INSTITUTIONAL CHANGE AND THE EFFECTIVENESS OF SUPPLY OF RURAL WATER CONSERVANCY IN CHINA

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ABSTRACT

This research examines institutional change's influence on rural water conservancy supply and tries to explain the logic of rural public goods supply in China.

In particular, my research will focus on rural water conservancy supply institutions' functions in the collapse and the reestablishment of effective rural water conservancy supply system since the reform era. I will pay attention to the mechanism of institutional change in rural water conservancy supply issues. The research is innovative because it focuses on different conservancy supply institutions and the collapse and reestablishment of rural water conservancy system in modern China. The research will supply information of social groups' functions in institutional development and changes. It will bring a new perspective to explain rural China's development and reforms through rural water conservancy issues. Empirically, it will also bring in some ideas to express problems of low effectiveness of rural public goods supply in China.

Since there is a lack of in-depth systematic study of China's rural water conservancy supply in the western academic context, this research will mainly take the method of case study by using conservancy supply cases in the market reform era and the new socialist countryside era to find the relationship between supply methods and supply effectiveness of rural water conservancy supply in places of Central and Western China.

Major theories of institutionalism will be utilized to verify findings from fieldwork. In particular, public goods theories will be applied in the research in order to examine various rural water conservancy supply methods in different eras. Property rights theory can be used to explain motivations and effectiveness of different water conservancy supply methods and institutional dilemma in different time periods. Institutional change theories will be applied to investigate how initiatives and actions of social groups can affect the effectiveness of water conservancy supply. Taken together, my research will try to combine institutional change theory, property rights theory and public goods theories to study the development and evolution of water conservancy supply in rural China. This research finds that market-driven rural water conservancy supply institutions could not work well and caused the collapse of conservancy supply system while polycentric conservancy supply institutions can help the government and different social groups to find appropriate positions in

conservancy supply issues. This research offers significant empirical materials of the change of rural public goods supply in China which fills relevant research gap. This research also proves that only effective cooperation between the government and social groups can establish suitable institutional arrangements for rural water conservancy supply issues.

Key words: Institutional Change, Conservancy Supply, Property Rights, Public goods, Social groups

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ABC	Agricultural Bank of China
CCP	Chinese Communist Party
CPRs	Common Goods/Common-Pool Resources
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
HRS	Household Contract Responsibility System
NPC	Nationalist Party of China (Kuomintang,国民党)
PRC	People's Republic of China
RCC	Rural Credit Cooperatives
RCIS	Rural Conservancy Information System
RMB	Ren Min Bin (人民币, Legal currency in the mainland China)
RWCS	Rural Water Conservancy System

CHAPTER 1 BACKGROUND OF THE RESEARCH

This chapter will mainly present the background of this research, especially the significance of the research topic and potential academic objectives. The first part of the chapter will be the general research background. Then this chapter will introduce the three major stages of the development and changes of rural water conservancy supply in modern China since the 1950s. Lastly, information about later chapters of this research will also be introduced.

1.1 BACKGROUND

China is a large agricultural state with a long rural water conservancy history. Rural water conservancy system plays a significant role in Chinese social and economic development. Conservancy governance was an important part of public affairs in ancient China.

There was a close relationship between Chinese society and rural water conservancy supply in the authoritarian time period (Talhelm et al, 2014). In 600 BC, Chinese politician *Guan Zhong* (*管仲*) brought up the idea that conservancy governance was the basis of governing the country (Gu, 1997, pp.229). Effective water conservancy management was helpful for the country's operation. If a dynasty could establish an effective rural conservancy supply system, its food supplement would be sufficient and the ruling would be stable. Otherwise, the dynasty would collapse due to various economic and social problems caused by low effective rural water conservancy supply system.

Because of China's natural conditions, rural water conservancy supply system plays a significant role in both agricultural producing and public administration. In most areas of China, rainfall is mainly in summer and autumn (Li et al., 2003). The spatial and temporal distribution of water resources is extremely uneven. Floods and drought have been major natural disasters for China's agricultural production. During the 2155 year between 206 BC and 1949 AD, there had been 1092 serious floods and 1056 serious droughts (Gu, 1997, pp.233). In order to reduce floods and droughts' negative influence and increase agricultural productivity, China highly relied on rural water conservancy system and has developed much more conservancy programs than western countries.

Therefore, Wittfogel argued that in order to manage conservancy supply

issues effectively, the ancient China established oriental despotism to monopoly resources. The development of rural water conservancy supply system helped China to organize its authoritarian political and social structures. Governors established formal institutions to weaken the development of non-government power and strengthen official wealth and power such as concentrating imperial power and limiting the development of business to keep their absolute authority in conservancy supply and national governance (Wittfogel, 1957, pp. 13-15). Even after the PRC was founded, water conservancy supply still had significant political and social meanings in rural China's public administration and political lives. Many traditional conservancy governance thoughts and approaches have been inherited and affected rural China's development. Therefore, studying supply of rural conservancy system in the modern era is helpful to have a better understanding about China's social and economic development and the changes of public goods supply.

In recent years, droughts have occurred in large areas of China. In 2006, Southwestern China met serious droughts that affected 101.04 million Mu (Chinese Acre)[1] farmlands with 18.1 million Mu farmlands having no harvest. The direct economic loss was 76.9 billion RMB. Similar situations also happened in 2007, 2009 and 2010. In the three years, 440.85 million, 161 million and 100 million Mu farmlands suffered from serious droughts, respectively. Economic loss of nationwide droughts in 2007 and 2010 were 78.8 and 77 billion RMB, respectively (Xinhua, 2012).

Climatic factors, engineering problems and problems of rural water conservancy supply institutions are seen as main reasons to lead to China's conservancy supply dilemma. Since climate change has obviously affected normal rainfall amount and temperature, monsoon climate's influences have been seen as major problems to cause floods and droughts in recent years by geographers and meteorologist (Wang et al., 2002; Li et al., 2003). Some scholars have argued that serious droughts in Southwestern China were the combination of structural droughts and meteorological droughts (Duan et al., 2015).

Another opinion is that serious floods, droughts and low effective conservancy supply system in recent years were due to poor construction of conservancy infrastructures. According to the 2006 data, in 125 countries in China, 20.35 million Mu farmlands, less than 45% acreage of farmland of the nation, could get effective conservancy service. Over 50% of rural water

[1] Mu is a agricultural unit to measure land acreage in China. One Mu is equal to 666.67 ㎡.

conservancy programs needed to be fixed and over 35% of farmlands could not get any conservancy services (Ge, 2010). Before 1980, the annual investment of conservancy supply infrastructures was about 6.7% of nationwide infrastructure construction investment. However, the percentage declined to 2.84% from the 1980s to the 2000s years. China would need 75 years to promote its major rural water conservancy supply infrastructures with the 2010 conservancy investment standard (Yang, 2011).

Since the market reform era, collective farming has collapsed. Farmers grew crops for themselves and the government also reduced its investment to maintain and manage conservancy infrastructures which caused deficiency in the construction of conservancy supply infrastructures. When rainfall was too much or too little, poor conservancy construction increased negative influences of natural disasters. The chief of Guizhou Provincial Water Resources Department argued that conservancy construction problems were key factors affecting water supply and causing serious droughts. Media reports also focused on shortages of conservancy infrastructures' constructions (Xinhua, 2012).

Meanwhile, some scholars also argued that the root cause of conservancy supply's low effectiveness was institutional arrangements. Hu Angang and his team argued that institutional failure was a major cause of deficiency in conservancy supply. He argued that market-based approaches would be more effective to configure water resource in the Yellow River Basin (Hu & Wang, 2002). Zheng Fengtian believed that marketization and privatization could only make the effectiveness of conservancy supply lower and led to serious droughts and floods (2009).

Floods and droughts are relevant to national governance capacity and characteristics of the times (Wang, 2007). Traditionally, agricultural disasters are mainly caused by natural reasons such as climate and geographical factors. Once the change of natural conditions went beyond people's abilities to resist disasters, natural disasters would affect agricultural productivity. Meanwhile, since the modern times, conservancy engineering and technology are much more advanced. Human beings have increased abilities to deal with natural disasters. Therefore, since the modern times, floods and droughts are not only led by climate change but also affected by engineering and institutional reasons. Since the reform era, technological conditions were stable and advanced enough to deal with conservancy supply problems in rural China. Low effectiveness of conservancy supply and agricultural disasters in recent years

can be predicted that are mainly caused by institutional problems.

