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Study on the Roles of FWUA in Construction, Management and Maintenance of Small-Scale Irrigation and Water Conservancy

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Abstract In recent years, China has been frequented by floods and droughts which has greatly evoked much concern from the Central Government about rural water conservancy construction. Irrigation is closely related to the "three rural" issues and concerns about the vital interests of farmers. To achieve a virtuous circle of agricultural water supply, it is necessary and urgent to establish Farmer Water User Association (FWUA) to participate in the construction, management and maintenance of small-scale irrigation system. Based on the survey on nationwide "Small-scale irrigation conditions", the roles of FWUA in the construction, management and maintenance of small-scale water conservancy have studied in this study.

Key words Small-scale irrigation, FWUA, Construction, Management and maintenance

In 2011, the Central Water Work Conference was held from July 8 to 9 after the issue of *Decision on Speeding up The Development of Water Conservation Reform Made by CPC Central Committee and the State Council* on January 29, showing that water conservancy construction has become a major issue again. China is rich in water resources, but water resources per capita is small, so China is one of 13 water-poor countries^[1], and the shortage of water resources has become a main factor restricting the development of our economy and society. Since the founding of the People's Republic of China, more than 20 million small-scale water conservancy projects have been built in China, but they have restricted the improvement of comprehensive agricultural production capacity, due to low standards of water conservancy infrastructure construction, insufficient follow-up investment and serious disrepair of the projects^[2]. As the important infrastructure of economic and social development in rural areas, small-scale water conservancy is an irreplaceable material base for improving farmers' living level and income and stabilizing rural economy.

The concept farmer water user association was put forward firstly by World Bank in the 1990s^[3]. According to international practice, it is defined as a nonprofit community organization in each hydrological unit (branch canals, small and middle reservoirs) make up of farmer water users who can maintain and manage engineering facilities and collect water use expenses. Based on China's national situation, farmer water user association is defined as a nonprofit rural specialized water management organization in each canal composed of farmers in the form of mutual assistance and cooperation, and it is a legal person and has independent management and accounting. The association mainly engages in the construction, management and maintenance of small-scale water conservancy projects, and it is in charge of water allocation,

water expenses collection, order maintenance and dispute resolution concerning water. The association aims to serve water users, irrigated areas and agriculture to improve water use efficiency. After ten years of pilot and promotion, farmer water user association has developed rapidly, and its number reaches more than 52 000 in China at present^[4].

As a new force, farmer water user association has played important roles in the construction, management and maintenance of small-scale water conservancy. Generally speaking, small-scale water conservancy projects refer to the rural water conservancy projects with an irrigation area of 667 hm², waterlogging control area of 2 000 hm², storage capacity of 0.1 million m³ and channel flow of below 1 m³/s^[5]. A small-scale water conservancy project has some characteristics as follows. First, it is a basic and strategic project. According to *Decision on Speeding up The Development of Water Conservation Reform Made by CPC Central Committee and the State Council*, speeding up water conservation reform concerns agricultural and rural development, as well as economic and social development; it is also related to flood protection, water supply and food security, as well as economic, ecological and national security. Therefore, small-scale water conservancy is the foundation of water conservation reform, and its basic status will be more prominent. Second, it is a charitable project. Some small-scale water conservancy projects have natural monopoly, but their water resources belong to the state or collective, and most projects aim to obtain social benefit and have properties of quasi-public goods. Third, small-scale water conservancy projects distribute around China, and they are closely related to farmers' production and lives. About one billion farmers will engage in their construction, management and maintenance, so they have strong characters of cooperation and mutual assistance.

1 Survey on basic conditions

1.1 Survey content and questionnaire design According to social hot topics about frequent floods and droughts as well as the

fact of weak water conservancy infrastructure in China in recent years, we determined to investigate "rural water conservancy and land use problems of China", and the survey content is composed of floods and droughts, land use and water conservancy. We mainly investigated their frequency, scale and effects on local villagers' production and lives, local land use and agricultural development situation, and status quo (especially the use of small-scale irrigation and water conservancy), construction and maintenance (including sources of funds for construction, establishment of maintenance system, and roles of villagers) of local water conservancy facilities. Among the three parts, floods and droughts are the prelude to reveal the status quo of irrigation and water conservancy in rural areas of China, find out problems and put forward effective measures.

