

A Study on Water Utilization in Chinese Rural Areas¹

RECHERCHE SUR L'UTILISATION D'EAU DANS LES REGIONS RURALES CHINOISES

Tan Rong² Liu Ping³ Yu zhiyong⁴ Cui Jie⁵

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 Jia Ge Zhuang and Yao Bai Zhuang 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

Résumé: En Chine, la population est grande et l'agriculture est très importante dans l'économie nationale. Les régions rurales sont devenues un sphère principal de la consommation d'eau. Il existe les problèmes d'insuffisance d'eau et le gaspillage d'eau dans la campagne. Les conflits sur les ressources d'eau fournie et demandée entre industrie and agriculture sont très fréquents. Les facteurs variés tels qu'idéologie, finance, technologie, management et politique limitent l'usage rationel et effectif de ressources d'eau. L'enquête sur les villages de Jia Ge Zhuang et Yao Bai Zhuang dans le pays Ji, Tianjin reflète ces problèmes. Le government tente de résoudre les problèmes par l'élaboration des lois et les politiques, ainsi que le support financier et technologique aux bourgs et villages. Au même temps, il est nécessaire pour le government à rendre conscients les officiels et les paysans l'importance de l'usage rationel en économisant par la publicité, en coordonnant les relations inter-gouvernementaux, et en déterminant les tâches des départements. Pour la réaliser l'objectif de l'usage d'eau rationel, il est nécessaire de prendre des mesures pour construire et perfectionner l'installations d'irrigation par l'investissement des gouvernements supérieurs et locaux ainsi que les forces des labours.

Mots clés: Les régions rurales chinoises, Ressource d'eau, usage rationel, fermier, Système d'Irrigation

¹The study was funded by the National Center for Innovation Research on Circular Economy of Nankai University

² Nankai University, China.

³ Nankai University, China.

⁴ Nankai University, China.

⁵ Nankai University, China.

*Received 10 October 2005; accepted 20 October 2005

1. 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 irreplaceable 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. (Table 1) Thus how to make good use of rural water resources deserves high attention.

In July 2004, 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 (1949~2002) ⁶
(Unit: one hundred million cu metre)

| Year category | | 1949 | 1959 | 1965 | 1980 | 1993 | 1995 | 1997 | 1998 | 2000 | 2001 | 2002 |
|-------------------------|-------------|------|------|------|------|------|------|------|------|--------|--------|--------|
| Gross water consumption | | 1031 | 2084 | 2744 | 4439 | 5198 | 5350 | 5566 | 5435 | 5497 | 5567 | 5497 |
| Agriculture | | 1001 | 1398 | 2545 | 3912 | 4055 | - | 4199 | 4068 | 3783 | 3845 | 3736 |
| Industry | | 24 | 96 | 181 | 457 | 906 | - | 1121 | 1126 | 1139 | 1141 | 1142 |
| Living water | Rural areas | - | - | - | - | - | - | 277 | 288 | 291 | 293 | 298 |
| | towns | 6 | 14 | 68 | 237 | 237 | - | 256 | 274 | 283.93 | 306.47 | 320.59 |

2. INVESTIGATION ON JIAGEZHUANG VILLAGE AND YAObAIZHUANG VILLAGE

2.1 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.

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 (Table 2: Rural Residents' Education Level in Tianjin Area, data from "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, Page 382; Page 107) was pertinent with the fact that the interviewees were 35 to 70 years old. Most of those who

⁶ The data are 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, Page 10

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 Area

| Rural Residents' Average Net Income in Tianjin Area (¥) | | | | | | |
|---|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------------|---------|
| Year | 1990 | 1995 | 2000 | 2001 | 2002 | 2003 |
| Average Net Income | 1069.04 | 2406.38 | 3622.39 | 3947.72 | 4278.71 | 4566.01 |
| 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 | |
| 9550 (sample size; 100%) | 546 (5.7%) | 2149 (22.5%) | 3597 (37.7%) | 2204 (23.1%) | 1037 (10.9%) | |

2.2 Background Information of Jiagezhuang Village⁷

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 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.

2.3 Background Information of Yaobaizhuang Village.⁸

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 hogs⁹, 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

⁷ From the interview with the village committee of Jiagezhuang Village

⁸ From the interview with the village committee of Yaobaizhuang Village

⁹ 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.

Guanzhuang Township. There're 35 collective or individual corporations in Chuanfangyu Township

These township businesses seize water for agricultural usage and become big local water consumers.

Table 3. The Transformation Trend of Efficiently Irrigated Areas

| category year | Farmland area(thousand square meters) | Efficient irrigation area(thousand square meters) | Percentage of efficiently irrigated area (%) |
|------------------|---|---|--|
| 1949 | 9788 | 1593 | 16.3 |
| 1952 | 10792 | 1934 | 17.9 |
| 1957 | 11183 | 2500 | 22.4 |
| 1962 | 10290 | 2870 | 27.9 |
| 1965 | 10359 | 3204 | 30.9 |
| 1975 | 9971 | 4612 | 46.3 |
| 1978 | 9939 | 4805 | 48.3 |
| 1979 | 9950 | 4833 | 48.6 |
| 1982 | 9861 | 4866 | 49.4 |
| 1985 | 9685 | 4793 | 49.5 |
| 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 |

2.4 The Villagers' Attitudes toward Water Resources Usage.¹⁰

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 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.