Although southwestern droughts made the public focused on inadequate construction of conservancy infrastructures, actually the government has tried to increase investment on conservancy supply infrastructures and promote conservancy constructions. In the period of the Eleventh Five Year Plan (2006-2010), the Chinese government invested about 70 billion RMB to promote conservancy supply which was 1.93 times of that in the Tenth Five Year Plan era (2001-2005). However, the increasing investment did not change the weakness of rural water conservancy supply obviously (Xinhua, 2012).

Therefore, poor conservancy infrastructure constructions are surface phenomena while institutional problems are key factors. The change of conservancy supply institutions and rural organizational structures led to different effectiveness of conservancy supply. Inappropriate and low effective supply methods, confusing configurations of property rights and policy failures have led to problems of rural water conservancy supply in agricultural development.

Governance failure is the deep reason of water resource risks. Institutional failures played much more significant roles than climate and engineering problems in modern conservancy supply issues. Since the 1980s, the collapse of government-driven rural water conservancy supply institutions established in the collective era broke original arrangements of collective conservancy supply. As the new conservancy supply institutions were not established due to several obstacles, the conservancy system was ineffective and caused a series of problems in recent years. Marketization and privatization led rural water conservancy supply onto a wrong developmental path. Conflicts between conservancy supply's features and household contract responsibility system made conservancy supply system less effective. It was hard to balance effective conservancy supply and family-based agriculture. Neither the government nor non-government organizations could dominate conservancy supply in the market-driven institutional environment. In order to promote the effectiveness of conservancy supply, both the government and social groups tried to cooperate with each other to establish a polycentric conservancy supply system in the market economy. However, the weak government, unorganized farmers and other social groups with different interests and purposes challenged the reestablishment of effective conservancy supply system especially new conservancy institutions. Nowadays, China is still trying to find an appropriate way to increase the effectiveness of the polycentric conservancy supply system.

Institutional arrangements and institutional problems have been core issues of the change of rural water conservancy supply. They are still affecting conservancy supply nowadays. Malpractice of water conservancy supply has been a prominent and significant problem in the 21st century's rural China. However, there has been no study that states and analyzes rural water conservancy supply problems clearly. Therefore, the research topic of rural water conservancy supply has both significant theoretical and practical implications. It can not only present conservancy supply situations in modern China but also fill the research gap of institutional change of public goods supply in rural China.

1.2 THREE MAJOR STAGES AND CHAGNES OF CONSERVANCY SUPPLY IN MODERN CHINA

Rural water conservancy supply institutions have experienced several changes since the PRC was founded. Supply methods, property rights configurations, organizational approaches, relationships among different actors are various in different eras. In order to make later analysis clear, this research will divide modern China's rural water conservancy supply into three stages.

The first stage: Collective era, when the supply of rural water conservancy supply system (RWCS) was centralized and coordinated[2] (Ministry of Finance, 1994, pp. 79). From the mid-1950s to the late 1970s, the average annual growth rate of government investment on rural water conservancy system accounted for about 7% of the investment in agricultural infrastructure constructions (the peak was 8.2% in 1974 to 1975) (China Statistical Yearbook, 2002). Since government gave unified administrative commands concerning engineering constructions and daily management of rural water conservancy supply, rural water supply method showed strong planned features and characteristics of pure public goods supply. In this stage, China changed the poor conservancy conditions and generally established the modern rural water conservancy supply system all around the country. Through over 20 years' constructions, China had had the ability to offer basic conservancy services for most farmland in Eastern China and some parts of areas in Mid-western China in the late 1970s (Pan, 2002).

The second stage: Market reform era, when RWCS was mainly supplied by individual families and through market mechanism. With the rural land and

[2] Using the 1950s as the formal start time in this research is because China has completed its socialist transformation in the aspects of agriculture, industry and business in 1956 and has established centralized government-driven producing and distribution method in social and economic areas.

market-driven reforms that started in the late 1970s, the Chinese central government actually transferred the accurate responsibilities of rural conservancy supply to the local level and individual families together with the land use rights (Ministry of Finance, 1994, pp.132-135). At the same time, both the central and local governments reduced the investment in rural water conservancy system. From 1980 to 1995, the average growth rate of government investment on rural water conservancy system in agricultural infrastructure constructions was less than 3% (China Statistical Yearbook, 2002). Worse, the individual family cannot afford the increasing expenditure of an entire conservancy system (Ministry of Finance, 1994, pp.146-149). Moreover, market-driven reforms in agriculture forced poor farmers to reduce or even give up the investment of rural water conservancy supply. Many farmers became free-riders by taking advantage of institutional loopholes. Segmented management and fragmented property rights allocation caused great damage to the overall effectiveness of rural water conservancy supply. During this stage, the modern rural water conservancy supply system established in the collective era had been seriously broken. Many conservancy infrastructures and facilities could no longer be used. The market-based supply system of conservancy services did not play its due role and could not supply effective conservancy services by market approach. The development and supply of conservancy services in rural China caught in stagnation in this stage (Wu, 2007).

The third stage: Polycentric supply era (the new socialist countryside era), when RWCS is being joint-supplied by both the government and social groups. In order to fill the loopholes of institutions and increase the effectiveness of rural water conservancy supply, the Chinese government has introduced polycentric governance-based institutional reform since the 2000s[3], keeping the stable growth of investment on rural water conservancy system at 5% of total infrastructure investment (China Statistical Yearbook, 2007). Institutional innovations and polycentric governance offer diversified supply modes of rural water conservancy services and increase the effectiveness of rural water conservancy supply. In this stage, the government together with social groups reestablishes the modern water conservancy supply system in rural China and increases the effectiveness of conservancy supply. New technology and multiple conservancy supply methods promote the revival of rural water conservancy

[3] Current polycentric governance reform includes policy innovations brought by the government aiming to increase the effectiveness of rural public goods supply. The governance includes bringing in different investors and responsible persons to join the constructions and daily management of rural public goods/facilities; multiple subjects' property rights reforms; using incentives to instead of subsidies; improving villagers' autonomous decision-making rights in the public goods supply issues and so on.

supply and push the reform of rural public goods supply (He et al, 2016).

The stagnation of conservancy supply in the market reform era and the reestablishment and revitalization of conservancy supply in the new socialist countryside era present the image of the changes and development of conservancy supply in rural China in the post collective era. The defects of institutional design and implementations are major reasons to cause problems and the collapse of modern conservancy supply system in the market reform era. New institutional arrangements and diversified supply approaches for conservancy services in the new socialist countryside era offer the chance for the government and social groups to increase investment and reorganize labours to fix conservancy supply problems occurred in the market reform era and improve conservancy supply effectiveness.

In general, the development pathway of rural water conservancy supply in China was from centralized government-driven supply (mainly from mid-1950s to the late 1970s) to market-driven supply (from the 1980s to the late 1990s), and then to polycentric supply (since the 2000s) (See Figure 1.1). Conservancy supply methods and institutional arrangements of the three stages in rural China cover major conservancy supply methods in the world. Samuelson's pure public goods supply theory can explain China's conservancy supply from the mid-1950s to the late 1970s; Coase's arguments of market-driven public goods supply theory can explain China's conservancy supply from the 1980s to the late 1990s and Ostrom's polycentric public goods supply theory can explain China's conservancy supply since the 2000s.

Three major conservancy supply approaches in rural China can be found in the following figure (see Figure 1.1).

