. It belongs to the Yu Qiao reservoir area, which is mainly on a plain, with mountain areas to the north. There are 300 rural households in the village, which amount to a population of 1100. The villagers' average annual income is about 4000 yuan. There are 1000 mu farmlands in the village, with 300 mu bottomlands (below 22 meters), which has already been appropriated for the continuation of the Yu Qiao reservoir. About 380 mu farmlands are used to relay cropping wheat and corn; the other 300 mu are used to plant grapes and apples. There are 6 irrigation wells in the village, and one of them is already dried up. The deepest one is 100 meters. The farmland irrigation basically relies on groundwater transported by ground trench. Farmland flooding and field flooding are combined in irrigation. Hogs, sheep and chicken are mainly bred in Yaobaizhuang Village. About 10 households have 20 to 30 hogs,² which increases water consumption. The villagers' living water comes from self-dug wells made by each household. The current average depth of the self-dug wells is about 10 meters. There's a collective costume factory in Yaobaizhuang Village, but it doesn't have much influence on water consumption.

Township business develops very fast in Guanzhuang Township and Chuanfangyu Township, at which Jiagezhuang Village and Yaobaizhuang Village are located respectively. There're 3 corporations whose industry production value reaches 20 million yuan in Guanzhuang Township. There're 35 collective or individual corporations in Chuanfangyu Township.³ These township businesses seize water for agricultural usage and become big local water consumers.

The Villagers' Attitudes toward Water Resources Usage⁴

Rational usage of water is the main topic of this interview. When being asked questions concerning this topic, the villagers told us they were aware of the wastes

¹ From the interview with the village committee of Yaobaizhuang Village.

² Because the villagers pile up the hogs, sheep and chicken's dejections arbitrarily, they infiltrate into the ground with rain water, which indirectly pollute people's living water.

³ Navigation of township government: "Background Information of Guanzhuang Township", "Introduction of Chuanfangyu Township", <http://www.tjjx.gov.cn>

⁴ From the interviews made in Jiagezhuang Village and Yaobaizhuang Village.

caused by ground trench transportation and flooding irrigation. They'd also heard of water saving techniques like plastic trench transportation, cement trench transportation, sprinkling irrigation and drip irrigation. But almost all of them thought there was no way they could use these techniques. 95% of them said the cost for establishing these techniques was too high for them and it should be assumed by the government.

The interviewees also noticed that the ground water level was sinking seriously. But when being asked how to solve this problem while maintaining the current farmland irrigation, all of them said they would dig deeper and deeper. When being asked whether there was any natural limits for drawing out ground water (in other words, whether the ground water would be reduced or dried), 65% of them said there was no limit; while the other 35% gave the opposite answer and said unrestricted usage of groundwater would definitely lead to exhausted water resources. When being asked whether they had thought of taking some water saving methods, 80% of them said it was the government's business, and had nothing to do with the peasants themselves. At the same time, 80% of them said if the government could bear the major cost, they would pay a small portion to establish the water saving techniques. When being asked whether the village committee, township government, or superior relative departments had taught or instructed them about the importance of saving water and daily water saving knowledge or techniques, 70% of them answered no.

From the interview, we learned that both Jiagezhuang Village and Yaobaizhuang Village were in bad shortage of water resources. Immoderate usage of ground water had made groundwater level sinking dramatically. Serious problems existed in their water usage behavior. Their wastes of water resources were obvious.

II. Current Water Usage Problems Existed in the Rural Areas in China

Besides the field survey, we also referred to correlative water usage data to analyze the current problems existed in Chinese rural areas. Then we drew the conclusion: water shortage was a common problem in Chinese rural areas; this was more serious in the north part of China.¹ Several problems existed in rural water usage.

The Conflict of Water Supply and Demand between Industry and Agriculture was Getting More Serious

From table 1 we can see that the gross agricultural water consumption occupies more than 75% of the gross national water consumption. In the past 50 years, industry and townsman's water consumption has become larger and larger. Based on prediction, the water supply gap will reach 100 billion cu meter in 2010, and 230 billion in 2030.² In accordance with the country's fast economic development, increased

¹ The north part of China is also called the north plain area. Divided by Qinling Mountains, it includes Xinjiang, Qinghai, Gansu, Ningxia, Shanxi, Neimenggu, Shanxi, Heilongjiang, Jiangsu, Anhui, Liaoning, Shandong, Hebei, Henan, Jilin, Tianjin and Beijing.

² Dong, Kebao, "The Discussion about Countermeasures and Methods of Water Resources' Sustainable Exploiting in Rural

industrialization and citification level, and growing population (according to the World Bank's prediction, China's citification rate will reach 40% in 2015, and 55% in 2020,¹ water resources usage will transfer to industry and other non-agricultural departments. This will sharpen the conflict between industry and agricultural water usage, which will worsen the water shortage condition in the rural areas.

The Problems of Water Pollution in the Rural Areas was Becoming Apparent

The using amount of water resource in cities have been increased a lot, at the same time, the pollution sources from various aspects lead to the water in rural areas getting polluted, the lacking of water in irrigation region is becoming worse. Currently, the water quality problem caused by pollution in China is more serious, which lets us worry about. In the evaluation of national rivers length in 2004, only 59.4% of all rivers length evaluated had been reached or exceeded the sort III (the better water quality level) water quality. The phenomenon reveals the problem of potable water safety in China is serious now, and nearly 0.323 billion persons in rural areas have been affected by unsafety potable water.

