

# Multivariate Supply Model of Small-Scale Irrigation and Water Conservancy Facilities in China Rural Area

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## Abstract

The supply of small-scale irrigation and water conservancy facilities has received wide attentions from the academic circles. In China, the deficiency of providing public goods in rural areas have hindered rural and agricultural development, and restricted the modernization of governance in China to some extent. It is urgent to seek a way to solve these issues. Through history and comparative analysis, this paper first divides the supply model of small-scale irrigation and water conservancy facilities into three categories on the basis of existing research, which are state centralized supply, self-financing farmers and multivariate supply; Secondly, we focus on launching a further research and refinement on multivariate supply model which is under way in current practice, and we proposed that four main actors and four stages constitute the multivariate supply model. Four main actors are government, farmers, NGOs and private sector and four stages refer to investment, construction, management and maintenance and usage; Thirdly, through the investigation and research of Z county in Anhui Province, we found that the small-scale irrigation and water conservancy in Z county is in general accord with the multivariate supply model. Specific performance is in the aspects of increasingly diverse investment channels, increasingly flexible construction ways and constant innovation of management and maintenance models, these characteristics verify the rationality and feasibility of multivariate supply model. Finally, we point out the matters needed to pay special attention when using multivariate supply model to effectively solve the problem in the process of supply of small-scale irrigation and water conservancy facilities in Rural China.

**Keywords:** Small-scale Irrigation And Water Conservancy, Public Governance, Multi-participation, Supply Model

## 1、 Introduction

A basic consensus is that farmland irrigation system has the property of public goods, small-scale irrigation and water conservancy is no exception. (Eleanor .Ostrom, 2000). During the period of planned economy in China, the government was the main supplier of public goods in rural areas(Chen Tan.etc,2010). Since the late 1970s, having implemented the reform and opening up policy, the government has gradually retreated in the fields such as the supply of small-scale irrigation and water conservancy facilities. Main suppliers transferred to the rural community, meanwhile, market mechanism and third sector began to intervene in the supply of small irrigation and water conservancy. Due to market failure and finiteness of third sector, "one case one meeting" system as an representative way of the rural collective supply has become an important supplement strategy(Chen Tan.etc,2010). However, in actual situation, "one case one meeting" system has its own shortcomings, that makes the supply of small scale irrigation and water conservancy difficult to meet the need.

Table 1. Capital Construction Investment of Agriculture during the period of 1953-2005 in China Unit: Billion yuan、%

Time line	Capital construction investment of Agriculture	Water conservancy construction investment	The proportion of capital construction investment of agriculture in basic construction investment	The proportion of water conservancy construction investment in capital construction investment of agriculture
"One five" period	4.18	2.43	7.1	58.1
"Two five" period	13.57	9.66	11.3	71.2
1963-65	7.45	2.89	17.6	38.8
"Three five" period	10.43	7.01	10.7	67.3
"Four five" period	17.31	11.71	9.8	67.7
"Double five" period	24.61	15.72	10.5	63.9
"Six five" period	17.28	9.30	5.1	53.8
"Seven five" period	24.12	14.37	3.3	59.6
"Eight five" period	69.78	44.07	3.0	63.1
"Eight five" period	314.32	199.37	5.6	63.4
"Ten five" period	578.04	347.38	6.3	60

As shown in Table 1(Note 1), during the period from 1953 to 2005, funds for agriculture and water conservancy construction had increased annually in China, but the proportion of water conservancy construction investment in capital construction investment of agriculture remained stable, the proportion of capital construction investment of agriculture in basic construction investment was declining year by year(See Figure 1(Note 2)). What means China's investment in water conservancy construction was declining compared to other constructions, and that fact resulted in funds of water conservancy construction couldn't meet the needs and caused the supply of small-scale irrigation and water conservancy facing a huge funding gap. According to the second national agricultural census data, there were more than 70% of villages without any investment in irrigation and water conservancy construction in China, while only 9.56% of villages have acquired national investment(Zhang Yijun,2011). In addition, uneven distribution of existing resources also put the supply of small-scale irrigation and water conservancy facilities into dilemma. Since 1978, funds of China's water conservancy construction directly used for agricultural productive expenditures accounted for only about 40%, almost no fund could be used for small-scale irrigation and water conservancy construction(Xu Nan, 2011). Insufficient supply lead to slow development or even regression of small-scale irrigation and water conservancy facilities in recent years, and aggravated damages of natural disasters such as floods and droughts. China Agricultural Yearbook (2013) showed 3.74 million mu of food crops suffered drought disasters in 2013, disaster area is 172 million mu, and 27.39 million mu have no harvest. The threats of natural disasters highlights the indispensable role of small-scale irrigation and water conservancy facilities in the development of agriculture.