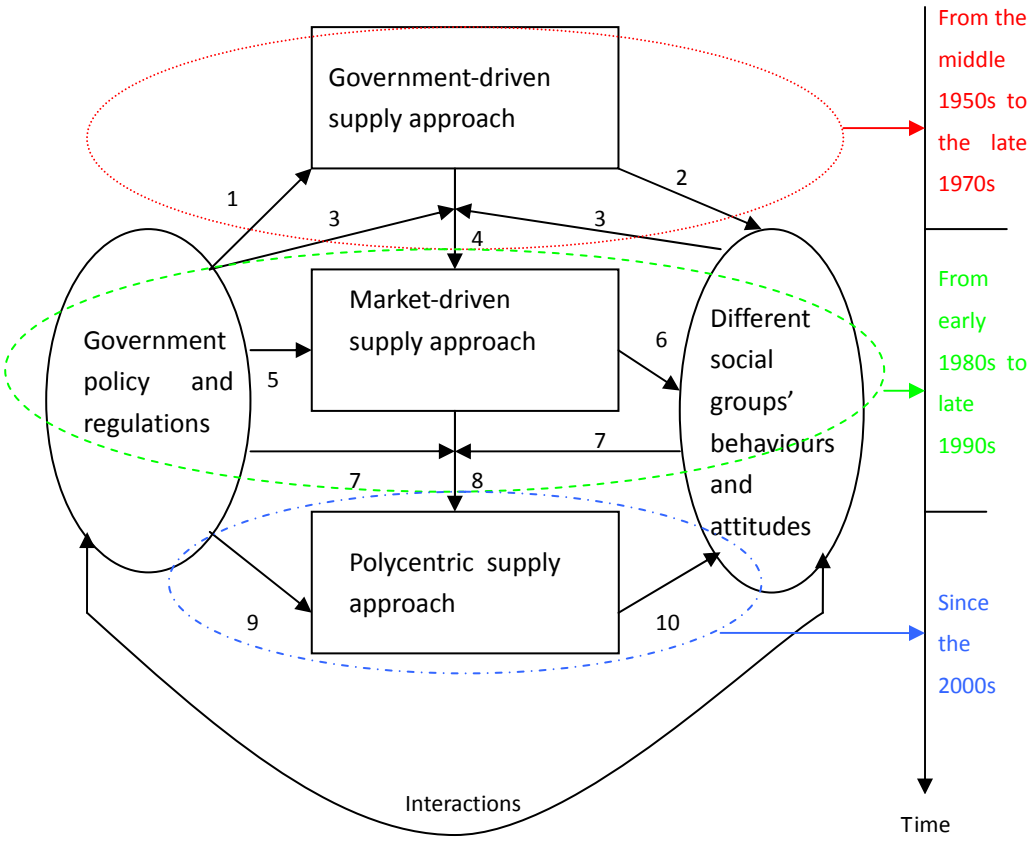


Figure 1.1 How rural water conservancy supply changes

Figure 1.1 has shown that the change of the whole set of rural water conservancy supply institutions could be separated into three different stages as mentioned above. Major interactions, compromises and other significant actions between the government and social groups in different eras have been marked out as numbers which follow the time series to show how rural water conservancy supply institutions have changed.

From the historical experience, it can be seen that since the PRC was founded in 1949, the Chinese central government and top leaders dominated conservancy supply construction and maintenance based on their political preference and bounded rationality (Lin, 1989). They copied the Soviet mode to establish rural China's modern conservancy supply system (Tang & Li, 2005). Therefore, the government's official actions to make government-driven conservancy supply institutions could be regarded as the start of the PRC's conservancy supply history. And the government and social groups are two major actors in rural water conservancy supply institutions which can be marked as A and B. On this basis, evolutionary path of rural water conservancy supply in rural China is shown as Figure 1.1:

The Chinese government made policies and regulations (A) to formally

establish the centralized government-driven supply approaches (1) of rural water conservancy supply in the middle 1950s. The government-driven supply approaches helped to establish modern rural water conservancy supply system in China and made great achievements in rural conservancy facilities' constructions. Meanwhile, the government-driven rural conservancy supply methods could not encourage participants' enthusiasm but left heavy pressures on farmers from the late 1950s to the 1970s (2) (Lin, 1989). As time passed by, problems of institutional arrangements were magnified in the government and farmers' non-cooperative interactions. Some top leaders, government officials and farmers would like to take actions to change the government-driven institutions in the 1970s (3). The spontaneous attempts of new institutions from some local government officials and some social group members especially farmers shaped the basic framework of market-driven public goods supply methods in the late 1970s and early 1980s (4). In the early 1980s, the Chinese government had made formal institutions to confirm the market-driven public goods supply institutions officially (5). Meanwhile, the market-driven conservancy supply approaches ignored farmers' abilities and demands in the market economy and caused low effectiveness of rural water conservancy supply which harmed many farmers' interests from the 1980s to the 1990s (6) (Fan et al, 2002, pp.13-15). In the late 1990s, neither government officials nor farmers would like to continue the problematic market-driven water conservancy supply institutions (7). Polycentric supply methods of rural water conservancy were attempted in some areas from the 1990s to the early 2000s (8). In the new socialist countryside era, the government has formally established the polycentric rural water conservancy supply institutions (9) (Wang, 2012). New supply methods encourage farmers' initiative and establish a sustainable cooperative relationship between the government and social groups. The government and social groups can coordinate their interests in conservancy supply issues. New polycentric institutions are helpful to offer effective conservancy supply services in rural China (10) (Tang & Li, 2005).

Table 1.1 Development of rural water conservancy supply in different periods

Time period	Relevant fees need to be paid by farmers	Farmers' roles in conservancy supply issues	Government's responsibilities in conservancy supply issues
1949-1956	None	volunteer works	Financial subsidy, administrative management
1957- the late 1970s	None	volunteer works; work points (*Gongfen*, 工分)	Financial subsidy, direct involvement
The late 1970s- the late 1980s	Water fees	volunteer works	Macro administrative management
The 1990s	Water fees	accumulation works	Macro administrative management
The 21st century to now	Water fees	accumulation works, capital investment	Financial subsidy, policy innovations

Source: Based on Tang & Li (2005). It is Author's research.

Fees, volunteer works and relevant responsibilities in Table 1.1 are parts of conservancy supply institutions. Table 1.1 shows that investment and responsibilities of farmers and the government for conservancy supply are various in different eras. Different conservancy supply institutional arrangements can lead to different effectiveness of the rural water conservancy supply system. Therefore, rural water conservancy supply is a typical representation to reflect social and economic development in contemporary rural China.

Since the existing literature has discussed advantages and disadvantages of collective agricultural producing methods, government-driven rural public goods supply approach and mentioned conservancy supply issues in the collective era (Bramall, 1995; Chen, 1993; Chen, 2009). This research will not treat conservancy supply in the collective era as one of the major research tasks but focus on the collapse of the rural water conservancy supply system in the market reform era and the reestablishment of effective conservancy supply in the the new socialist countryside era. There is much less research focused on conservancy supply issues in the two time periods and the research can offer significant explanations and evidences of institutional change for rural public goods supply problems in the post collective era. Rural water conservancy supply approaches, effectiveness, property rights configuration, institutional arrangements and institutional change in the market-driven institutional environment and polycentric institutional environment in the post collective era will be the main research target of this study. This research will mainly use cases of rural water conservancy supply in two eras (the market reform era and the new socialist countryside era) to study the research topic.

1.3 BRIEF INTRODUCTIONS OF FOLLOWING CHAPTERS

Following Chapter 1, Chapter 2 will review literature about relevant theories and the research topic. It will introduce key theories of institutionalism first. Then the chapter will state three different operation modes of conservancy supply institutions. The last part of the chapter is about rural water conservancy supply in agricultural-based developing countries and socialist countries.

Chapter 3 will offer the methodology of this research. The first part of the chapter is about key definitions in this thesis. The second part will state the major research question and two sub-questions of this research. The last part of the chapter will offer some information about data and fieldwork.

Chapter 4 will discuss rural water conservancy supply institutions and conservancy supply in china's pre-reform era. There are two major parts of this chapter. The first part of the chapter will give generic explanation of rural water conservancy supply institutions from four different aspects. The second part of the chapter will briefly state rural water conservancy supply in rural china in the collective era.

Chapter 5 will talk about the stagnation of modern rural water conservancy supply system in the market reform era. The chapter will offer information about the establishment, institutional framework and arrangements of market-driven rural water conservancy supply institutions. Later, this chapter will state the actual operation of market-driven conservancy supply institutions and make institutional analysis. The last part will introduce the failure of the market-driven rural water conservancy supply institutions.

Chapter 6 is about the benign development of modern rural water conservancy supply system in the new socialist countryside era. The first part of the chapter will state the establishment of polycentric conservancy supply institutions. The second part is about institutional framework and major arrangements. The third part will offer the actual operation of polycentric conservancy supply institutions. The fourth part is the institutional analysis and final part is about problems of polycentric rural water conservancy supply institutions.

Chapter 7 will conclude the whole thesis. Summary and findings of the research will be offered first. The second part is about contributions. The last of the chapter is about research limitations and future research.

CHAPTER 2 LITERATURE REIVEW

In this chapter, I will review key theories (public goods theory, property rights theory and institutional change theory) of institutionalism which will be applied in this research. The three major theories can offer the macro analytical framework and basic arguments of this study. This chapter will also state different modes of rural water conservancy supply institutions all around the world especially in socialist countries and developing countries. There is few theory can explain the development of China's conservancy supply development well and there is few empirical study focus on China's conservancy supply cases in the post-collective era. Therefore, this chapter tries to establish the link of key theories and accurate rural water conservancy supply issues in China to find out possible reasons of the low effectiveness of conservancy supply in the post-collective era.