Nowadays, the chemical fertilizer is widely used in Chinese rural areas, but the effective exploiting rate of chemical fertilizer is only 30% to 40%. Annual using amount of chemical fertilizer in rural areas is exceeding 1.2 million tons, and nearly 10% to 20% are dropping on the plants, others are dropping into soil and water.²

Although the living standard for rural inhabitants have been improved, less have been changed with their living style such as the traditional living style of draining off waste water at will. The Chinese rural inhabitants are living disperse, the public facilities which used to dispose living water centralized in massive regions are not available. Meanwhile majority of the living garbage and livestock's night soil are piled out in the open air.

The Ground Water was over Exploited in the Rural Areas

Currently in China, various factors lead to the fact that the percentage of efficiently irrigated farmland is very low (see Table 3). One of the most important one is that water resources is distributed unevenly in both space and time. It is general summarized as "rich in the south and thin in the north". 70% to 90%'s precipitation is concentrated from June to September.³ This leads to seasoned water shortage in some areas, and "water-logging in the south and drought in the north" in a certain season. Because of its geography, the north part of China is dry and has less precipitation, which leads to water shortage in general. However, about 65% farmland is located in this area (see Table 4).⁴ Insufficient precipitation makes groundwater a

Areas", Modern Agricultural Science and Technology, 2007, Issue 2.

¹ China Academy of Sciences Sustainable Development Strategy Research Group, 2004 Strategic Report :China Sustainable Development, Beijing: Science Press, 2004.

² Dong, Kebao, "The Discussion about Countermeasures and Methods of Water Resources' Sustainable Exploiting in Rural Areas", Modern Agricultural Science and Technology, 2007, Issue 2.

³ Zheng, Jiayi, "Limits and Measures of Rural Water resource", Shandong Agriculture, 2001, Issue 2.

⁴ This is calculated by the authors according to reference data, refer to "Farmland Acreage in Different Areas", from National Bureau of Statistics of China: Chinese Statistic Yearbook 2004, p.475.

necessary or even primary supplement to agricultural irrigation. In north China,¹ groundwater occupies 65%² of the total water supply amount. In Jiagezhuang Village and Yaobaizhuang Village, groundwater is nearly the only source for agricultural irrigation and people's living. In the areas where these 2 villages are located, people could get water from 5-6 meters below ground surface when the People's Republic of China was newly founded. At present time, because of the immoderate exploitation of groundwater, the water level has subsided dramatically. The minimum depth from where people could get water is 40 meters. As stated earlier, it is 100 meters in Yaobaizhuang Village and 240 meters in Jiagezhuang Village. Because of the ground water sinkage in Yaobaizhuang Village, the nearby Yu Qiao reservoir's water has been reversely flowed into the ground.³

The ground water is a sort of natural reservation of water resource, once it is exploited inappropriate or above the normal, the water source supply is not enough and the water level has been dropped a lot, thus a series of ecology environmental problems have appeared and even got worse. Massive ground funnel regions have been emerged in past well-irrigation areas. The ground dropping or gapping are due to the emergence of funnels.⁴ According to the statistics of China Geology and Mining Economics Ministry, there are 150 regions that over exploited water resource have become regionalized funnels, and 56 large ground water dropping funnels have been emerged that are nearly 90 thousand square kilometers.⁵ The situation is most serious in Huabei of China is in Hebei Plain. The ground water resource in the Yangtze River Delta is also losing persistently, and the level of ground water is also declining in Northwest of China.

Table 3. The Transformation Trend of Efficiently Irrigated Areas (1978~2004)⁶

year \ category	Farmland area(thousand square meters)	Efficient irrigation area(thousand square meters)	Percentage of efficiently irrigated area (%)
1978	9939	4805	48.3
1979	9950	4833	48.6
1982	9861	4866	49.4
1985	9685	4793	49.5

¹ North China refers to the area which is located north of Qinling Mountain and Huai River, south of the Great Wall, and at the middle or lower reaches of the Yellow River. It includes Beijing, Tianjin, Hebei, Shanxi and Inner Mongolia.

² This is calculated according to the correlative data about Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia. Refer to "Natural Resources", from Chinese Statistic Yearbook 2004, p.5.

³ The Yuqiao Reservoir is one of the primary water resources for Tianjin city. The reverse flow of Yuqiao Reservoir directly influences Tianjin city's industry and people's living water.

⁴ Xin, Yu, etc., "The Problems existed in Water Resources' Management in Rural Areas And Countermeasures", Modern Agriculture, 2007, Issue 7.

⁵ Lei, Chuanhua, etc., "The Study on Water Resources' Current Situation, Problems and Countermeasures in China", Saving Water Irrigation, 2007, Issue 4.

⁶ Resource: Han, Hongyun, etc., "China Irrigation Agricultural Development—Problems and Challenges", Journal of Economics of Water resources, 2004, Issue 1.