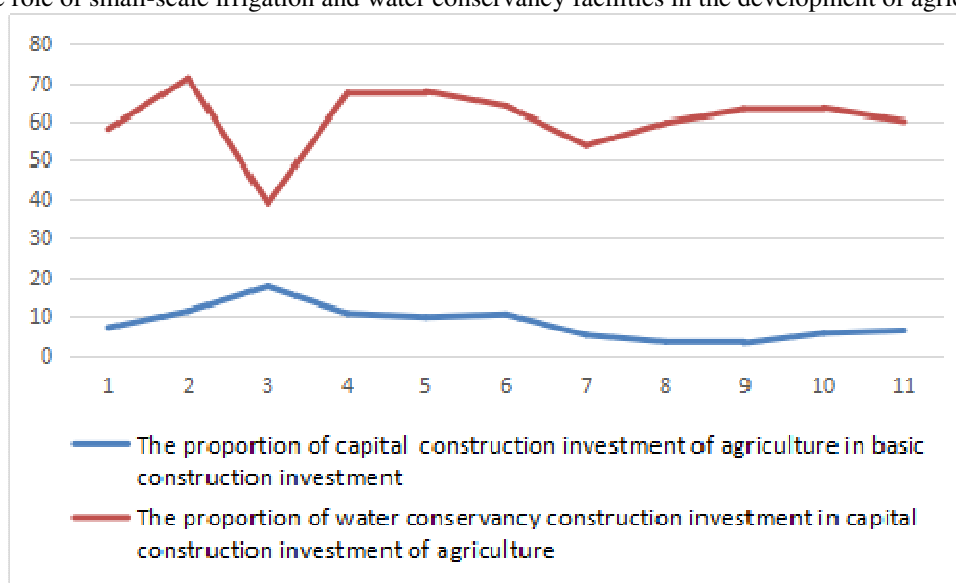


Figure1.Capital construction investment of agriculture during the period of 1953-2005 in China In view of the practical dilemma and needs of the supply of small-scale irrigation and water

conservancy facilities, the problem about how to solve the supply of small-scale irrigation and water conservancy facilities so as to realize the effective governance in rural affairs has aroused more and more attention in academic circles.

The current academic research focuses on the supply status of small-scale irrigation and water conservancy facilities (Lv Hengxin, 2014; Chen Yunpeng, 2011; Wang Meiduo, 2013; Xiao Fumin, 2014), existing supply models (Xu Li, 2009; Song Chaoqun, 2011), factors impacting the supply (LUO Renfu, 2007; Guo Zhen, 2015), providers (Du Weixuan, 2015) and solutions (Development Research Center of the State Council “Task group on improving the Small-scale Construction of Water Conservancy Works and the Management Mechanism, 2011; He Xuefeng, 2006; Lv Hengxin, 2014). In terms of the supply model of small-scale irrigation and water conservancy, an independent governance model advocated by Elinor Ostrom based on trust revealed the experience of irrigation system governance abroad, however, what was not entirely applicable to China. He Xuefeng et al (2006) proposed the formation of national and rural cooperative complementary pattern with the state coercive power as guarantee. However, not every subject related to the development of small-scale irrigation and water conservancy facilities are included in the pattern, and their focus is a certain aspect of supply (such as investment or construction). To its credit, Song Chaoqun (2011) put forward a multivariate supply model involving government, society and farmers to solve the supply problem of small-scale irrigation and water conservancy facilities in China. Therefore, how to construct a multivariate supply model of small-scale irrigation and water conservancy and the role of each participant and other issues need to be further discussed.

The article suggests that the multivariate supply model is an effective way to the supply of small-scale irrigation and water conservancy facilities. In view of this, this article decided to further deepen and refine multivariate supply model on the basis of existing research with the theory of public goods and governance, and proposing an multi-stage, multi-participation supply model in the rural public goods, and then through a case study in Z County of Anhui to verify the rationality of the model. Specifically, this paper attempts to answer the following questions: How to form a multivariate supply model of small-scale irrigation and water conservancy? Who should be involved? What is the role of these participants?