2.1 KEY THEORIES OF INSTITUTIONALISM

This part will review some key theories of institutionalism which can be applied to this research. It will include the public goods theory, property rights theory and institutional change theory.

2.1.1 Public goods theory

The relevant literature about theories and definitions of public goods and different supply methods of public goods will be reviewed in this part.

Definitions of public goods

The concept of public goods was proposed by Erik Robert Lindahl in 1919 and developed by Paul A. Samuelson in 1954. According to Samuelson, the *collective consumption goods* (pure public goods) are the goods or services that each individual's consumption "leads to no subtraction from any other individual's consumption of that goods" (1954). For him, public goods/services have three obviously distinctive features from private goods/services: indivisible utility, non-rivalries and non-excludability (Samuelson, 1954). If some goods or services have both features of non-rivalry and non-excludability, they can be regarded as public goods/ services. If goods or services can be utilized by private entities and have features of divisible utility, rivalries and exclusive benefits to others, they can be seen as private goods (Samuelson, 1955). In between are quasi-public goods/services (Buchanan, 1965).

Samuelson gave a clear definition of public goods. However, this definition covers just a small part of the whole public goods. He did not classify quasi-public goods and services. The theory of pure public goods can just be implemented in some polarized or extreme cases (Buchanan, 1965).

In order to round out the theory, Charles Tiebout argued that some local public goods can only be consumed by people in certain areas (1956). Those public goods have the feature of regional excludability. On this basis, Buchanan developed the concept of quasi-public goods to fill the gap between pure public and pure private goods (1965). Buchanan defined the non-rivalry and excludable goods as club goods, thereby expanding the definition of public goods. Accordingly, as long as social groups agree to offer some goods or services collectively for certain reasons, the goods or services can be seen as public goods (Buchanan, 1965).

Other goods which have features of rivalry and non-excludability are common goods/common-pool resources (Gordon, 1954; Brann & Foddy, 1987; Héritier, 2002, pp.20). The public share all the common goods/common-pool resources' (CPRs) but each individual consumes his or her unique resource unit (Ostrom, 1990, pp.6). The individual's use cannot exclude others' consumption (Brewer & Kramer, 1986). Meanwhile, given common good's public nature, its consumption may have the problems of crowding-out effects and overuse due to human being's rational choice (Ostrom et al., 1994, pp.4).

In this research, public goods will be defined in the broader sense, including pure public goods and quasi-public goods since the feature of rural water conservancy supply has changed over time in China. In the collective era, rural water conservancy facilities and infrastructures were regarded as pure public goods. While in the market reform era, they were treated as private goods. In the new socialist countryside era, rural water conservancy service has been seen supplied as quasi-public goods/services.

The studies of supply and production of public goods

As public goods can be divided into different types, there are different supply methods of public goods (Oakland, 1972). Transaction cost, exchange embeddedness and interlocal cooperation of those public goods supply methods are different from each other (Shrestha & Feiock, 2011). Academia holds different arguments about supply methods and effectiveness in the delivery of public goods (Andreoni, 1995; Alesina et al, 1999; Fischbacher et al, 2001).

Some scholars believe that since public goods are non-excludable and non-rival, supply by (or, provision through) market could easily result in high

additional costs, economic inefficiency and free riders (Pigou, 1924; Fischbacher & Gachter, 2010; Shrestha & Feiock, 2011). Therefore, they agreed that government should instead offer the public goods to ensure enough supply and high economic effectiveness. The government could better coordinate different actors' interests, reduce unnecessary conflicts and problems and allow them to cooperate each other with the official control (Kahneman & Knetsch, 1992).

In reality, government failures are very common (McKean, 1965). Government's supply and production of public goods may lead to monopolies and low efficiency (Andreoni, 1990). Government's provision of public goods in the real world is not as effective as the theories expected. The government itself also could lead new problems to reduce the effectiveness of public goods supply (Fischbacher & Gachter, 2010). To some extent, the government has been the major resistance to increase the effectiveness of public goods supply in some cases (Cooper et al, 2009, pp.23-24).

Although government offering and producing public goods directly is very common in the traditional context, government takes more responsibilities to join in and interpose economic activities during the process of offering public goods (Buchanan & Tullock, 1965, pp.26; Wendner & Goulder, 2008). The government has excess burdens to increase the size of its agencies to satisfy the increasing demands of public goods (Wendner & Goulder, 2008). The public fiscal expenditure therefore is also increasing (Sefton et al, 2007). At the same time, the marginal benefit of government supply public goods is reducing since the government's domination could lead to free riding problems in public goods supply issues (Labaree, 1997). The shortages and increasing problems push scholars to reconsider public goods supply methods.

Welfare economists regard government as an external variable which does not cause transaction costs. However, Coase realized that the government is an internal variable, which means it also incur some transaction costs (Coase, 1960). This cost sometimes is even higher than that in market trading (Atkinson & Stern, 1974; Murphy et al., 1993). Besides that, if the government offers and produces public goods, some interest groups that have close relationships with the government can get space to seek rents (Sefton et al, 2007). It will lead to extra costs and other problems for public goods supply such as collusion between officials and businessmen and so on.

Another criticism is that Samuelson did not take into any consideration of alternative supply methods of club goods and common-pool resources rather

than government supply (1954; 1955). Despite the fact that pure public goods like national defense can be supplied by government, club goods and common-pool resources may have some alternative supply methods since they do not have the features of non-rivalries and non-excludability at the same time (Buchanan, 1965; Shrestha & Feiock, 2011). Some scholars thus argue that it is possible to supply quasi-public goods through the market/private approaches.

Goldin argued that supply methods decide whether goods or services had public features (1977). He mentioned that pure public goods can be accessed equally by all the people while quasi-public goods can just be accessed by certain groups of people. Demsetz pointed out that if the market can "kick out" free riders, private enterprises can offer quasi-public goods effectively (1970). Besley, Coate and others find that previous studies cannot measure people's real demands and actions in terms of whether they would like to pay to access quasi-public goods effectively in the real world. Those scholars agree that signing contracts with real consumers can solve the free riders' problems in offering public goods (Brubaker, 1975; Marwell & Ames, 1981; Besley & Coate, 2003). Some scholars also argued that the market could solve interest distribution problems in public goods supply and offer more chance for different actors to cooperate with each other (Andreoni, 1995; Alesina et al, 1999; Fischbacher et al, 2001; Shrestha & Feiock, 2011).

Coase used real cases to support the possibilities of market/private entity offering public goods (1960; 1974). The most famous case is lighthouses in the UK. Most people recognize lighthouses, as a type of public good, can just be supplied by government. However, Coase proved that lighthouses in the UK had been actually offered by private corporations or individuals since the 17th century. Coase found that privately supplied lighthouses also kept high effectiveness. Therefore, he concluded that economists should rethink about ways through which government supplies public goods (1974).

Many scholars agreed that some large-scale pure public goods can just be supplied by government in order to fill the supply gap by the market and society (Fischbacher et al, 2001). Meanwhile, they also supported the idea that there should be various supply methods of quasi-public goods which can reduce public expenditure, increase total economic effectiveness and avoid the free-rider problem (Andreoni, 1995; Shrestha & Feiock, 2011). They believe that the market is helpful for the cooperation among different actors in public goods supply and coordinate ethnic and regional problems.

However, Elinor Ostrom brought in some new ideas. She challenged that

the previous theories focused on only one side: the government or the market/private sectors (Ostrom, 2010). The classic theories such as rational cooperation in the finitely repeated prisoner's dilemma (Kreps, 1965), the logic of collective action (Olson, 1965, pp.3) and tragedy of the commons (Hardin, 1968) tried to solve the problem of public goods supply by either government or market. However, scholars made negative comments on the effectiveness of those public goods supply approaches (Ostrom, 1990, pp.26). Ostrom argued that previous theories are problematic since neither government nor market can offer public goods effectively by the singularized supply method (Ostrom, 2010).

Ostrom introduced the idea of using autonomous organizations to manage public goods. She pointed out that a group of people can organize themselves to take autonomous governance, avoid possible problems and achieve long-term common benefits (1990, pp.12). Her innovation was to consider public goods supply as interactions of different public organizations and public authorities that exist in a pluralistic system. Ostrom believed the public goods supply method should not be established by state but by spontaneous orders (2010). She also argued that autonomous organization supply public goods may be not the only method. And there should be many other ways to manage and supply public goods/services effectively (1990, pp.40). On this basis, the Ostroms developed the theory of polycentric governance[4], one that has been proved quite useful to explain common-pool resource problems in the real world (Ostrom, V., & Ostrom, E., 1999; Ostrom, 2010). Ostrom's theory gives explanations of different social subjects' interactions and compromises in offering and managing common-pool resources. Besides that, typical cases which Ostrom used to explicate her theory include the public pools and rural water conservancy supply system in Sri Lanka (1994, pp.3; 2010). Ostrom's autonomous organizations and polycentric governance theory is helpful to understand the polycentric supply method of rural China's water conservancy system since the 2000s. Her observations and research methods about rural water conservancy supply system in Sri Lanka can provide useful lessons for this research.