To study farmers' and village cadres' views on floods and droughts, land use and rural water conservancy construction, we designed two kinds of questionnaire for villages and farmers respectively according to the survey content. Farmers' questionnaire contains farmers' basic information, such as sex, age and household income; village-level questionnaire involves administrative village area, collective income of villagers, and total quantity of water conservancy facilities.

1.2 Survey time, range, objects and methods From July to August in 2011, we mainly surveyed seven big regions (Northeast China, East China, North China, Central China, South China, Southwest China and Northwest China) covering 28 provinces, cities and autonomous regions, especially Guangdong region. Villagers and village cadres at age 30 at least were investigated, and their age was divided into three ranges, namely age 30–45, 45–60, and above 60. Most farmers and village cadres were surveyed through questionnaire, while some farmers and local villagers' committees were visited to investigate local rural conditions more detailedly, especially the construction, management and maintenance of irrigation and water conservancy facilities. As shown in Table 1, there were 3 000 questionnaires given to farmers in this survey, and 2 743 questionnaires were collected, of which there were 2 365 effective questionnaires, so 78.8% of questionnaires issued were effective. Meanwhile, 1 000 questionnaires were given to village cadres, and 892 questionnaires were collected, of which there were 816 effective questionnaires, so 81.6% of questionnaires issued were effective.

Table 1 Distribution of survey questionnaires

Region	Number of questionnaires given to farmers	Number of questionnaires given to village cadres
Northeast China	100	50
North China	200	110
East China	300	140
South China	1 600	350
Central China	200	100
Southwest China	200	50
Northwest China	400	200

2 Status quo of construction, management and maintenance of small-scale irrigation and water conservancy in China

2.1 Small-scale irrigation and water conservancy construction seriously lags behind, and the infrastructure has been aged and fallen into disrepair According to Fig. 1, the popularizing rate of mechanical irrigation is only about 30% in China, while the proportions of human irrigation in South China, Central China and North China are 40%, 35% and 30%, and the proportion of rainfall irrigation reaches 60% in Northeast China. It shows that irrigation and drainage facilities of irrigation and water conservancy in China still fall behind at present. According to statistics, many small-scale irrigation and water conservancy facilities were built before the founding of the People's Republic of China; more than 50% of farmland has irrigation and drainage facilities, and about 40% of irrigation facilities have been damaged; about 40% of small reservoirs have serious dangerous problem, and around 80% irrigated cropland can only withstand general droughts^[6]. In China, small-scale irrigation and water conservancy projects were often built by farmers, and many facilities have low standard and lagging equipment and technology. After running for many decades, most projects have been aged and fallen into disrepair, so they should be renewed and rebuilt. Due to the reform of taxation expenses in rural areas, "two labors" (rural compulsory labor and accumulative labor) system was abolished, so that small-scale irrigation and water conservancy facilities that were constructed, managed and maintained by "two labors" system originally have fallen into disuse further.

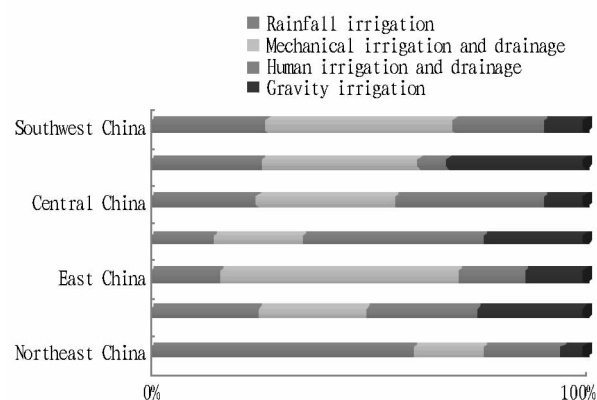


Fig. 1 Main irrigation methods of rural areas in China at present

2.2 Property right of small-scale irrigation and water conservancy facilities is unclear, and the management have some setbacks, while the construction, management and use are seriously out of line As shown in Fig. 2, investment in the construction of rural water conservancy facilities has complex ingredients, and it is mainly national and collective input supplemented by farmers' input under the long-term planned economic system. Thus, the projects built belong to the state or rural collective, so that the property right of irrigation and water conservancy facilities