## 2. Multivariate supply model of small scale irrigation and water conservancy facilities

### 2.1. Development of supply model of small scale irrigation and water conservancy facilities

Scholars made different classifications of the evolution of small-scale irrigation and water conservancy facilities supply model according to different standards. Wang Zhaoyang (2011) according to the construction effect, divided the supply mechanism of small-scale irrigation and water conservancy facilities into six phases from 1949 to 1957, 1958 to 1970, 1971 to 1980, 1981 to 1990, 1991 to 2001, 2002 to 2008. He Xuefeng(2010) according to the evolution of the basic rural operation system, divided the supply model of small-scale irrigation and water conservancy facilities into large collective period, double layer operation period and the period of tax reform. Development Research Center of the State Council “Task group on improving the Small-scale Construction of Water Conservancy Works and the Management Mechanism(2011)according to the evolution responsibility of the government, divided the supply model of small-scale irrigation and water conservancy facilities into four phases from 1949 to 1978, 1979 to 1988, 1989 to 2002, the period of tax reform. In this paper, the three division methods are combined and used for reference, and according to the change of supply subject. It divides the supply model of small-scale irrigation and water conservancy facilities into three stages (see Table 2).

Table 2 . Evolution of small scale irrigation and water conservancy facilities supply model

Phases	Time	Supply model	Actual effect and evaluation
First phase	From 1949 to 1978 Planned economy period	National concentrated supply model: National investment, farmers put in labor	Small-scale irrigation and water conservancy facilities flourish
Second phase	From 1978 to 2002 Before the tax reform	Farmers self-financing model: Multi channels, diversified investment mechanism	Small-scale irrigation and water conservancy supply is relatively backwards
Third phase	From 2003 to the present	multivariate supply: Multiple participants, multi-level supply	Small irrigation and water conservancy supply is in trouble

In the period of planned economy, National concentrated supply model was the dominant supply model of small-scale irrigation and water conservancy facilities, what showed that the state was the single investment subject, and farmers participated in the form of labor. With the rise of the wave of construction of small irrigation and water conservancy facilities all over the country, farmland irrigation area increased from 19.959 million hectares in 1952 to 49.965 million hectares in 1978 (Chen Shulan, 1999).

After 1978, the state gradually retreated in the supply of small-scale irrigation and water conservancy,

self-financing farmers became a marked feature in that period, and gradually formed a multi-channel, diversified investment mechanism, “santi wutong”(Note 3) had become major source of rural funds for public goods. In addition, the government impose farmers to engage in public goods production, the two workers’ system(Note 4)came into being . Due to the limitation of farmers self-financing model in investment and construction, the process of development of small-scale irrigation and water conservancy facilities was slow. Relevant data showed that during the period of 1982-1990, the annual rate of effective irrigation area appeared negative growth (-0.2%) for the first time(Wang Chaoyang, 2011).

Since 2003, the supply model of small-scale irrigation and water conservancy facilities in China was developing in the direction of diversification. Current supply model of small-scale irrigation and water conservancy mainly includes three ways: top-down national investment, "who investment who benefits " and the system of “one case one meeting”. Among them, the system of “one case one meeting” is becoming the main model of supply of small-scale irrigation and water conservancy facilities in rural areas(Xu Li, 2009). In addition, China have introduced policies to encourage private capital to participate in the construction of rural small- scale irrigation and water conservancy facilities, some local governments support the establishment of water usage association(Irrigation Association) to manage small-scale irrigation and water conservancy facilities and farmland irrigation. The diversified and multi-level model of small-scale irrigation and water conservancy facilities have some institutional innovation, but can only be called the rudiment of multiple model supply. In reality, due to the limitation of the system of “one case one meeting” in rural areas and the inadequate enthusiasm of farmer who are supposed to put in labor and investment (Chen Yunpeng, 2011), and with maintenance difficulties as a result of the current blurred property rights of small-scale irrigation and water conservancy facilities.The supply of small-scale irrigation and water conservancy facilities is in dilemma.

## 2.2 The construction of multivariate supply model of small-scale irrigation and water conservancy facilities

It can't deny the validity of the multivariate supply model although current supply of small-scale irrigation and water conservancy facilities in China is in dilemma. What we should do is to explore more mature and perfect, multi-subject and multi-stage supply model, which could be expected to gradually solve the problem of insufficient supply of small-scale irrigation and water conservancy facilities and management and maintenance difficulties. Therefore, this paper puts forward a more complete multivariate supply model of small-scale irrigation and water conservancy facilities, which is characterized by diversification of participants and diversity of governance methods. The model is constituted by four subjects (governments, farmers, NGOs and private sectors), and four stages (investment, construction, management and usage) (See Table 3).