1988	9572	4791	50.1
1990	9567	4839	50.6
1991	9565	4895	51.2
1995	9497	5041	53.1
1996	9497	5116	53.9
1997	9497	5227	55.0
1999	13004	5434	41.8
2000	13004	5501	42.3
2001	13004	5425	41.8
2002	13004	5435	41.8
2003	13004	5401.4	41.5
2004	13004	5447.8	41.9

Table 4. Water Resources, Water Consumption and Farmland Conditions in Various Areas of China¹

Areas \ Category		Gross amount of water resources (100 million cu meter)	Gross water amount demanded (100million cu meter)	Farmland area (1000 hektare)	Percentage of local farmland area in the gross national farmland area (%)
China	Beijing	22.1	34.3	343.9	0.26
	Tianjin	10.1	23.0	485.6	0.37
	Hebei	107.3	204.0	6883.3	5.29
	Shanxi	88.5	59.3	4588.6	3.53
	Neimenggu	411.3	178.7	8201.0	6.31
	Liaoning	261.4	141.2	4174.8	3.21
	Jilin	353.6	102.9	5578.4	4.29
	Heilongjiang	727.9	286.2	11773.0	9.05
	Jiangsu	404.4	546.4	5061.7	3.89
	Anhui	580.5	241.9	5971.7	4.59
	Shandong	199.3	225.8	7689.3	5.91
	Henan	321.8	227.0	8110.3	6.24
	Shan'xi	275.5	84.1	5140.5	3.95
	Gansu	184.6	122.3	5024.7	3.86
	Qinghai	569.0	32.2	688.0	0.53
	Ningxia	10.6	77.6	1268.8	0.98
	Xinjiang	953.1	513.4	3985.7	3.07
					65.15

¹ Resource: The gross farmland acreage: from the statistic made during the national general investigation in 1996; the farmland acreage of Chongqing: included in Sichuan province, refer to "Water resources Condition", "Water Supply and Demand Condition" and "Farmland Acreage in Different Areas", from Chinese Statistic Yearbook 2004, p.424, 425, 475; Chinese Statistic Yearbook 2007, www.stats.gov.cn/tjsj/ndsj/2007/indexch.htm.

South China	Shanghai	27.6	118.6	315.1	0.24	35.85
	Zhejiang	903.6	208.3	2125.3	1.63	
	Fujian	1623.5	187.3	1434.7	1.10	
	Jiangxi	1630.0	205.7	2993.4	2.30	
	Hubei	639.7	258.8	4949.5	3.81	
	Hunan	1770.3	327.7	3953.0	3.04	
	Guangdong	2216.2	459.4	3272.2	2.52	
	Guangxi	1881.1	314.4	4407.9	3.39	
	Hainan	227.6	46.5	762.1	0.59	
	Chongqing	380.3	73.2	-	-	
	Sichuan	1865.8	215.1	9169.1	7.05	
	Guizhou	814.6	100.0	4903.5	3.77	
	Yunnan	1711.7	144.8	6421.6	4.94	
	Xizang	4157.1	35.0	362.6	0.28	

Serious Waste of Water Resources

During the investigation, we found that water resources was seriously wasted in Chinese rural areas. This had two reflections. One was the lost of natural precipitation. When the flood season came, natural precipitation from the up rivers couldn't be efficiently dammed and reserved.¹ The other one was that the efficient usage rate of agricultural irrigation was very low. Due to the limitation of economic development level, nowadays the style of farmland irrigation in Chinese rural areas is mainly the traditional ground irrigation, more than 75% of earth surface irrigation areas use channel irrigation, and only 20% of more than 3 million hectares' channels can prevent leaking.² According to correlative data, currently in China efficient usage rate for trench irrigation is 30% to 40%, and 60% for motor-pumped well irrigation. And this number has already reached 70%-90% in the developed countries.³ At the same time, the production efficiency is less than 1 kg foodstuff per cu meter water can produce, while it is 2-3 kg in the developed countries.⁴ In Jiagezhuang Village, nearly 1/2 of the farmland is irrigated by ground trench, while in Yaobaizhuang Village, all the farmland irrigation is realized by ground trench. Traditional irrigation methods like flooding irrigation and field irrigation are commonly used. But these kinds of methods make nearly 50% of the irrigation water absorbed or vaporized before it can benefit the plants, which causes tremendous waste of water.

¹ Su, Ping, "Continuous Usage of Rural Water resources and Water Saving Agriculture", Northwestern Water resources and Water Engineering, 2000, Issue 3.

² Dong, Kebao, "The Discussion about Countermeasures and Methods of Water Resources' Sustainable Exploiting in Rural Areas", Modern Agricultural Science and Technology, 2007, Issue 2.

³ Zheng, Jiayi, "Limits and Measures of Rural Water resources", Shandong Agriculture, 2001, Issue 2.

⁴ Ibid.

□. The Factors Which Disturbs Efficient Usage of Rural Water Resources in China

According to our first-hand investigation and various data analysis, we concluded that the following factors hinder efficient usage of water resources in Chinese rural areas.