Some thoughts on the application of public goods supply theories in the research

Unlike western states where there are the stable public goods supply system and

[4] The concept of "*polycentric governance*" was developed by the Ostroms. It was first introduced to talk about elements of sub urban centers. It is widely used to explain the multi-subjects' functions in public goods supply. It encourages multi supply methods of pubic goods and the cooperation among autonomous organizations in public issues.

method, relying on either government or market, China has witnessed its public goods supply method changing over time (Zhang et al, 2004). Therefore, western theories have limits in explaining China's public goods supply cases well.

Public goods' characteristics and supply methods have changed over time in China. The deep reason is that the institutional change over time has led to the change of public goods supply methods and therefore their different effectiveness (Luo et al, 2007). However, the existing literature fails to examine details of how rural public goods supply has changed. Bramall (1995), Lin (1989) and some other scholars who focused on Chinese cases, normally pay attention to a certain historical time period, is not enough to explain the collapse of rural public goods supply in the market reform era and its reestablishment in recent years.

Water conservancy supply can be a good case to explain the institutional change of rural China's public goods supply. Western scholars regard water conservancy supply as common-pool resources (quasi-public goods) (Ostrom, 2010). Meanwhile, in rural China, characteristics of rural water conservancy supply have changed several times in the past decades (Liu et al, 2013). Therefore, it is suitable to use water conservancy supply institutions as cases to examine the change of rural public goods supply's prosperity and decline in China. This research will try to combine western classic public goods supply theories with empirical cases in China and will apply the classic analytical framework to explain rural public goods supply issues in China.

2.1.2 Property rights theory

In this part, I will review Coase's property rights theory and later scholars' further research and the limitations of the property rights theory in explaining China's public property rights problem.

Coase's property rights theory

Coase proposed the concept of transaction costs to discuss the boundary between markets and firms (1937), thus opening a new line of research on property rights. From the late 1950s to the mid-1960s, Coase further discussed the economic functions of property rights. He argued that if property rights are not clear, the externality of free-riders and other problems will cause damages to economic activities. Only clarification of property rights and use of the market pricing mechanism can reduce or eliminate the negative impacts of externality (Coase, 1958). Coase later extended the definition of transaction cost to social cost,

claiming that the clear property rights can overcome the externality of free-riders, reduce social cost and maintain effective allocation of resources institutionally (1960).

The development of Coase's theory

Coase's property rights theory has evolved into three different schools. Different interpretations of Coase's theory from scholars such as Williamson, Buchanan and Sehultze brought the studies of property rights toward different directions. In particular, Some scholars pointed out that whether market operations and resource allocations are economically effective or not was decided by the degrees of freedom of transactions and the transaction costs (Williamson, 1973; 1979; 1985, pp.16; Dyer, 1997). Some others emphasized the importance of ownership and legal system by arguing that the nature of the transactions of resource was the transactions of rights (Buchanan & Tollison, 1984, pp.4; Buchanan, 1984, pp.14; Lesmond et al, 1999). As long as the right's boundary is clear and the exchange is voluntary, resource allocation is bound to be effective (Mueller, 2003; Bajari & Tadelis, 2001). Finally, Sehultze believed the key idea of Coase's argument was to use the property rights to set a fully competitive market environment (1977, pp.13).

However, there are some limitations of the property rights theories. The ideal prerequisites of Coase's theory need a zero transaction cost environment which is impossible in reality (Coase, 1998; Jacobides & Winter, 2005). Besides that, Coase and other property rights theorists paid much attention to private sectors and discussed functions of firms and market in solving the property rights problem (Coase, 1998; 2013). Meanwhile, privatization and redistribution of property rights are not enough and are not always effective in solving the property problem of public goods supply (North, 1990, pp.85). Property rights theorists seldom considered the country's involvements (North, 1981, pp.20). Cases in the existing literature such as lighthouses have clear property rights boundaries which mean that firms or facilities can be totally privatized. However, public goods do not always have clear property rights boundaries in the real world. Property rights arrangements could not avoid government's involvement, especially in developing countries (Zhou, 1995). Therefore, it is difficult for market to kick out free-riders and reduce transaction cost by privatizations.

The problem of property rights in rural China

Although above theories are proved useful in some Western cases, their applications in China have met some problems. The biggest problem is that property rights allocation in developmental state such as China cannot establish

private-private relationships (Demsetz, 1974). The state plays a significant role in property rights arrangements in developing countries (Zhou, 1995).

Since the 1980s, China has reformed its land property rights and public goods property rights configurations. The economic growth rate in the 1960s and 1970s showed that China needed to privatize its collative land and release productivity to increase its economic capacity. Meanwhile, it was constrained by the socialist ideology to make privatization. Therefore, the CCP and the central government invented the concept of a socialist market economy with Chinese characteristics instead to solve the problem and keep the long-term economic development (Ho, 2001; 2017, pp.45-48).

The reform proved successful in many aspects of the economic development. However, the property rights problem still haunts in rural areas in the operational level. The household contract responsibility system did not reestablish property structure effectively in rural China. Farmers just got land use rights rather than ownerships. Hence, they were not clear about what rights they could really have and they did not have willingness to invest in agricultural infrastructures and join public goods supply (Ho, 2017, pp.86-88). They were afraid that their contract with the government was just a piece of paper that the government would redistribute the land and property again if necessary (Ho, 2001).

In fact, land property rights were readjusted frequently in the 1980s and 1990s with the supervision of the CCP since the configuration of the land property rights should be recognized to show the spirit of equality (Ho, 2001). According to the data of the Central Policy Research Office, in 1991, of the 274 villages in a survey, 20.1% had redistributed their land property once since the reform, 69.4% had redistributed two to four times, and over 10.5% had redistributed five times or more. Until 1998, over 80% of the Chinese villages had redistributed their farmlands more than once (Wang, 1998).

Frequent redistribution of farmland's property rights were recognized as affecting economic growth and rural public goods supply negatively. It made farmers and others in rural China doubted the basic structure of property rights configuration. They were wondering officials' political promises about property rights were not credible (Diermeyer et al, 1997, pp.20). The redistribution of land property rights since the 1980s has caused various problems in rural China and even the collapse of the rural public goods supply system. Since land redistributions were not credible and stable, other rural public goods' property rights attached on land rights were also not clear (Ho,

2017, pp.121-125).

Some scholars argued that the messy property configuration was a social evolution that all Soviet countries had experienced if they wanted to transfer their economic and social structures to match with the market economy (Murrell, 1991). Meanwhile, some other scholars had proved that property rights problems in the market economy were caused by institutional arrangements and were avoidable. In developing countries, property rights are normally decided by government's policies and formal institutions (Oi & Walder, 1999, pp.2). In his work, Peter Ho discussed the relationship of institutional arrangements and credible land property rights (Ho,2001; Ho, 2005; Ho, 2006). He found that the if the government could establish stable institutional arrangements to protect farmers' vested interests in land reallocations, the government would have higher prestige among farmers and farmers would be easier to follow the government's administrative commands.

However, there was only a few empirical researches studying property rights problems of rural public goods other than land property rights to prove the relationship between institutional arrangements and credible property rights configuration (Ho, 2017, pp.86-90). Property rights problems are significant factors to affect the supply effectiveness of rural water conservancy system in the post-collective era. Wang Yahua found that in the Yellow River Basin, different villages fought for water use rights (Wang, 2003). He argued that unclear property rights of rural water conservancy supply and inappropriate distributions were roots of using violence to fight for the water conservancy infrastructures' ownership. Wang proved theoretically it possible to trade water use rights to solve the water supply problems (Wang, 2012). Meanwhile, he also recognized the difficulties of trading water use rights with a proper way in reality. This research hopes to offer evidence to prove that institutional arrangements especially formal ones have significant influences on the effectiveness of property rights configuration and rural public goods supply.

2.1.3 Institutional change theory

In this part, I will mainly discuss North's institutional change theory and rural China's institutional change.