Multivariate supply model of small-scale irrigation and water conservancy facilities has many characteristics, such as multi-subjects, multi-stage and diversification of supply methods. Besides governments, farmers, private sectors and non-governmental organizations also play an important role in the supply of small-scale irrigation and water conservancy facilities. Meanwhile, multivariate supply model involves four stages: investment, construction, management and maintenance and usage, which are important parts for small-scale irrigation and water conservancy facilities (Development Research Center of the State Council “Task group on improving the Small-scale Construction of Water Conservancy Works and the Management Mechanism, 2011). Multivariate supply model emphasizes the ways of government investment, service outsourcing, cooperation with civil organizations and farmers and farmers self-financing to achieve the goal. In the supply model, each participant plays an important role at any stage, what diversified the means of supply. For example, in addition to the investment by government and farmers, introduction of private funds makes a diversified investment mechanism to become a reality; The involvement of farmers and private sectors would become main source of the construction of small-scale irrigation and water conservancy facilities; The government through the means of guidance, supervision to promote the involvement of civil society organizations and villagers to manage the water conservancy facilities. In order to make the multivariate supply model implement smoothly and gain obvious effect, following points should be paid special attention to.

Table 3. Multivariate supply model of small scale irrigation and water conservancy facilities in China

Stage	Period	Principle	Participant
First stage	Investment	Diversification of investment subject, well-prioritized	Government, private capital, farmers self-financing
Second stage	Construction	Farmer participation and contract construction simultaneously	Government, construction companies, farmers
Third stage	Management and maintenance	Decentralization, civil responsibility	Government / village committee, farmers, Irrigation Association
Fourth stage	Usage	Transparent management, reasonable price	Irrigation Association, government, farmers

(1). Diversification of investment and well-prioritized

The attribute of public goods of small-scale irrigation and water conservancy facilities determines that main investment subjects should be the government, non-governmental investment and fund-raising by farmers is auxiliary. Governments at all levels should implement the policies prescribed by the central government which defines 10% extraction from land transfer fees for the construction of irrigation and water conservancy facilities. Increasing the investment to the small-scale irrigation and water conservancy facilities, so as to establish a stable growing mechanism of public finance, at the same time, dividing the responsibility of governments at all levels scientifically. Responsibilities in small-scale irrigation and water conservancy facilities funding of the central, provincial, city, county and township should be clarified, avoiding the absence of government. Government and the village committee should take various measures to mobilize farmers to care about and participate in the water conservancy facilities. For the water conservancy facilities which benefit whole village, the village committee should held villagers' congresses to raise funds through the "one case one meeting" system; For some small-scale water conservancy facilities such as wells and ponds which barely benefit part of villagers, it could in accordance with the principle of "who invests, who benefits", mobilizing the benefited masses to raise funds. The introduction of private capital into the construction of irrigation and water conservancy facilities is an effective way to innovate financing channels and expand the source of funds. Governments at all levels should introduce policies and rules to encourage and support private capital to participate in the construction of small irrigation and water conservancy facilities.

(2). Farmer participation and contract construction simultaneously

It should be said that farmers are the most direct beneficiaries of small-scale irrigation and water conservancy facilities. Therefore, the state should mobilize and guide farmers to actively participate in the construction of small-scale irrigation and water conservancy facilities, through incentives, subsidies and other ways in the process of construction to make up for the loss of farmers. For the variety of small-scale irrigation and water conservancy facilities, which from large reservoirs to wells and ponds, it is necessary classify small scale-scale irrigation and water conservancy facilities so as to clear subject of construction and achieve effective supply. Comparing to the reality of lack of irrigation reservoir in north areas, where irrigation depends on thousands of wells, the South has pumping stations with a certain technical content and other small irrigation and water conservancy facilities. Local government and village committee outsource the construction of water conservancy facilities to the construction company, and ensure the quality and quantity of the project through inspection, acceptance and other means of supervision.

(3). Decentralization, civil management

With the principle of "who invests, who owns, who benefits, who manages", clarifying the ownership of small-scale irrigation and water conservancy facilities and implementing the subject of management responsibility. Also in the process of managing small irrigation and water conservancy facilities, the government cannot and should not undertake the whole thing, so decentralization is the best way to encourage farmers' participation and supervision. We can learn from the experience of Taiwan irrigation management, government invest in the construction of small-scale irrigation and water conservancy facilities, farmers responsible for management and maintenance to the local irrigation facilities through the establishment of the irrigation association. The government's financial support does not increase the control to the association, so the association has enough free space to conduct local irrigation system governance (Wai Fung Lam, 1996). Irrigation association in rural areas cannot be only a self-formed water cooperation organization by farmers, but also a civic organization established by the government. It is important to gradually develop irrigation association as a main body of using water and managing water, and government should reduce the control to irrigation association, so that it can independently assume the water demand of farmers in the area.