Ideology

One of the most important factors that hinder efficient usage of rural water resources is ideology. This includes two aspects: one is the individual peasant's ideology, the other is the government and the governmental officials' ideology. Among the rural households that were interviewed in Jiagezhuang Village and Yaobaizhuang Village, only 20% of them thought it was necessary to save water, 65% thought the groundwater would never be dried up so they could use it infinitely. Few of them ever thought of saving water or efficient usage of water. This showed the peasants' indifferent attitudes toward saving water and efficient usage of water resources. The government didn't give much introduction to the peasants about efficient usage of water resources, either. During the investigation, nearly 70% of the interviewees said they had never been given any instruction on water saving techniques by either the village committee or superior government.

Finance

The finance factor is concluded on base of the peasants and grass roots government's financial condition. Among the interviewed rural households, nearly 20% had realized the importance of water saving and had heard of water saving techniques like sprinkling irrigation and drop irrigation. However, the cost for these techniques is so high for the peasants that they are either resuming traditional irrigation methods or placing their hope on the government's funding. At the same time, some grass roots governmental officials, especially the officials in the professional departments, also know that the technical problems could only be solved by the government's financial investigation and the village committee's support. But due to the grass roots government's limited funding, the support is far from meeting the peasants' needs.

Take Tianjin as an example, there is a serious aging problem with the water conservancy facilities in the rural areas. Most of the state-owned pumping stations have already extended service period and existed grave problem. The major rivers and channels are grimly choked with silt; the supportive farmland facilities such as bridges, floodgates, culverts, etc. are worn down by the years unrepaired. Most of the water storage facilities were set up in 1970s, among which five large-to-medium reservoirs are in danger in different degrees. Most motor-pumped wells were built during 1970s and a large number of them have extended service period, most of

which have just been abandoned and very few been replaced.¹

Technology

Financial problems will definitely lead to technical problems. In order to realize efficient usage of rural water, technical transportation methods should be established and irrigation and water conservancy should be improved. Currently the rural irrigation and water conservancy is outdated. The primary water transportation method is still traditional ground trench irrigation. Higher techniques like plastic trench and concrete trench irrigation haven't been popularized. Efficient irrigation methods like sprinkling and drop irrigation still remains at test phase (Jiagezhuang Village was once a testing spot for sprinkling irrigation). In Yaobaizhuang Village, most of the irrigation wells are dug before 1978 (one of them is already dried up). The laggard irrigation techniques will definitely lead to waste of water resources.

Only few big provinces such as Henan Province have made use of various water-saving measures on dry farmland and some technologies bring about great effects of increasing production. Those technologies include mulch cultivating technology, furrow sowing technology, ground-covering technology, water-saving irrigation technology and so forth.² Nevertheless, the agricultural water-saving technology in China is still at a comparatively low level overall. For instance, the area of farmlands which are irrigated by such water-saving technology only accounts for a third of the total irrigation area. Impermeable channel and pipe irrigation still dominate the scene. Furthermore, the area of farmlands which are irrigated by highly effective irrigation methods such as spray or drip irrigation only occupies 4.3% of the total irrigation area, which lags far behind of the developed countries. Moreover, the variety and quality of water-saving irrigation devices still cannot meet the developing need of water-saving irrigation.³ The backwardness of irrigating and water-saving technology causes the insufficient utilization of water resources.

Management

Incomplete management is the systematic source for the extensive and inefficient usage of rural water resources. It has two reflections: one is lack of general planning and supervision on the usage of water resources. Instead of mutual cooperation, the local governments and correlative departments always make planning according to their own interests. Also, the correlative authorities didn't make effective instructions and supervisions on the rural usage of water resources in their precinct. For example, well excavation should be approved by the water conservancy department. But during our investigation, nearly none of the peasants even knew they should submit an application before they dug a well. The local water conservancy department never made any inspection, and its superior department never supervised

¹ Liu, Shuai, "The Analysis on Water Resources' Exploiting in Rural Areas of Tianjin", *Hai River Water Conservancy*, 2006, Issue 6.

² Wu, Jicheng, etc., "A Tentative Discussion on the Effective Ways to Develop the Water-Saving in the Dry Farmlands of Henan Province", *Henan Agricultural Science*, 2006, Issue 1.

³ Li, Xiaoqing, "Agricultural Water Resource Problem and Its Effective Utilization", *Gansu Agriculture*, 2007, Issue 7.

the local water conservancy department's work.

The other is multi-departmental management on water resources. For example, the water conservancy department and subterranean mineral department monitor the groundwater, the environmental protection department is in charge of water pollution, the weather bureau deals with atmosphere water resources¹, and the land management department assists supervising the conservation of soil and water. There's no uniform management system and each department has its own jurisdiction. Some of them overlap, thus conflicts come up, which makes the government's water resources management disordered and inefficient.

Policy

In nowadays China, the rural water price in most areas is rather low. It can't reflect water supply cost to a large extent. In some areas, water can be used absolutely free. Jiagezhuang Village and Yaobaizhuang Village are two examples. Irrigation water can be used with no charge. The peasants only pay for the electricity fee caused during pumping water. The village committee even gives the peasants certain amount of electricity subsidy. Based on Jiagezhuang Village's statistic, each of those who owned lands only needs to pay 50 cents for irrigating once. The rest part is paid by the village committee. The low water price shows the government's favor to the peasants' interests. But it also continues the unceremonious water policy before China's Reformation to some extent. The low water price policy is not good for improving the peasants' consciousness in water saving. Also, it is not good for advancing efficient usage of water resources in the rural areas.