North's institutional change theory

As one of the key scholars of the institutional change theory, North emphasized the institutional change is path dependent. The path of the institutional evolution will affect economic effectiveness (North, 1973, pp.23-24; Mantzavinos et al,

2004). According to North, “institutions are the rules of the game in a society or more, formally, are the humanly devised constraints that shape human interaction” (1990, pp.3).

Institutional change is composed of “marginal adjustments to the complex of rules, norms and enforcement that constitute the institutional framework” (North, 1990, pp.83-85). Organizations and entrepreneurs are the agents to shape the directions of the path-dependent institutional change (Mueller, 2000). They make the path of institutional change to meet their own interests through professional knowledge and social activities (North, 1990, pp.73-76; Scott, 2010).

Formal and informal institutions are the key points of North’s institutional change theory (1990, pp.36, pp.46, pp.54). Formal institutions include political and judicial rules, economic rules and contracts and government official policies and regulations in various levels (North, 1990, pp.47). Informal institutions, which are culture and tradition based, include codes of conduct, norms, behaviours and conventions (North, 1990, pp.36). North pointed out formal institutions were only small parts of institutions and informal institutions have subtle influences on institutional change (North, 1990, pp.36). Regardless of the fact that informal institutions are hard to have direct influences on formal institutions in a short time, informal rules and norms will have long-term effects on long-term institutional change. Formal and informal institutions establish the root of path-dependence (Scott, 2010).

North believed complex interactions between formal and informal institutions push the institutional change. Those interactions shapes our daily life and keep the stability and changes of institutions (1990, pp.83). When formal institutions change, they break balance among different actors and could lead to instability of institutions and institutional change (North, 2000). Informal institutions change in response to to changes of formal institutions. The interaction between formal and informal institutions acts on the stability (Redmond, 2003). The ongoing institutional evolutions shape the dependent path of institutions.

In explaining major questions of institutional change, North argued that his analysis was not perfect. North’s theory contains some biases and knowledge blind spots making it impossible to cover all the variables of institutional change (1993). North did not analyze detailed cases, especially how accurate human being behaviours affect institutional change (Musole, 2009). Since North focused on the political or social issues in the era of the rise of capitalism, he

explained institutional change within the time period well but his theory is inadequate for explaining institutional change in non-western context (Dacin et al., 2002).

North's arguments about institutional change, formal institutions and informal institutions are recognized in this research. This research will try to combine North's argument and China's rural water conservancy supply institutions in the past decades.

The development and application of institutional change theory in China

By localizing North's institutional change theory, Justin Yifu Lin proposed concepts of mandatory institutional change and induced institutional change in China's settings (1989). Lin argued that when technological conditions are stable, transaction costs are the core of institutional arrangements. If pure benefits of individuals are higher than transaction costs, an induced institutional change will happen (led by people's spontaneous behaviours) (Lin, 1988). However, since the induced institutional change still leads to high transaction and organizational costs and may bring in free riders, the economic performance of new institutional arrangements will be lower than the theory predicts. The government might also involve in institutional change. Its involvement will lead to mandatory institutional change (Lin, 1989). Lin pointed out that the induced institutional change, which belongs to the spontaneous change is caused by a group of people seeking benefits from institutional loopholes. But mandatory institutional change is led by government regulations or orders (Lin, 1989).

According to Lin, induced institutional change happens when existing institutional arrangements cannot offer certain benefits. And informal groups will take spontaneous actions to make institutional change. However, mandatory institutional change is normally led by government and top leaders' political preference and bounded rationality (Lin, 1989). It happens anytime as long as the government and top leaders feel it worth doing so. Mandatory institutional change is constrained by ideology, interest groups, local knowledge and other factors (Lin et al., 1996). Hence, mandatory institutional change and induced institutional change exist simultaneously and work together for the stability and change of institutions.

Lin used examples of China's agricultural reform to support his arguments. Lin mainly studied institutional change of land use rights in the early reform era. Lin argued that the government-driven institutions were not effective due to the collective work method could not offer enough incentives to farmers and village leaders (1991). Formal institutions could not offer the residual claim to

encourage farmers and some village leaders to pay attention to the collective work (1991). Compared with Mao's era, the market-driven approach could supply more agricultural products and better encourage farmers and better incentivize farmers and rural leaders in agricultural works (Lin et al., 1996). Therefore, Lin concluded that China's experience has shown that institutions with effective incentive mechanism are more successful and got better economic performance (1989).

In general, Lin's argument makes sense. However, there are some problems with his theory. The first one is that Lin considered the effectiveness of supply method from the perspective of private property rights but did not consider much that some public goods were hard to be provided by the market. Another problem of his theory is that as an economist, Lin just considered economic factors in his model while in reality rural problems involve many other factors. He did not give enough explanations or detailed cases about the mandatory/ induced institutional change.

In contrast to Lin, Susan Whiting focused on social groups and individuals in institutional change in her analysis of institutional change of rural industries (2006, pp.7). By analyzing behaviours of local government officials, villagers, financial organizations and other groups, she argued that individual behaviours and relationships among different social actors have significant influences on institutional change. However, she found that it was hard for different social actors to have effective cooperation (Whiting, 2006, pp.30-35). Ineffective relationships among different actors would be easy to cause disorder status. The disorder status would reduce the economic performance of rural industries (Whiting, 2006, pp.30-35). Whiting identified and explained the particular patterns that emerged in the redistribution of property rights and development of rural institutions (2006, pp. 27-29). Whiting is innovative in her offer of explanations of rural China's institutional change mechanism from the perspective of individual and social groups (2006, pp. 10-13). Whiting's research covered a period from the late 1970s to the early 1990s which was about the early stage of privatization and market-driven reform era.

In a departure from Whiting's work, this research will try to offer more empirical evidence to explain social groups' actions in rural public goods supply. Methodologically, the research will also borrow what she used- interviews and case study- to analyze social groups in institutional change.

Some thoughts of applying institutional change theories

North, Lin and Whiting's studies are all helpful for this research. The research

direction, academic achievements and research methodology mentioned above are all worth learning. North offered the basic knowledge and theoretical framework of institutional change theory. Lin's arguments about mandatory institutional change and induced institutional change offered a useful classification method for analyzing rural China's institutional change. Whiting's findings also inspire me to think about social groups' roles in rural public goods supply. The research of social groups is the supplement to study institutional change in rural China. It will be helpful to present the image of the reestablishment of effective rural water conservancy supply system. The research of social groups' functions in rural conservancy supply will also offer a new perspective to study individual and social groups' behaviours and actions in different institutional arrangements.

2.2 THE OPERATION OF RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

There are different types of rural water conservancy supply institutions in different time periods and regions. Autonomous institutional arrangements (self-organize), market-driven institutional arrangements and government-driven institutional arrangements are three major types of conservancy supply institutions exist in the world. The operation of different conservancy supply institutions has different characteristics. This part will review literature about how different rural water conservancy supply institutions deal with the issues of water configuration and management. It will introduce general features of different rural water conservancy supply institutional arrangements by specific cases.

2.2.1 Autonomous institutional arrangements of rural water conservancy supply

As one of the most significant parts of the agricultural system, rural water conservancy system exists in all planting agriculture areas. Since the central government of a country was hard to supply detailed rural public goods to towns and villages in the ancient time, local squires and farmers organized rural water conservancy supply themselves in most time (Duara, 1983, pp.63-67). In some areas, self-organized rural water conservancy supply institutions are still inherited and applied by local farmers nowadays as in the past. This part will mainly use the conservancy supply case in Valencia, Spain to introduce autonomous institutional arrangements.

In 1435, 84 farmers in Valencia, Spain who relied on rural water conservancy supply system for farming signed an agreement to establish institutions about conservancy supply issues. The agreement made formal institutions about who could use irrigating water from two canals nearby, how to configure water in drought years and normal years, how to distribute responsibilities to maintain factices, how to select leaders/supervisors of conservancy supply organizations and how to punish those resisted the arrangements, and etc. (Ostrom, 1990, pp.159-162). Formal institutions of rural water conservancy supply in Valencia were established on the basis of conventional custom. Before the establishment of formal conservancy supply institutions, farmers in this area had made, revised and applied the custom for over 550 years (Glick, 1970, pp.233).

As Valencia is in a semi-arid area, the natural rainfall is not enough and stable to develop agriculture. Therefore, this region highly relies on rural water conservancy system to offer irrigating water. Effective autonomous institutional arrangements of rural water conservancy supply in this region stops conflicts between farmers and local officials and between farmers in the upper stream and lower stream (Maass & Anderson, 1986, pp.35-36). Local farmers still follow those institutional arrangements to manage conservancy supply issues at present though they have had the Catalan Nissim Dam to store river water and new technology to get groundwater since the 1950s.