(4). Transparent management, reasonable price

Irrigation costs generally consists of two parts, water and electricity. As the main body of management and maintenance, the rural water usage association should take the work of charging for water, and charging for electricity is an affair that belongs to the power supply company. Irrigation cost should be fully considered the water demand and affordability of farmers. Regulating farmers' demand for irrigation water not only have to protect the legitimate rights and interests of farmers, but also must take into account the rational use of water resources and establish a fair and reasonable price mechanism. In dry season, it should meet the irrigation needs firstly, then to reduce the cost of irrigation. And the government should increase subsidies to farmers and reduce the burden of irrigation.

### 3. Analysis of the supply problem of small-scale irrigation and water conservancy facilities in Z county

Z county, in the hinterland of Anhui province in China, is a national commodity grain base county. S town is subordinate to Z county, where is one of the management reform and innovation pilots of small-scale irrigation and water conservancy, with a total area of 120.3 square kilometers, 69000 mu of arable land, 14 village committees with a population of 71000. In 2015 from May to June, the author conducted a field survey in Z



county: visited four networked levels organizations: municipal, county, township and village, and interviewed relevant government staff, village cadres, person in charge of rural water usage association, villagers, and investigated the local small-scale irrigation and water conservancy supply situation. Just for the need of study, this paper use pseudonyms instead of real names.

Public goods property of small-scale irrigation and water conservancy facilities requires central government and local government to take the responsibility of supplying and capital investment, but completely supplied by the government is unrealistic and lack of efficiency. Therefore, multivariate supply model require that at the time of government increase capital investment, farmers, NGOs and the private sector subjects should be mobilized and involved at the form of raising funds, then form a diversified funds input mechanism. For this problem, a village cadres in Z county said after the abolition of agricultural tax in 2005, the supply of public goods in rural areas was mainly provided by the means of "one case one meeting", but the funds raised are limited. There are about 2,600 people in their village, the principle of "one case one meeting" set a maximum of 15 yuan per person each time, so at most 39000 yuan they could raise up, the sum isn't even enough for digging a pond. Of course, the situation has improved after 2011. According to a responsible person of Z county water authority, after 2011, the capital investment in Z county for small-scale irrigation and water conservancy had increased significantly. In 2014, the investment of small-scale irrigation and water conservancy reached 246.97 million yuan(Note 5). At present, water conservancy funds of Z county mainly from six channels: province, municipal, county, township, the masses and private. Among them, government investment is the dominant, private funds have increased, the corresponding reduction in the proportion of rural fund raising. Field research and interviews showed that funds investment of small-scale irrigation and water conservancy facilities in Z county no longer rely on the rural "one case one meeting" system, but gradually formed an investment model with the government investment as the mainstay and rural capital and private capital as a supplement (Figure 2(Note 6)). In the investment stage, governments, farmers, NGOs and the other subjects participate actively, what greatly increased capital investment and reduces the burden on farmers. In a diversified investment mechanism, governments at all levels have gradually become the main force of investment of small-scale irrigation and water conservancy, this is consistent with the diversification of the investment subjects and the well-prioritized principle emphasized in the multivariate supply model.

On the way of construction, deputy mayor of S town and a local village cadres introduced: We implement independent construction. The project which individual invests within one hundred thousand yuan, we encourage village collective or new agricultural business entities(Note 7) to construct their own, they can either mobilize villagers to participate in the construction or outsource the project to professional construction company; And the project more than one hundred thousand, township government would bid it to the construction company to design and build. Local village cadres take digging reservoirs as an example: The village group needs to apply to village committee, then village committee hold a village representative assembly to make decision, the leader of the village group would be appointed as the person in charge the construction of the reservoir, they need to raise funds and employ professional construction to work with the villager. From the point of view of the above approach, for the small-scale irrigation and water conservancy facilities which involves the interests of farmers, local government did not intervene too much, what they did is decentralization. But for more complex project with a certain technical content, it would be constructed by contracting company, and local government and village committee will supervise the construction of the project by means of inspection and acceptance. Farmer participation and contracting company intervention could better give full play to the initiative of farmers and profession of the construction company, so as to better construct the small-scale irrigation and water conservancy facilities.