□. The Methods and Problems in Realizing Efficient Usage of Rural Water Resources in China

At present, the utilization ratio of agricultural irrigating water in China is only about 1.0 kg/m³, compared with the world's advanced level of 2-2.5 kg/ m³,² which means that there is still large room to improve in this aspect in China. Therefore, how to adopt effective measures to realize the reasonable usage of water resources has become the critical problem that needs to be solved immediately especially in China's rural areas. According to the current situation in China's rural areas, the following measures should be adopted.

Realize Efficient Usage of Water Resources by Enforcing Laws and Rules

Aimed at realizing efficient usage of water resources, the Chinese government has been trying various policy adjustments for a long time.

¹ Atmosphere water resources includes the water vapor within the atmosphere and its derived solid and liquid water. The evaporation of ocean and land is the critical tache of water recycle.

² Lin, Maosen, "The Discussion about Approaches and Methods of Agricultural Droughting and Saving Water", Gansu Science and Technology, 2007, Issue 5.

Since 1950s, the Chinese government's policy on rural water resources usage and water control has experienced 3 periods. Firstly, in 1950s, the government focused on preventing and managing the disasters caused by flood and waterlogging. Secondly, in 1970s, with the development of rural economy the government paid more attention on rural irrigation problem. Thirdly, since 1980s, the government has more and more emphasized broadening sources and reducing expenditure of water usage.

In 1988, the central government issued the "People's Republic of China Water Law". In chapter 1 item 7, it was stated, "planned usage of water is implemented by the government, water saving is strictly enforced",¹ which indicated the legalization of efficient usage of water resources. On October 1st, 2002 the "Revised Water Law" prescribed, "Saving water should be strictly enforced, water saving methods should be strongly promoted. New technologies and techniques about water saving should be advanced. Water saving industry, agriculture and service trades should be developed in order to establish a water saving society".² The "Revised Water Law" reflects the government's strengthened efforts on promoting its water saving policy, which makes the course of efficient usage of water resources develop in a more scientific way.

One of the correlative problems about efficient usage of rural water resources is the water price, which is mentioned earlier. Some people suggest marketing system be introduced to rural water resources management to decide the water price.³ However, according to current condition in Chinese rural areas, problems exist in setting the water price. On one hand, the natural distribution of water resources varies significantly among different provinces, which makes it difficult to set a uniform water price, even in the same province; On the other hand, it is difficult to measure water consumption. When the water amount is stable, irrigation fees could be charged according to irrigation time, but when the water amount changes with season and time, irrigation fees need to be adjusted. Furthermore, because different plants need different amount of water, the water price might influence the peasants' planting structure, or even some other aspects. In one word, problems still exist in charging water fees in the rural areas. The main problem is setting the water price. Only the measurement of water consumption will cause huge costs.

In theory, water resources is a semi-common substance which is rare, competitive and nonexclusive. Whether or not it is beneficial to manage a semi-common substance like water resources by introducing the marketing system needs to be further discussed. Undoubtedly, at present, it should be improved and implemented the water-getting and waste-emitting license systems as soon as possible.

¹ Policies and Laws: the People's Republic of China Water Law (1998), www.mwr.gov.cn/zcfg/zcfg.wct .

² Policies and Laws: the People's Republic of China Water Law (2002), www.mwr.gov.cn/zcfg/zcfg.wct .

³ Han, Hongyun, etc., "China's Rural Water resources Usage in the 21st Century", Agricultural Economy, 2002, Issue 11.

Coordinate the Relationship between Each Governmental Department and Make Rational Defines on the Functions and Purviews of Each Department.

How to make efficient usage of rural water resources and continuous development of rural economy involves lots of issues. Various governmental departments must be concerned in order to solve these problems. In the past few years, because of different governmental departments' different interests, there came the complexion of "water resources controlled by several departments", which was, several superiors were in charge of the management of rural water resources, which caused overlaps of their purview. In order to solve this problem, in May 1984, the State Council set up the Environmental Protection Committee to coordinate the work between different departments. In December that year, the State Council further set up the Environmental Protection Administration as a functionary institute of the Environmental Protection Committee, which was under the charge of the Department of Urban and Rural Construction and Environmental Protection. After this, most local governments also set up local environmental protection committee one after the other. The State Council's institution reform in 1998 canceled the Environmental Protection Committee and made the State Environmental Protection Administration take on its functions. However, the State Environmental Protection Administration was not a compositive institute of the State Council so that it lacked the deserved authority and necessary measures to complete its responsibility. Thus the former Environmental Protection Committee's coordination function couldn't be well performed, and the multi-superior management on the rural water resources couldn't be solved. Aimed at this, the State Department approved to set up the National Joint Conference of Environmental Protection Departments in 2001. Still, the government's coordination system is far from perfect, and the National Joint Conference of Environmental Protection Departments can't exert the coordination function very well. In the process of administering water resources in rural areas, it is imperative to demarcate the duties and coordinate the relationship of the various departments of the government.