is unclear, and the management have some setbacks. Unclear property right has weakened the power of project management and input, which is the main reason for poor management and maintenance. Since the implementation of household contract responsibility system in rural areas, the contradiction between farmers' separate management and collective benefit of irrigation and water conservancy projects has aggravated day by day, so that previous collective management body disappears, and farmers only use many water conservancy facilities in farmland, but there is no people manage and maintain them. In addition, limited funds are mainly used in project construction instead of management and maintenance, so the construction, management and use are seriously out of line. During the research interviews, we found that small-scale irrigation and water conservancy facilities do not form a completeness in some regions.

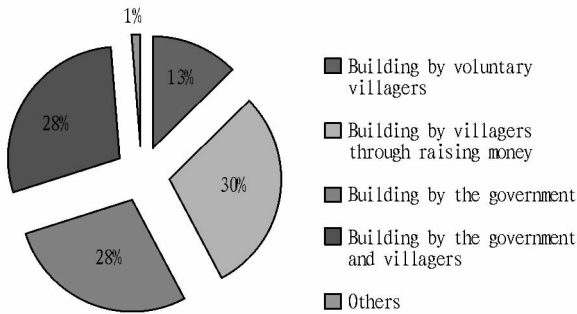


Fig. 2 Building ways of rural water infrastructure in China

2.3 Insufficient financial funds and technical input as well as lagging supporting policies have restricted the development of small-scale irrigation and water conservancy China has invested large amounts of human, material and financial resources in water conservancy construction every year, but most of them were invested in large and middle water conservancy projects like building a water power station, heightening and thickening a river dam. At the same time, owing to floods and droughts as well as loss, management and maintenance during the running, the central government needs to provide large amounts of funds and technical support for the project after their building every year, and the unlimited investment has made the state bear heavy fiscal burden, so the state has paid no attention to the need of farmers for small-scale irrigation and water conservancy service.

Seen from Table 2, the dissatisfaction degree of farmers with the funds and technical investment of local governments in water conservancy construction is about 50%, and it reached 66.67% in Northeast China. Before reform and open, agricultural investment for supporting industrialization process accounted for above 5% of state-owned unit investment, but it decreased to 2% in 1995^[7]. According to relevant data, China should provide solid water conservancy foundation for the stable development of agriculture and national food security, and the capital investment in irrigation and water conservancy construction should be about 2 000 billion yuan in next ten years. However, the capital investment in irrigation and water conservancy construction is less than 40 billion

yuan every year at present, and few local financial funds are in place. Besides, supporting policies often lag in many areas. In fact, small-scale irrigation and water conservancy infrastructure is far worse than "typical project" and "visited project" along motorways and railways^[8].

Table 2 Satisfaction degree of farmers with local governments' funds and technical investment in water conservancy construction %

Region	Very satisfied	Quite satisfied	Satisfied	Not very satisfied	Not satisfied
Northeast China	0	17.78	15.56	31.11	35.56
North China	2.21	13.24	26.47	47.79	10.29
East China	3.54	13.64	31.31	44.95	6.57
South China	5.26	17.46	29.73	34.71	12.83
Central China	2.96	13.02	27.81	39.05	17.16
Northwest China	0	29.10	47.01	18.66	5.22
Southwest China	8.24	29.80	24.31	29.41	8.24
China	4.70	18.58	29.67	35.08	11.98

Note: Data in the table above are from the effective questionnaire collected from July to August in 2011, as well as the data of figures 1–4 and Table 3.

2.4 Insufficient participation of water users and farmer water user association As shown in Fig. 3, few farmer water users and farmer water user associations take part in the management and maintenance of water conservancy infrastructure in most rural areas of China at present. The average participation rate of farmer water user associations in China is lower than 10%, and besides Northwest China (about 40%), few farmer water user associations participate in the management and maintenance of water conservancy infrastructure in other regions. Among them, it is higher than 10% in North China (about 15%) and Southwest China (around 12%), but lower than 10% in South China (8%), Central China (6%) and East China (4%).