On the management and maintenance model, an S town government staff said: We adhere to the principle of self-construction, according to the ownership of property rights, there are two main models of management and maintenance, they are the mass self-management and new agricultural business entities management. To the mass self-management as an example, complete management and maintenance model firstly according to the scope of benefit to clear property rights of small-scale irrigation and water conservancy facilities, the property rights within the village belong to rural collective economic organizations. Secondly, determine the management and maintenance subject and appoint management and maintenance person. Most of the time, it is accordance with the principle of "who use, who manage, who benefits, whose pay", holder of the right of using small irrigation and water conservancy as the subject of management and maintenance. For example, the village group. Finally, village committee signed a management and maintenance agreement with the maintenance subject. The management and maintenance protocol mainly includes: both sides of maintenance responsibilities, the scope of protection, content, cost, power and liability for breach of contract, useful life is generally 2-3 years. It will be seen from this that, to better manage and maintain the local small-scale irrigation and water conservancy facilities, Z county insist on self-constructed and self-managed, and actively guide the farmers and non-governmental organizations and other entities involved in while decentralization. For example, township government decentralize the power of management and maintenance down to the village level, through

signing with the village group, detailing provisions on the content of the management and protection. Also playing the role of government guidance and supervision, strengthening training of farmers and water usage association, what makes them become main body of using water and managing water. And above practice is in accordance with the principle of government decentralization and civil responsibility what has emphasized by multivariate supply model. It is worth noting that local water usage association is not widespread in Z county, the mass self-management has become the main model.

When it comes to the usage, a villager in Z county introduced that irrigation need to pay water and electricity fees before, but in recent years, the water fees is no longer charged. During the dry period, irrigation is free, but in normal year, electricity is about 0.5 yuan per degree, what is charged by power supply company, the price is reasonable and villagers are able to withstand. As unpopularity of water usage association and water fee reduction in Z county, electricity is main cost of local irrigation. And the price of 0.5 yuan per degree to take into account the needs and affordability of farmers.

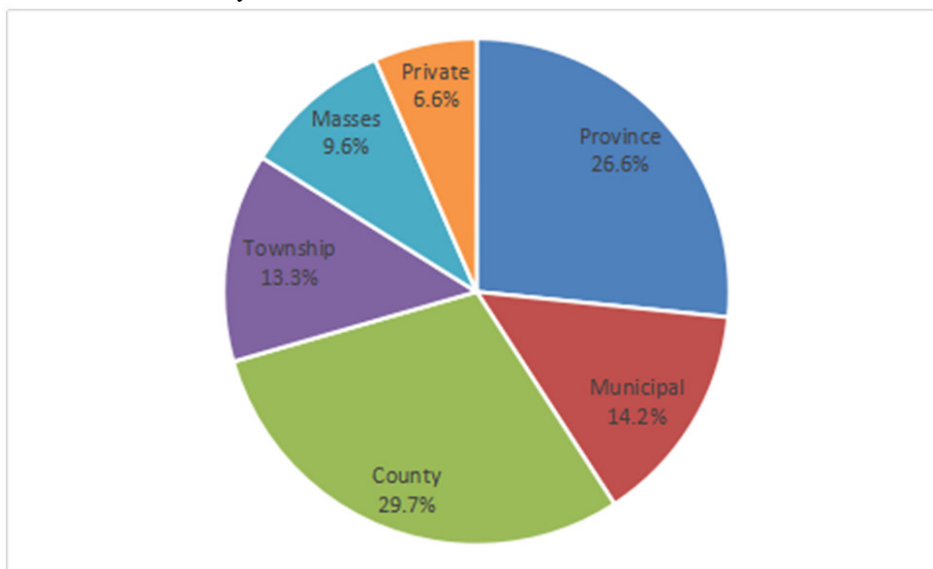


Figure 2. the investment source of small-scale irrigation and water conservancy facilities during the period of 1953-2005 in Z county

Through case study in Z county, we can see that in the cooperation of the local supply of small-scale irrigation water conservancy facilities related to governments, farmers, NGOs and the private sectors, all participants have played important roles in the various stages of supply and they comprised a complete multivariate supply model, as shown in Figure 3.