In the year of 2007, the 17th CPC National Congress puts forward the reform of administrative polity, which includes "strengthening the institutional integration" and "perfecting coordinating and cooperative mechanism of different departments".¹ In this institutional reform, the National Environmental Protection Bureau has been upgraded as the Environmental Protection Ministry. However, the problem of how to effectively manage the water resources through administrative reform remains to be solved. The similar problem once bothered Japan during 1990s. However, after the reform, the Japanese government had integrated 9 relevant divisions within 6 ministerial organizations into a "Liaison Conference for Building a Sound Water Recycling System of Provinces", which transforms the multi-administration system of water resources to uni-administration system, with the aim of building a sound water

¹ Hu, Jingtao, "Hold High the Great Banner of Socialism with Chinese Characteristics, to Win the Comprehensive Construction of a Well-off Society and Strive for New Victories", *Report on the 17th Plenary of the CPC*, Beijing: People's Press, 2007, p.32.

recycling system. Within the conference, information is communicated among different departments, the departments cooperate and coordinate to manage water resources, attaining fabulous achievement,¹ which provides us with valuable experiences.

The Government's Financial Funding and Policy Support.

As we mentioned earlier, during our investigation on Jiagezhuang Village and Yaobaizhuang Village, we found that some peasants did have the nice wishes to save water. But in order to realize these wishes, the government's financial and technical assistant and policy support are needed.

First of all, efficient usage of rural water resources needs the government's strengthened efforts in financial support. One of the reasons why the effects of water saving in the rural areas are not so obvious is lack of financial support. Insufficient governmental investment made it difficult for the rural areas to develop basic irrigation projects. In recent years, the government's investment on irrigation works mostly concentrates on large-scale projects like power station and flood prevention dams. The rural irrigation system is rarely considered. Because the triune management system of national government's investment, local government's assistant funding and peasant's labor devotion hasn't been established yet, plus the latter two factors are hard to be put into effect, lots of irrigation areas have become "half-done" projects. Thus the national government's investment can't exert its expected effects. We learned from our investigation that Jiagezhuang Village was once honored as the "demonstration base of sprinkling irrigation" of Ji County. However, because of insufficient funding and the follow-up problems, it became unworthy of its title in the end. Furthermore, because the central government and local government had few investments on motor-pumped wells, the peasants needed to pay by themselves. And because of the peasants' poor cooperation, some well and trench combined irrigation areas couldn't exert any effect.

Since the agricultural water conservancy facilities account for a large part of proportion of the agricultural production cost, the National and different level's governments should set up stable investing mechanism for transform and building water conservancy facilities, as well as to improving current irrigation technologies. Meanwhile, the Government should emphasis on improving the current projects and advancing effective irrigation ratio and water utilization one, taking overall anti-seeping measures in the major channels of irrigation area; increasing the speed of building reservoirs in mountain areas, strengthening regulation ability of water resources utility, so as to gaining optimum benefits from current projects.

Second, efficient usage of rural water resources needs the government's technical support. It is necessary for the government to put more efforts in promoting

¹ Li, Songyu, "Learning Water Safety Measurement Abroad and Conducting Water Safety Society (1)", *China Water Conservancy Paper*, Mar.1, 2007.

the research and popularization of rural water saving technologies. One of the reasons why rural water saving technology develops rather slowly is that the government hasn't made sufficient investment on agricultural technology for a long period of time. According to "Chinese Statistic Yearbook 2004", the percentage of agricultural expenditure in gross national finance expenditure is 13.43% in 1978, 10.05% in 1992, 8.23% in 1999, and 7.12% in 2003.¹ The percentage of three primary agricultural technology costs² in gross agricultural expenditure is 0.70% in 1978, 0.79% in 1992, 0.84% in 1999 and 0.70% in 2003.³ These data show that the government's financial devotion in agriculture is in a digressive trend since 1978. And although the percentage of the three primary agricultural technology costs in gross agricultural expenditure fluctuates each year, the government's agricultural technical devotion is descending in general. Currently, the primary producing method in Chinese rural areas is a small-scale producing way with family as its basic unit. Under this condition, it is really hard for the peasants to bear the high cost of techniques like trench irrigation, sprinkling irrigation and drop irrigation. They need the government's help and more devotion in water saving technologies, water saving projects, water saving high yield cultivation techniques and water saving anti-drought breed techniques. The effective utilization of China's channel irrigation is 0.3~0.4, and 0.6 for the well irrigation, so there is great potential in agricultural water saving. China's government ought to help rural areas to improve water utilization ratio and efficiency, promoting water usage technology research.⁴

What's more, in order to advance the economic efficiency of water resources in rural areas of China, the industrial structure needs to be adjusted. The optimization of industrial structure and cultivating structure is the foundation for optimizing the allocation of water resources. In view of the situation that the process of urbanization and industrialization of China greatly take up the agricultural-oriented water, it should design an overall program to distribute municipal and industrial water, so as to secure the fundamental need of people. Besides, the layout of agriculture and industry should be adjusted, broadening town industry, advancing the ability of technology transformation, limiting big water-consuming branch, downsizing the scale of low water-utilizing efficiency industries. As for agriculture, it should adjust crops layout to suit to local condition, constricting crops that consume much water produced in areas that short of water, encouraging developing agricultural technologies that with high water utilization efficiency, and enlarged the cultivation areas of water-saving crops. As to the drought-resistant and water-saving agricultural products, the government could make proper policy and grant appropriate support for the production and sale.