In Valencia, the basic rule of conservancy water distribution is that water consumption is proportional to land area. People who do not have their own land next to canals cannot participate in local conservancy supply organizations. In order to keep the normal operation of institutional arrangements, there is a water court operated by local squires and leaders of autonomous conservancy supply organizations to process conservancy conflicts (Ortega-Reig et al, 2014). The water court is also responsible for coordinating interests and conflicts of different conservancy supply organizations (Glick, 1970, pp.64-68).

Farmers always elect leaders and supervisors of autonomous conservancy supply organizations each two or three years in Valencia. Their responsibilities include participating issues of the water court and implementing intuitional arrangements in their organizations. Those leaders and supervisors have authority to process conflicts within the organization, absolute power to control the amount of irrigating water to each farmland and punish those who resisted the arrangement (Glick, 1970, pp.38). Since leaders and supervisors have strong power in conservancy supply issues in the region, they are also

supervised by the water court (García-Mollá et al, 2014).

Besides leaders and supervisors of each autonomous conservancy supply organization, farmers also elected two or more ombudsmen to help and supervise organization leaders in the ancient times. Since the 20th century, conservancy supply organizations have evolved the intuitional arrangement of ombudsman into an executive committee (Ortega-Reig et al, 2014). Committee members work with organization leader to make decisions of conservancy supply issues in that region and issues of the water court (Ostrom, 1990, pp.164-166). In fact, the organization leader/supervisor has been the executor of decisions made by the executive committee of the autonomous conservancy supply organization in recent years.

When the leader/supervisor and the executive committee manage conservancy supply issues, they made decision based on different natural conditions (García-Mollá et al, 2014). When there is sufficient water in canals and rivers, everyone in the organization can use the water without any limitation; when the region meets seasonal low water level, all the farmers have to follow complicated conservancy supply institutions to get irrigating water. Before the organization offers conservancy service, they will make a table to determine farmers' orders to get water. Normally, farmers get water from upstream to downstream one by one with fixed turn. The organization offers irrigating water for several rounds a season to satisfy farmers' needs. All the farmers can get enough amount of irrigating water in each round if they do not waste water. If someone does not open the water gate to his farmland immediately and misses his turn to get water, he has to wait until the next round. The ones who jump the queue or waste water seriously will be fined by the organization leader and ombudsmen (Maass & Anderson, 1986, pp.28-30); when the whole region meets serious drought, autonomous conservancy supply organizations take another series of institutional arrangements. In serious drought, those who grow crops with large water demand can get irrigating water first. The time length of each conservancy supply round will be reduced and numbers of conservancy supply rounds will be increased to allow more people get water (Glick, 1970, pp.60-62).

The more serious the drought is, the greater power the leader/supervisors of those organizations have in managing conservancy supply issues. When meeting serious drought, leaders/supervisors of conservancy supply organizations need to consider features and habits of different crops and each farmer's need with professional knowledge and fair judgment. Although the

development of technology has reduced the possibility of serious droughts in recent years, conservancy supply institutional arrangements in serious droughts have been kept (Glick, 1970, pp.69-71).

Similar autonomous institutional arrangements of rural water conservancy supply also exist in Murcia and Orihuela, Spain and many other places in the world. Local squires and farmers organize conservancy supply issues themselves without government or market's involvement (Ortega-Reig et al, 2014). Water court and autonomous conservancy supply organizations have played major roles to keep the normal operation of conservancy supply institutions (Ostrom, 1990, pp.124-126). Since autonomous rural water conservancy supply institutions have existed in some areas for centuries, detailed arrangements have included local knowledge and considered regulations in different situations. In general, autonomous rural water conservancy supply institutions are stable and can solve conservancy problems with relatively high effectiveness in many areas.

2.2.2 Market-driven institutional arrangements of rural water conservancy supply

In some places with arid climate and semi-arid climate, not every farmer can get enough water for irrigation. Neither the government nor autonomous organization can effectively solve the problem of serious water shortage. Water resource has been the valuable resource for trade. Therefore, some areas establish rural water conservancy supply institutions based on market approach. Market mechanism has been the major power to distribute limited water resource. This part will use conservancy supply in Alicante, Spain, as the major case to explain market-driven institutional arrangements of rural water conservancy supply.

When the Spanish took back Alicante from Muslim, they separated water use right from land ownership. The water right trade market was also independent from the land trade market. In Alicante, farmers who have farmlands next to rivers or canals have water use rights naturally. However, unlike in Valencia, any farmers in Alicante can get irrigating water from the water right trade market even they do not have farmland next to water source (Molina et al, 2006). It means that the market dominates conservancy supply issues in Alicante. Farmers and regional conservancy supply organization have made contractual arrangements about conservancy supply issues (Ostrom, 1990, pp.173-175).

There are 3700 hectares of farmland which belong to 2400 farms in

Alicante. However, over 63% of the farms have land less than 1 hectare and 93% of farms have land less than 5 hectares. In order to save water, farmers normally choose to intercrop fruit trees, crops and vegetables. Therefore, based on different kinds of crops, some farmers need more water than others. Farmers can sell or rent their water use rights to others (Maass & Anderson, 1986, pp.101).

Before the establishment of the Tibi Dam in Alicante, the number of people who held water use right was fixed. Farmers could only trade limited permissions of using irrigating water at market price (Martí, 2005). With financial and policy support from the Spanish King Philip II and local government, Alicante established the Tibi Dam to increase the amount of water supply. Farmers who invested and participated in the construction program of the Tibi Dam got the right to distribute and trade the increased amount of water after the program finished (Maass & Anderson, 1986, pp.119-120).

Before the Alicante regional conservancy supply organization offers irrigating water, it will announce the date to offer water and the date to buy water tickets. Only farmers who have water tickets and register in the regional conservancy supply organization can get irrigating water. In one round of offering irrigating water, there are about 90 hours in total from the regional conservancy supply organization for public sale (Sánchez-Rubio, 2008). The unit of water ticket is from 20 seconds to 1 hour. Through tickets, farmers can buy different amount of irrigating water they needed. There are three major ways to use irrigating water legally (Pérez-Sánchez, 2017). The first one is that farmers can buy water tickets from those who have the right to deal with the increased amount of water from the Tibi Dam. The second one is to buy tickets from the regional conservancy supply organizations (90 hours in total) as mentioned above. The third one is that farmers also can trade the water use right as commodity in local market square (Maass & Anderson, 1986, pp.119-120).

The regional conservancy supply organization uses the money of selling 90 hours conservancy services each round to hire professional supervisors to keep the operation of the regional organization, manage conservancy supply issues and prevent farmers from stealing water (Maass & Anderson, 1986, pp.114-116). When the regional conservancy supply organization opens water gate and offers irrigating water, farmers who have got water tickets can tell the supervisor when they would like to the ticket and the supervisor will allocate the time when water flow through farmers' land and supervise them to control

the time. The organization and supervisors' actions are totally supervised by farmers who have water use right (Ostrom, 1990, pp.125-128).

The price of water tickets is decided by natural conditions and the amount of water that can be sold. When there is sufficient natural rainfall, farmers need less water from canals, rivers and the Tibi Dam. The price of water tickets will be low; when Alicante meets serious drought, there will be no water for sale. Market institutional arrangements of rural water conservancy supply cannot operate; when Alicante has seasonal drought, many farmers will need water for canals, rivers and the Tibi Dam. The price of water tickets will be high (Ostrom, 1990, pp.125-128). The price of water tickets in Alicante totally follows the market mechanism and the change of supply and demand.

Different from Valencia, Alicante had only one major conservancy supply organization. Only farmers who own over 1.8 hectares of land have the right to elect the executive committee of the Alicante regional conservancy supply organization. And if they want to be the member of the executive committee, they should have at least 3.6 hectares of land (Garrido et al, 2006). Everyone meeting the minimum requirement have equal right in electing the executive committee. There are twelve members in the committee and one of them will be elected as the chief. Each member's term is four years (Maass & Anderson, 1986, pp.117).

The executive committee holds an annual meeting each year to discuss financial budget of the conservancy supply organization and try to make more agreements with private corporations to find various water source for local farmers. The committee normally hires an executive secretary for the daily management of conservancy supply organization and several professional supervisors to manage technical issues of conservancy supply and coordinate conflicts between farmers (Torregrosa & Sevilla, 2010). Unlike Valencia, the private authority of the executive committee chief in Alicante does not have significant influence on conservancy supply.