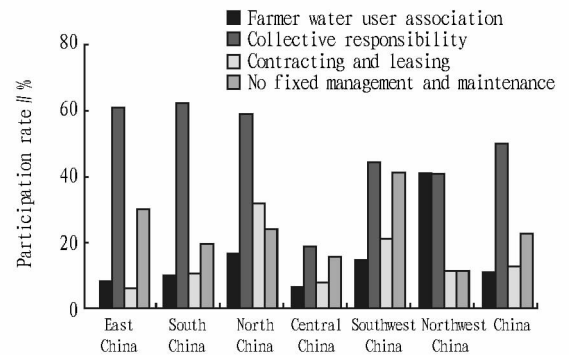


Fig. 3 Management and maintenance ways of rural water conservancy infrastructure in China

Under the current management system, the government has invested large quantities of funds in water conservancy facilities, and the nature is in a dominant position, while farmers are in a weak position and have no say in the matter, which must lead to insufficient participation of farmers in the management and maintenance of water conservancy facilities. Moreover, some farmers overuse small-scale irrigation and water conservancy facilities. After the reform of the household contract responsibility system in ru-

ral areas, households only pay more attention to their own farmland instead of public utilities like basic construction, management and maintenance of small-scale water conservancy, and there exists a serious contraction between integrated character of water conservancy construction and individuality of land contracting and management. Therefore, farmers exhibit weak cohesion in constructing, managing and using water conservancy facilities^[2]. At the same time, each side has paid more attention to project construction than management, and farmers take part in project construction actively; after the operation of the projects, each side (like government, the masses and farmer water user association) has paid less attention to project management and maintenance.

2.5 Imperfect laws and regulations According to the survey results, there are no rules and regulations relative to the construction, management and maintenance of water conservancy facilities in most rural areas of China at present except for 24% of rural areas. Water conservancy department has not issued rules and regulations relative to the construction, management and maintenance of small-scale water conservancy, so it is difficult to discuss and deal with matters for farmers, water user association and water management department, and laws and regulations relative to rural small-scale water conservancy are lagging.

Table 3 Proportion of irrigation water sources in rural areas of China

Region	Northeast China	North China	East China	South China	Central China	Northwest China	Southwest China	China %
River and lake	34	18	54	49	42	32	41	46
Groundwater	20	45	28	23	38	23	29	28
Pond and reservoir	27	28	39	42	36	50	43	42
Rainfall	61	54	51	37	53	74	41	44
Others	50	10	60	10	0	0	0	10

3.2 Need for coping with frequent floods and droughts According to the survey results, 48% of floods and droughts are related to irresistible factors like climatic anomaly, and 23% of them result from lagging water conservancy facilities. From time immemorial Chinese nation has struggled with floods and droughts. For a long time, most Chinese water conservancy facilities have been built along big rivers, while small-scale irrigation and water conservancy project construction has been neglected. From August 2009 to April 2010, the big drought of Southwest China afflicted more than 50 million people and impaired about 5 million hm² of crops. In June 2010, the flood afflicted 9.721 million hm² of crops and 140 million people, of which 1 072 people died, and 619 people disappeared, while around 1.1 million rooms collapsed, so that the direct economic loss reached about 209.6 billion yuan^[7]. Before the flood haze dispersed fully, winter drought invaded the region again, and afflicted major grain producing areas. Among them, 1.854 million hm² of winter wheat in Shandong Province suffered from drought, and 1.05 million hm² of winter wheat in Henan Province called "China granary" suffered from drought, so that it is difficult to drink water for people and animals, and economic loss is inestimable. The great loss of China brought by floods and droughts shows that it is urgent to construct irrigation

3 Necessity of strengthening small-scale irrigation and water conservancy construction, management and maintenance

3.1 Shortage of water resources, vast population and limited farmland have made small-scale irrigation and water conservancy construction in a permanent foundation position during agricultural development Seen from Table 3, the proportion of natural rainfall as an irrigation water source is 44% in China. It shows that farmland irrigation in most areas of China depends on natural rainfall to a certain degree, where modern small-scale water conservancy facilities like ponds and reservoirs have not play important roles in farmland irrigation. Chinese agricultural products are mainly produced in irrigation areas, and water resources are insufficient and it is impossible to greatly improve the total amount of agricultural water, so it is urgent to speed up capital construction of small-scale irrigation and water conservancy as well as renewing and transformation of water conservancy facilities in irrigation areas to continuously enlarge irrigation area and increase irrigation guaranteed rate, which is a strategic act to stabilize agricultural development.

and water conservancy in China, especially small-scale irrigation and water conservancy.