Furthermore, efficient usage of rural water resources needs the government's

¹ Refer to "National Finance's Payouts in Agriculture", "National Finance's Payouts in Scientific Research", from National Bureau of Statistics of China: Chinese Statistic Yearbook 2004, p.294.

² "The 3 primary agricultural technology costs" refers to the technical expenditure in national budget. It includes new product trial-manufacture fees, middle experimental fees, and important scientific research subsidy fees. Refer to Chinese Statistic Yearbook 2004, p.311.

³ These data was calculated by the authors according to the data from Chinese Statistic Yearbook 2004, p.294.

⁴ Li, Xiaoqing, "Agricultural Water Resource Problem and Its Effective Utilization", *Gansu Agriculture*, 2007, Issue 7.

proper policy guide. A few years ago, in order to solve the “sand storm” problem, “reuse farm for forest” policy was put forward. However, because of some local government’s misunderstanding on the national policy, some rich farmlands were used to plant trees. Then the State Department carried out “the Central Committee of the Communist Party of China and the State Council’s Notions on Some Policies Aimed at Increasing the Peasant’s Incomes”,¹ in which strict farmland protection systems were re-stated in order to protect the farmlands, especially the essential lands.

During our visit to Chuanfangyu Township, we learned that it was honored as the “example base of environmental protection” in 2001. However, the fact was that saplings were planted on plains which were suitable for crops. Planting trees on rich farmlands was against the developmental rule of rural economy. The sapling’s relatively developed root system not only seized water from its neighbor lands, but also blocked lights from the sun, which had lots of negative effects on its neighbor crops. This went against the government’s wish to “reuse farmlands for forests” and it did no good to the conservation of soil and water, either. The peasants’ interests were harmed. When they tried to re-plant crops on the former saplings’ lands, the output would be influenced for a couple of years. This would bring negative effects in the peasants’ minds.

From this we learn that proper policy guide is very important to efficient usage of rural water resources. The government’s pendulous policy will make the peasants at loose ends when making decisions. Thus it is impossible for them to make expected investment on rural irrigation establishments.

Epilogue

In a word, currently in China, how to make efficient use of rural water resources is a great issue which is concerned with China’s sustainable development, the national economy and people’s livelihood. The Chinese government needs to make feasible policies and give financial and technical supports to the local township governments and peasants to realize this goal. The governmental officials and peasants should be trained and educated to make efficient usage of water resources widely known in the countryside. Governmental departments’ functions should be clarified. The relationship between different departments should be coordinated through governmental reforms to better serve the rural areas and rural people. Because of the vast territory and relative laggard economy of the Chinese rural areas, it is impossible for the government to update the rural irrigation system and complete large-scale investment within a short period of time. However, it is still possible to implement the triune management system of central government’s investment, local government’s assistant funding and peasant’s labor devotion. With the buildup of the peasants’ self consciousness and the government’s help and support, stepwise development and perfection of scientific and reasonable rural irrigation establishments and efficient usage of rural water resources isn’t too far behind to catch up with.

¹ People's Daily, Feb 9th, 2004, 1st edition.

This article is not initiated to put forward a professional scheme. We try to make objective analysis on the current water usage condition in the rural areas and find out its choke points and possible way outs. All of our endeavors aim to offer a positive and beneficial reference for promoting the course of efficient usage of water resources in Chinese rural areas.

References

- Babbie, Earl, *The Basics of Social Research* (8th Edition), translated by Qiu, Zeqi, Beijing: Huaxia Press, 2002.
- China Environment News Office (translate and edit), *Stride toward the 21th Century—Literature Collection of the United Nation Environment and Development Conference*, Beijing: China Environmental Science Press, 1992.
- China Academy of Sciences Sustainable Development Strategy Research Group, *2004 Strategic Report: China Sustainable Development*, Beijing: Science Press, 2004.
- China Social Science Environment and Development Research Center, *China Environment and Development Review*, Beijing: Social Science Academic Press, 2004.
- Gan, Shijun, *Sustainable Development: A Decision which Goes beyond Centuries*, Beijing: The Central Party School Publishing House, 1997.
- Huang, Hengxue, *Public Economy*, Beijing: Peking University Press, 2002.
- Hu, Jingtao, “Hold High the Great Banner of Socialism with Chinese Characteristics, to Win the Comprehensive Construction of a Well-off Society and Strive for New Victories”, in the *Report on the 17th Plenary of the CPC*, Beijing: People’s Press, 2007.
- Myers, Norman, *Ultimate Security the Environmental Basis of Political Stability*, translated by Wang Zhengping etc., Shanghai: Shanghai Translation Publishing House, 2001.
- National Bureau of Statistic of China, *Chinese Statistic Yearbook 2004*, Beijing: Chinese Statistic Publishing House, 2000~2004; 2007.
- Portney, Paul R., *Public Policies for Environmental Protection*, translated by Mu Xianqing etc., Shanghai: Sanlian Bookstore, 2004.
- State Environmental Protection Administration of China, *China’s agenda 21*, Beijing: China Environmental Science Press, 1995.
- State Environmental Protection Administration of China, *China Environmental Protection Actions Plan 1991-2000*, Beijing: China Environmental Science Press, 1994
- Wang, Jun, *Continuous Development*, Beijing: China Development Press, 1997.
- Wang, Weizhong, *Comparative Study on International Continuous Developmental Strategies*, Beijing: The Commercial Press, 2000.
- Zhao, Xudong, *The Environmental Protection Tidal Wave and China’s Countermeasures*, Beijing: World Affairs Press, 1999.
- Deng, Wei, etc., “Water resourcess: One of the Most Important Issues which Deserves More Global Attention in the 21st Century”, Changchun: *Chinese*