¹⁰ From the interviews made in Jiagezhuang Village and Yaobaizhuang Village

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

| 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 (%) | |
|----------------|--------------|--|---|------------------------------|---|--------------------|
| Areas | | | | | | |
| North China | Beijing | 18.4 | 35.0 | 343.9 | 0.26 | 65.15 ^a |
| | Tianjin | 10.6 | 20.5 | 485.6 | 0.37 | |
| | Hebei | 153.1 | 199.8 | 6883.3 | 5.29 | |
| | Shanxi | 134.9 | 56.2 | 4588.6 | 3.35 | |
| | Neimenggu | 495.6 | 166.9 | 8201.0 | 6.31 | |
| | Liaoning | 220.0 | 128.3 | 4174.8 | 3.21 | |
| | Jilin | 326.5 | 104.0 | 5578.4 | 4.29 | |
| | Heilongjiang | 826.8 | 245.8 | 11773.0 | 9.05 | |
| | Jiangsu | 619.1 | 433.5 | 5061.7 | 3.89 | |
| | Anhui | 1083.0 | 178.6 | 5971.7 | 4.59 | |
| | Shandong | 489.7 | 219.4 | 7689.3 | 5.91 | |
| | Henan | 697.7 | 187.6 | 8110.3 | 6.24 | |
| | Shan'xi | 574.6 | 75.1 | 5140.5 | 3.95 | |
| | Gansu | 247.2 | 121.6 | 5024.7 | 3.86 | |
| | Qinghai | 634.7 | 29.0 | 688.0 | 0.53 | |
| | Ningxia | 12.3 | 64 | 1268.8 | 0.98 | |
| | Xinjiang | 920.1 | 500.7 | 3985.7 | 3.07 | |
| South China | Shanghai | 15.1 | 109.0 | 315.1 | 0.24 | 35.85 |
| | Zhejiang | 574.5 | 206.6 | 2125.3 | 1.63 | |
| | Fujian | 806.6 | 182.8 | 1434.7 | 1.10 | |
| | Jiangxi | 1362.7 | 172.5 | 2993.4 | 2.30 | |
| | Hubei | 1234.1 | 245.1 | 4949.5 | 3.81 | |
| | Hunan | 1799.2 | 318.8 | 3953.0 | 3.04 | |
| | Guangdong | 1458.4 | 457.5 | 3272.2 | 2.52 | |
| | Guangxi | 1901.0 | 278.4 | 4407.9 | 3.39 | |
| | Hainan | 291.8 | 46.3 | 762.1 | 0.59 | |
| | Chongqing | 590.1 | 63.2 | — | — | |
| | Sichuan | 2589.8 | 209.9 | 9169.1 | 7.05 | |
| | Guizhou | 915.5 | 93.7 | 4903.5 | 3.77 | |
| | Yunnan | 1699.4 | 146.1 | 6421.6 | 4.94 | |
| Xizang | 4757.1 | 25.3 | 362.6 | 0.28 | | |

**3. RRENT 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 China¹¹. Several problems existed in rural water usage.

3.1 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 2030¹². In accordance with the country's fast economic development, increased 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 2020¹³), 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.

3.2 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 (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 July to September¹⁴. 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 (table 4¹⁵). Insufficient precipitation makes groundwater a necessary or even

primary supplement to agricultural irrigation. In north China¹⁶, groundwater occupies 65%¹⁷ 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.¹⁸

3.3 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 reserved¹⁹. The other one was that the efficient usage rate of agricultural irrigation was very low. 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%²⁰ in the developed countries. At the same time, the foodstuff production efficiency per unit water consumption is less than 1 kg per cu meter water, while it is 2-3 kg21 in the developed countries. 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

¹¹ 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

¹² Deng, Wei, etc., "Water resourcess: One of the Most Important Issues which Deserve More Global Attention in the 21st Century", Changchun: *Chinese Geographical Science*, 1999, Issue 2

¹³ China Academy of Sciences Sustainable Development Strategy Research Group, *2004 Strategic Report :China Sustainable Development*, Beijing: Science Press, 2004

¹⁴ Zheng, Jiayi, "Limits and Measures of Rural Water resourcess", Jinan: *Shandong Agriculture*, 2001 Issue 2

¹⁵ 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*, Page 475

¹⁶ North China refers to the area which is located north of Qinling Mountain and Huaihe River, south of the Great Wall, and at the middle or lower reaches of the Yellow River. It includes Beijing, Tianjin, Hebei, Shanxi and Neimenggu.