3.3 Inevitable choice for realizing the strategic objectives of ensuring food security Grain security is related to the overall situation of economic and social development as well as major strategic issues of the national economy and the people's livelihood. According to *Production Capacity Plan for Increasing 50 Billion kg of Grain in China from 2009 to 2010*, total production of grain will reach 550 billion kg, increasing by 50 billion kg, realizing food self-support. The total investment of the plan reaches 300 billion yuan, and central government invested more than 200 billion yuan. It is predicted that the investment in large-scale water conservancy construction accounts for about 60% of total investment, while the investment in small-scale irrigation and water conservancy construction is not shown. Presently, as the rapid development of Chinese economy, the demand of economic construction for grain has increased constantly. However, farmers' enthusiasm for planting grain has turned sour gradually due to high agricultural production cost, bad agricultural infrastructure, low agricultural product profit and unstable price of agricultural products. To realize the target of increasing 50 billion kg of grain in China to ensure grain security, it is most fundamental to strengthen capital con-

struction of small-scale irrigation and water conservancy to make farmers plant grain actively.

3.4 Farmers hope to speed up small-scale irrigation and water conservancy construction As shown in Fig. 4, small-scale irrigation and water conservancy infrastructure is insufficient and current water conservancy facilities can not run normally in most areas of China. According to statistics, there are no irrigation facilities in more than 50% of farmland in China, and the old irrigation facilities in other farmland have aged and fallen in disrepair, which has seriously threatened farmers' demand and stable agricultural production. Agriculture is an industry that can stable China, and farmers have paid more attention to small-scale irrigation and water conservancy construction that is the infrastructure construction of rural production areas, so it is necessary to speed up small-scale irrigation and water conservancy construction.

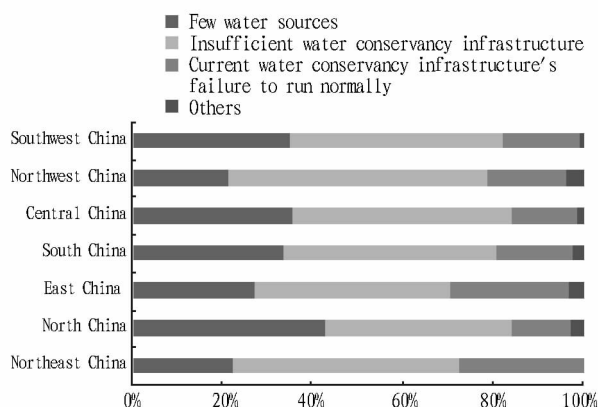


Fig. 4 Reasons for the failure of current water conservancy infrastructure in rural areas of China to meet the demand of farmers for water

4 Roles of FWUA in the construction, management and maintenance of small-scale irrigation and water conservancy

4.1 Fully mobilizing farmers' enthusiasm for investment and working

Farmer water user association can mobilize farmers' enthusiasm for investment and working to make up government resources and "charity vacuum" caused by the abolishment of "two labors". Farmer water user association is a water management organization based on the masses, and it is the concrete embodiment of villagers' autonomy in democratic water management in China. Based on the premise of fully considering farmers' wishes and ability to bear, the association fully mobilizes farmers' enthusiasm for investment and working, and encourages farmers to take part in the construction, management and maintenance of small-scale irrigation and water conservancy through policy guidance, funds support, democratic procedure and technical service. The founding of farmer water user association can not only address the problems like single government investment and less investment from enterprises in infrastructure due to large funds, long term and low benefit, but also make up government resources and "charity vacuum" caused by the abolishment of "two labors", and

ensure the construction and stable running of small-scale irrigation and water conservancy. For instance, when the damaged canal project needs to be repaired, the association will hold a member congress to discuss founding programs to manage and maintain it. The association can not only make farmers take part in investment, construction, management and maintenance actively to reduce fiscal burden, but also attract private capital through publicizing the importance of small-scale irrigation and water conservancy construction.