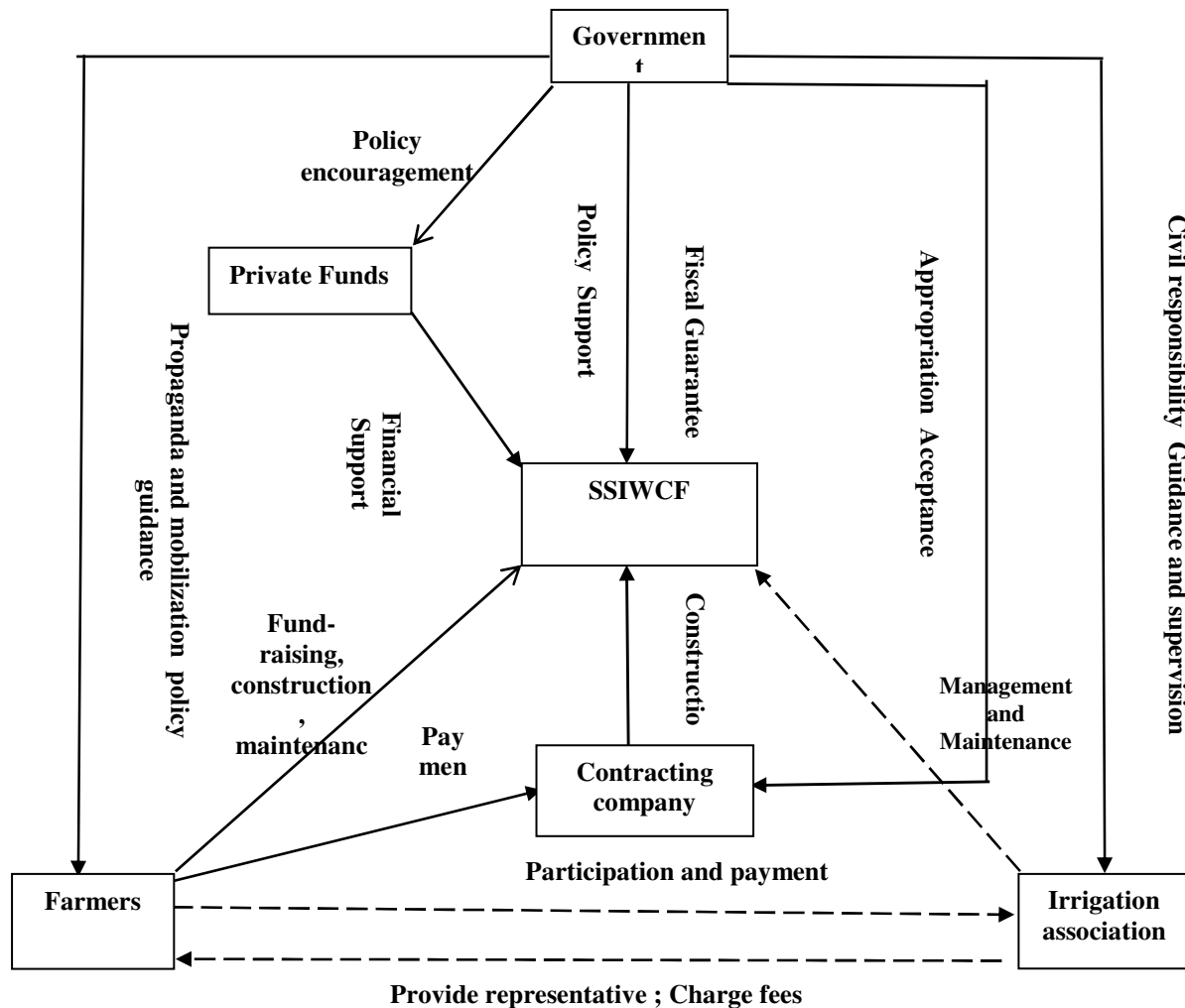


Figure 3. The supply model map of small irrigation and water conservancy in Z county (Note 8)

The supply model of small-scale irrigation and water conservancy in Z county showed in Figure 3 is consistent with the multivariate supply model constructed in this paper, what verifies the rationality and feasibility of the proposed multivariate supply model of small-scale irrigation and water conservancy facilities. Of course, the locals made certain innovation, such as the mass self-management has become the main model of management and maintenance, and showed some of local characteristics. Although multivariate supply model is not perfect in the process of implementing, the practice of Z County proved the model is expected to make an important contribution to solve the supply of rural small-scale irrigation and water conservancy facilities, so it has reproduction value and significance of the promotion.

#### 4. Conclusion and discussion

For many years, the rural areas has always been the difficulties and blind spots of national governance, the deficiency of providing public goods in rural areas restrict the modernization of governance in China to some extent. Based on this view, this paper further deepen and refine the multivariate supply model of small-scale irrigation and water conservancy from the perspective of public governance. The multivariate supply model contains four main participant and also four stages: the four main participant are government, farmers, NGO and private sectors, and the four stages of this model indicate investment, construction, management and maintenance, usage. To prove the rationality and feasibility of multivariate supply model, we selected Z country of Anhui province to conduct field investigation and interview related public employees and local farmers. Through investigation and research, we found that there are some changes in the supply model of small-scale irrigation and water conservancy in Z country, government, farmers, NGO and private sectors, those multivariate participant play an actively role in the supply of small-scale irrigation and water conservancy, in turn, making great achievements in these fields, such as increasing diversified investment channels, flexible and varied ways of construction and innovating management and maintenance model.