¹⁷ This is calculated according to the correlative data about Beijing, Tianjin, Hebei, Shanxi, and Neimenggu. Refer to "Natural Resources", from *Chinese Statistic Yearbook 2004*, Page 5

¹⁸ The Yuqiao Reservoir is one of the primary water resourcess for Tianjin city. The reverse flow of Yuqiao Reservoir directly influences Tianjin city's industry and people's living water.

¹⁹ Su, Ping, "Continuous Usage of Rural Water resourcess and Water Saving Agriculture", Xi'an, *Northwestern Water resourcess and Water Engineering*, 2000 Issue 3

²⁰ Han, Hongyun, etc., "China's Rural Water resourcess Usage in the 21st Century", Shenyang, *Agricultural Economy*, 2002 Issue 11

²¹ Zheng, Jiayi, "Limits and Measures of Rural Water resourcess", Jinan: *Shandong Agriculture*, 2001 Issue 2.

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.

4. 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.

4.1 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.

4.2 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.

4.3 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 irrigation 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 China's reformation in 1978 (one of them is already dried up). The laggard irrigation techniques will definitely lead to waste of water resources.

4.4 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 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 resources²², 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.

²² 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.

4.5 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.

5. THE METHODS AND PROBLEMS IN REALIZING EFFICIENT USAGE OF RURAL WATER RESOURCES IN CHINA

5.1 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.

The Chinese government's policy on rural water resources usage and water control has experienced 3 periods since the 1950s. 1) In the 1950s, the government focused on preventing and managing the disasters caused by flood and waterlogging; 2) In the 1970s, with the development of rural economy, the government paid more attention on rural irrigation problems; 3) Since the 1980s, more and more emphasis has been put on broadening sources and reducing expenditure in water resources 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"²³, 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"²⁴. 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 price²⁵. 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.

5.2 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

²³ Policies and Laws: *the People's Republic of China Water Law* (1998), www.mwr.gov.cn/zcfg/zcfg.wct

²⁴ Policies and Laws: *the People's Republic of China Water Law* (2002), www.mwr.gov.cn/zcfg/zcfg.wct

²⁵ Han, Hongyun, etc., "China's Rural Water resources Usage in the 21st Century", *Shenyang: Agricultural Economy*, 2002, Issue 11.

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 composite 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.

From these facts, we learned that during the rural water resources management process, rational defines between the governmental departments' functions and purviews have become urgent affairs.

5.3 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.

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 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 2003²⁶. The percentage of three primary agricultural technology costs²⁷ in gross agricultural expenditure is 0.70% in 1978, 0.79% in 1992, 0.84% in 1999 and 0.70% in 2003²⁸. 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.

Furthermore, efficient usage of rural water resources needs the government's proper policy guide. A few years ago, in order to solve the "sand storm" problem,

²⁶ 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*, Page 294

²⁷ "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*, Page 311

²⁸ These data was calculated by the authors according to the data from *Chinese Statistic Yearbook 2004*, Page 294

“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”, 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.

6. 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.

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.
- China Sustainable Development Information Website and Water resources and Water Environment Shared Website: <http://sdinfo.chinawater.net.cn>
- Deng, Wei, etc., ‘Water resources: One of the Most Important Issues which Deserves More Global Attention in the 21st Century’, Changchun: *Chinese Geographical Science*, 1999, Issue 2.
- Dong, Yuxiu, ‘Reflection on Continuous Development and Continuable Usage of Rural Water resources’, Taiyuan: *Shanxi Hydrotechnics*, 2003, Issue 4.
- Gan, Shijun, *Sustainable Development: A Decision which Goes beyond Centuries*, Beijing: The Central Party School Publishing House, 1997.

- 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.
- Huang, Hengxue, *Public Economy*, Beijing: Peking University Press, 2002.
- Li, Fadong, etc.' Problems and Measures for Continuous Usage of Rural Water resources in China', Wuhan: *Water Saving Irrigation*, 2001, Issue 4. Myers, Norman, *Ultimate Security the Environmental Basis of Political Stability*, translated by Wang Zhengping etc., Shanghai: Shanghai Translation Publishing House, 2001.
- 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.
- Ministry of Water resources of People's Republic of China, 'Water resources Bulletin 1999,2000,2001,2002', www.mwr.gov.cn
- National Bureau of Statistic of China, *Chinese Statistic Yearbook 2004*, Beijing: Chinese Statistic Publishing House, 2000~2004.
- 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.
- Su, Ping, 'Continuous Usage of Rural Water resources and Water Saving Agriculture', Xi'an: *Northwestern Water resources and Water Engineering*, 2000 Issue 3.
- 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.
- Tianjin Ji County government website: <http://www.tjjx.gov.cn>
- 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.
- Zheng, Jiayi, "Limits and Measures of Rural Water resources", Jinan: *Shandong Agriculture*, 2001 Issue 2.

THE AUTHORS

Tan Rong, Nankai University, P. R. China.

Liu Ping, Nankai University, P. R. China.

Yu Zhiyong, Nankai University, P. R. China.

Cui Jie, Nankai University, P. R. China.