4.2 Effectively dealing with water disputes and creating good water use environment

When crops suffered from droughts, farmers often conflicted over water use sequence, and there have been disputes among village groups or between village groups and water management department. Water disputes can not only destruct water order, but also result in many contractions in rural areas, even harm social stability. Farmer water user association should make full use of its advantages to address shortage of water supply, difficult water transfer and complicated contradictions, eliminate water disputes in the budding stage, and mobilize water users to take part in the construction and management of water conservancy. These measures can not only prevent the interest of the masses from losing, but also resolve conflicts between farmers, and increase the relation between association cadres and the masses, thereby creating good water use environment.

4.3 Strengthening restriction and supervision of water management department

At present, most local governments are "payroll finance", so government assistance can be obtained in a limited range. After the founding of farmer water user association, small-scale irrigation and water conservancy is managed by the government and farmer water user association. The association can effectively improve farmers' degree of organization, try to obtain funds, credit program and compensation policy, and put forward reasonable suggestions for the determination of water price, collection, use and management of water expense, and investment in irrigation facilities. Meanwhile, the association can effectively strengthen restriction and supervision of water management department, especially funds for water conservancy project, and it is strictly forbidden to use water conservancy funds in other fields.

4.4 Ensuring the implementation of construction, management and maintenance of small-scale irrigation and water conservancy

For a long time, when carrying out irrigation and water conservancy planning and construction, water conservancy department has often pay more attention to main canals instead of branch or smaller canals, so that rural water conservancy facilities have aged day by day. After the establishment of farmer water user association, the association can lead farmers to manage branch or smaller canals, and link canal management and maintenance with farmers' interests. For example, 22 farmer water user associations have been built in Guazhou County, Gansu Province, and since the implementation of low-yielding field reform during comprehensive agricultural development in 1998, the associations have lead farmers invest 20.74 million, 87 electromechanical wells, 116.9

km of lateral canals lining, 163 km of farm canal lining, and 10 600 hm² of supporting area. Farmers took part in the construction of the projects above actively, which is equivalent to more than 26 million yuan. It is proved that the establishment of farmer water user association is beneficial to the construction, management and maintenance of small-scale irrigation and water conservancy.

4.5 Speeding up the reform of grass-roots water service system At the meeting about national grass-roots water service system construction held in Qianjiang City, Hubei Province on August 2011, Li Guoying, the assistant minister of the Ministry of Water Resources, pointed out that grass-roots water service system is an organic whole composed of various organizations and institutions, and can provide all-around service for grass-roots water conservancy construction, running, maintenance and management, including grass-roots water service agency, farmer water use cooperative association and quasi public professional service team at least^[9]. Traditionally, most grass-roots water service agencies are water management department, and management and operation functions are vague, while work efficiency is low.

After the founding of farmer water user association, the relationship of farmer water user association, water management department and farmers becomes clear, and the responsibilities of government, water management department and farmer water user association are known. The matters which are difficult to be managed for the government and water management department can be managed by the association, while the government and water management department are in charge of water resources and technical guidance and supervising the association. Farmer water user association is responsible for the construction, management and maintenance of small-scale irrigation and water conservancy, and further improves the construction of water conservancy infrastructure and water service system in rural areas to integrate the management and maintenance of water conservancy.

5 Conclusions

Irrigation and water conservancy is the basic facility and lifeline of agricultural production, and small-scale irrigation and water con-

servancy, the indispensable infrastructure for ensuring grain, economic, ecological and national security, plays supporting roles in the development of economy and society in China. As a grass-roots non-government organization, farmer water user association can know the construction, management and maintenance conditions of small-scale irrigation and water conservancy in rural areas depending on its special properties and operating mode, and make it serve "three rural" issues, the building of the new socialist countryside, and water conservancy reform of China.

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