However, we cannot deny that there are still deficiency in the overall supply of small-scale irrigation and water conservancy facilities in China, so does Z county. To solve the supply problems of small scale irrigation and water conservancy facilities and improve the multivariate supply model, we should attach great importance to these aspects:

First and foremost, the government in China should enhance investment in the field of farmland water conservancy and allocate resources more effectively and rationally. Take Z country for instance, as the city government and country government didn't implement the national policies concerning small-scale irrigation and water conservancy completely, and the allocation of resources was not fair, there are still huge fund shortage of small-scale irrigation and water conservancy facilities in Z county. In 2014, the land-transferring fees of Hefei city and Z county were 33.521 billion and 1.824 billion RMB (Hao Zheng,2014),however, the investment of farmland water conservancy were 1.75 billion and 40.85 million RMB, far away from the requirements of central government. The investment of water conservancy in Hefei accounted for ten billions in the same year, but the percentage of investing in farmland water conservancy was only 17.5%(Note 9). In view of this situation, it is necessary for governments at all levels bear their responsibilities in the supply of small-scale irrigation and water conservancy facilities, strictly implement the policies that 10% of land-transferring fees should be transferred to farmland water conservancy construction, and build stable growing mechanism of public finance.

Second, improve the mechanism of diversified investment. From the investigation in Z county, many rural areas lack investment by farmers. To satisfy the need of superior check, the local government take investment from other channels as investment by farmers on purpose. There are still big scope for investment by farmers. Therefore, the local government and village committee should encourage farmers to participate in the construction of water conservancy facilities , improve the systems of gathering investment by farmers, increase the investment on small-scale irrigation and water conservancy facilities construction, so as to improve the mechanism of diversified investment.

Third, the improved management and maintenance model is the security for effective supply. Currently, part of the rural areas in Z country still emphasis on construction while neglect maintenance. For example, some areas lack the maintenance organizations, workers, and funds. While some areas clarify their maintenance parts, but as the result of undefined responsibilities, lack of maintenance funds, weak maintenance awareness, the maintenance of water conservancy are comparatively poor. There are only six water association in the country, and in the process of working, their functions are ignored by other parts, they hold the view that the water association have restricted influence. As the small-scale irrigation and water conservancy facilities lacks well maintenance, so a lot of embankments barren. Therefore, when upholding the principle of self self-management and empowering the people, the local government should strengthen the guidance and training for the maintenance parties to let them know the importance of maintenance. Government, property rights owner and parties of maintenance should strictly implement the agreement of management and maintenance, put maintenance funds in their right place, bear their own responsibility, so as to take the "guardian" role in small-scale irrigation and water conservancy facilities , to avoid small-scale irrigation and water conservancy facilities barren. Water Usage Association is one of the effective ways to solve the farmers' demand for irrigation and maintenance of small-scale irrigation and water conservancy , so Z county should pay attention to the establishment and development of rural water usage associations, through guidance and supervision and other means to promote the healthy operation of the Water Usage Association. At the same time, water usage associations should manage and maintain the local small -scale irrigation and water conservancy facilities to meet irrigation needs. Under the principle of self self-management, the government should gradually develop framers and water usage associations into the parties of water usage and management, so that they can satisfy farmers' water usage needs independently.

The multivariate supply model of small-scale irrigation and water conservancy is based on the practice of Z county , we believe this model will benefits and provide reference value for other provinces or regions, especially large agricultural province such as Anhui or other developing areas. Of course, There are great differences between eastern and Midwestern regions in China, no matter in natural conditions or economic development,In fact, we need to specifically analyse the the actual situation of different regions.In future,whether the multivariate supply model is applicable to other provinces or regions and what kind of management and maintenance model is more effective still needs further research and analyse.

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Note:

Note 1, Note 2: Data from China's Rural Statistical Yearbook 2013, as well as China's Annual Statistical Yearbook.

Note 3: Santi, Wutong: The village retention is the village collective economic organizations in accordance with the provisions extract from the production and income of farmers for the village to maintain or expand reproduction, the establishment of public welfare undertakings and daily management expenses in general. Including three items, that is, the provident fund, welfare and management fees; Town pooling fund is collected by the cooperative economic organizations in town, who in accordance with the law to charge the subordinate units (including township and village enterprises, partnerships enterprise) and farmers for running schools (i.e. rural education surcharge), family planning, allowances, militia training, rural roads building and other civilian payment.).

Note 4: Two workers refer to rural compulsory labor and labor accumulation

Note 5, Note 6, Note 9: Related investment data is provided by the Hefei municipal water affairs bureau.

Note 7: new agricultural business entities: farmer's land contract management transfer to the family farm, major professional, farmer cooperatives, agricultural industrialization leading enterprises and other new types of agricultural production and operation subjects.

Note 8: Because of the imperfect farmer water usage association (Irrigation association) in Z county, this kind of organization is not fully played its role, therefore, it is indicated by the dotted line.