Geographical Science, 1999, Issue 2.

Dong, Kebao, "The Discussion about Countermeasures and Methods of Water Resources' Sustainable Exploiting in Rural Areas ", Hefei: Modern Agricultural Science and Technology, 2007, Issue 2.

Dong, Yuxiu, "Reflection on Continuous Development and Continuable Usage of Rural Water resources", Taiyuan: *Shanxi Hydrotechnics*, 2003, Issue 4.

Han, Hongyun, etc., "China's Rural Water resources Usage in the 21st Century", Shenyang: *Agricultural Economy*, 2002, Issue 11.

Han, Hongyun, etc., "China Irrigation Agricultural Development—Problems and Challenges", Nanjing: *Journal of Economics of Water resources*, 2004 Issue 1.

Han, Suhua, etc., "Making Efficient Usage of Rural Water resources by Adjusting the Water Price", Beijing: *Journal of China Institute of Water resources and Hydropower Research*, 2004, Issue 2.

Huang, Daying, "Tentative Analysis on the Latent Dangers in Continuous Usage of Water resources in the Rural Areas of Beijing", Beijing: *Beijing Water resources*, 1998 Issue 5.

Lei, Chuanhua, etc., "The Study on Water Resources' Current Situation, Problems and Countermeasures in China", Wuhan: Saving Water Irrigation, 2007, Issue 4.

Li, Fadong, etc., "Problems and Measures for Continuous Usage of Rural Water resources in China", Wuhan: *Water Saving Irrigation*, 2001, Issue 4.

Lin, Maosen, "The Discussion about Approaches and Methods of Agricultural Droughting and Saving Water", Lanzhou: Gansu Science and Technology, 2007, Issue 5.

Li, Xiaoqing, "Agricultural Water Resource Problem and Its Effective Utilization", Lanzhou: *Gansu Agriculture*, 2007, Issue 7.

Liao, Yongsong, "Problems and Way Outs for Rural Water Price Reformation", Wuhan: *Chinese Village Water Conservation and Water and Electricity*, 2004 Issue 3.

Liu, Geli, "Rethinking of Water Saving", Beijing: *Water resources Planning and Design*, 2002 Issue 3.

Liu, Shuai, "The Analysis on Water Resources' Exploiting in Rural Areas of Tianjin", Tianjin: Hai River Water Conservancy, 2006, Issue 6.

Li, Sonwu, "Learning Water Safety Measurement Abroad and Conducting Water Safety Society (1)", *China Water Conservancy Paper*, Mar. 1, 2007.

The Central Committee of the Communist Party of China and the State Council's Notions on Some Policies Aimed at Increasing the Peasants' Incomes, *People's Daily*, Feb. 9, 2004 1st edition.

The State Council's Notions on Further Improving the Reuse Farmlands for Forests Policy, *People's Daily*, Jun 21, 2002, 1st edition.

Su, Ping, "Continuous Usage of Rural Water resources and Water Saving Agriculture", Xi'an: *Northwestern Water resources and Water Engineering*, 2000 Issue 3.

Wu, Jicheng, etc., "A Tentative Discussion on the Effective Ways to Develop the Water-Saving in the Dry Farmlands of Henan Province", Zhengzhou: *Henan Agricultural Science*, 2006, Issue 1.

Xin, Yu, etc., “The Problems existed in Water Resources’ Management in Rural Areas And Countermeasures”, Huhehaote:Modern Agriculture, 2007, Issue 7.

China Sustainable Development Information Website and Water resources and Water Environment Shared Website: <http://sdinfo.chinawater.net.cn>

Ministry of Water resources of People’s Republic of China, “Water resources Bulletin 1999”, www.mwr.gov.cn

Ministry of Water resources of People’s Republic of China, “Water resources Bulletin 2000”, www.mwr.gov.cn

Ministry of Water resources of People’s Republic of China, “Water resources Bulletin 2001”, www.mwr.gov.cn

Ministry of Water resources of People’s Republic of China, “Water resources Bulletin 2002”, www.mwr.gov.cn

Ministry of Water resources of People’s Republic of China website: www.mwr.gov.cn/zcfg/zcfg.wct, 2007.

Zheng, Jiayi, “Limits and Measures of Rural Water resources”, Jinan: *Shandong Agriculture*, 2001 Issue 2.

Tianjin Ji County government website: <http://www.tjx.gov.cn>

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