Through anthropological research, Maass and Anderson found that market-driven institutional arrangements of rural water conservancy supply in Alicante are more flexible and effective than autonomous institutional arrangements in Valencia (1986, pp.83-85). On the one hand, autonomous conservancy supply institutional arrangements in Valencia have to consider all the farmers' interests and offer conservancy service to each farmer. The coordination and management limits and reduces the effectiveness of conservancy supply. On the other hand, market-driven institutional

arrangements in Alicante can use market power effectively and encourage farmers to participate in conservancy supply and water right trade actively (Torregrosa & Sevilla, 2010).

Market-driven institutional arrangements of rural water conservancy supply need a large geographical area and enough people to establish the water use right trade market. Water distribution methods of market institutional arrangements are also more strict and clear than autonomous institutional arrangements since farmers follow those methods to trade and transfer water use rights. Once market-driven conservancy supply institutional arrangements are established with effective contractual arrangements and supervision, they can show the feature of stability and high effectiveness.

2.2.3 Government-driven institutional arrangements of rural water conservancy supply

Since the establishment and maintenance of rural water conservancy supply system needs huge labor and capital investment, local squires and farmers in some places are hard to afford the huge investment especially in areas with poor natural and economic conditions. Therefore, in some areas, the government has been the major power to manage rural water conservancy supply issues. This part will use the case of Sri Lanka to introduce government-driven institutional arrangements of rural water conservancy supply.

Sri Lanka is in the tropical monsoon climate zone. The agriculture development in Sri Lanka highly relies on rural water conservancy supply system and the country has a long history of using the system (Meinzen-Dick & Bakker, 2001). The modern rural water conservancy supply system in Sri Lanka was established by the British colonial government in the 19th century. After Sri Lanka's independence, the national government continued to invest conservancy supply programs with the support of foreign aid (Ostrom, 1990, pp.236-240).

Since the 1950s, rice production in Sri Lanka has had significant growth. Bringing in high-yielding rice varieties were one reason. More importantly, more farmland in Sri Lanka could get conservancy supply services (Madduma Bandara, 1984, pp.298-301). However, government officials and professionals in charge of conservancy supply programs still were dissatisfied with the effectiveness of those conservancy programs. Few conservancy supply programs with official investment and support have reached the design capacity and served for enough farmland.

Although there is no official judgment and evaluation for conservancy supply programs in Sri Lanka, Harriss found that one significant conservancy supply program – the Gal Oya conservancy program – had much higher discounted cost than discounted profit (1984, p.318). The actual irrigation area of another conservancy program in Udawalawe was only one third as planned. Most farmland in this area still could not get enough water (Uphoff & Wijayaratna, 2000).

The reason of the low effectiveness is there is a huge gap of irrigating water between the demand planned by government and farmers' needs. On the one hand, compared with other crops, most types of rice are highly sensitive to water shortage and relatively insensitive to water excess (Levine, 1980, p.50-54). Farmers can reduce farmland management work if they can keep sufficient water in their farmland. Therefore, farmers in Sri Lanka took legal and illegal ways to get irrigating water without limitation. They would never think about saving water (Uphoff & Wijayaratna, 2000). On the other hand, government is the major power to supply conservancy service in Sri Lanka. The government itself took the heavy financial burden to establish and maintain conservancy programs without collecting money from farmers (Meinzen-Dick & Bakker, 2001). At the same time, Sri Lanka's government did not have detailed regulations of water distribution. It allowed farmers in different villages to decide water distribution based on the self-discipline principle. However, most farmers chose to use much more water than their real needs to reduce their works. The waste of water caused the gap of the reality and engineers' optimal water use model (Lundqvist, 1986, p.56-60).

Since the government could not make detailed conservancy construction plans for each village, government officials, conservancy professionals and engineers could only rely on general information of the whole region and mathematical models to estimate the possible water demand and control the general supplement of water to avoid waste (Hussain & Hanjra, 2004). The extensive control of conservancy supply and the self-discipline water distribution principle without considering farmers' nature of self-interest led to the low effectiveness of conservancy supply. Farmers who got irrigating water illegally would not get punishment from the government (Uphoff & Wijayaratna, 2000). Farmers chose to take short-term, individualistic behaviors to break the normal operation of the conservancy supply system (Ascher & Healy, 1990, p.65-69).

Although government-driven conservancy supply institutional

arrangements in Sri Lanka lacked incentive mechanism and effective supervision to keep the general effectiveness of conservancy supply programs, they were hard to be changed. Farmers were too weak to break institutional arrangements operated by the government. Even central government officials were also limited by institutions since those arrangements were hard to be changed by individuals. Many current conservancy supply institutions follow British colonists' arrangements which had lasted for over 100 years (Meinzen-Dick & Bakker, 2001). The British made standardized arrangements (fixed the water supply time and amount) to operate conservancy supply system. Those institutional arrangements were helpful to keep British colonial authority in Sri Lanka, reduce the workload of colonial officials and avoided possible problems 100 years ago (Harriss, 1977, p.35-368). Meanwhile, they also caused the fossilized management system of conservancy supply in modern Sri Lanka.

In the decade after independence in 1948, the Sri Lankan central government completely inherited conservancy supply approaches of British colonists. Major pools and relevant drains were managed by water department. One official and two staff members from the water department controlled the time and amount of water supply. They were also responsible for reporting any damage of conservancy supply facilities. The water department paid fixed salary to its officials and staff (Leach, 1980, p.108). Besides, village leaders (the Vel vidane) appointed by the government also had great authority and power in conservancy supply issues. They played roles as supervisors to supervise farmers' agricultural production activities and whether they wasted water or not. They got their salaries from the tax department and the salaries were paid by agricultural tax. In principle, they could punish anyone who wasted water (Uphoff & Wijayaratna, 2000). However, in reality, some village leaders leaned toward landlords and tolerated their behaviors of wasting water since landlords normally paid more agricultural tax than ordinary farmers (Harriss, 1977, p.367-370).

Since village leaders' salaries were not fixed but came from crop harvest partly, they preferred to make full use of the conservancy supply system to increase agricultural productivity. Meanwhile, officials and staff who got fixed salaries from the water department preferred to make appropriate use of the conservancy supply system and maintain the system regularly (Harriss, 1977, p.367-370). The conflict of interests in different departments and among officials caused the low effectiveness of conservancy supply.

From 1958, Sri Lanka government took an institutional reform and transferred conservancy supply responsibilities from tax and water departments to the agricultural department (Roberts, 1980, pp.198-201). The strategy of the agricultural department to manage conservancy supply issues was that it gave up the supervision of large-scale conservancy supply programs and paid more attention to small-scale conservancy supply programs. New institutional arrangements increased the effectiveness of each small-scale conservancy supply programs but reduced the cooperation and coordination of different conservancy supply programs especially for big conservancy supply programs (Molle & Renwick, 2005).

Executive secretaries appointed by agricultural department replaced village leaders to supervise conservancy supply issues at the local level (Uphoff & Wijayaratna, 2000). Meanwhile, compared with village leaders, executive secretaries lacked the authority and power to punish those who resisted water configuration (waste water or illegally broke drains et al.) and did not have the right to report damage of conservancy facilities (Molle & Renwick, 2005). Since executive secretaries got fixed salaries, they also did not have motivation to keep the effectiveness of conservancy supply or involve in conservancy supply conflicts between farmers.

For many farmers, it was rational to break drains and guide water to their farmland. When farmers had conflicts about conservancy issues, few of them chose to get help and judgment from executive secretaries. Most of them chose to solve problems themselves by violence (Harriss, 1977, p.373-376). Many landlords kept in touch with local politicians and even national leaders for political protection to get as many as irrigating water. And politicians got economic interest and political support from landlords through interfering in conservancy supply issues (Uphoff & Wijayaratna, 2000). Conservancy professionals (especially water engineer) seldom put in time and efforts to maintain conservancy supply facilities. Their working performance was based on the achievement of constructing conservancy supply programs rather than maintaining conservancy supply facilities. Staff recruitment of water department was mainly based on academic qualifications and exam scores and the promotion was entirely based on qualifications and length of service. Moreover, many conservancy professionals were overworked and underpaid (Meinzen-Dick & Bakker, 2001). Not many conservancy professionals were passionate about their works. All above reasons accelerated the collapse of government-driven conservancy supply institutions in Sri Lanka.

From the mid-1970s, Sri Lanka Ministry of Agriculture and local agricultural departments actually lost control of conservancy supply issues. Compared with 1960, the irrigated-area in Sri Lanka in 1980 reduced about 50% (Leach, 1980, p.113-115). Not until the mid-1980s, Sri Lanka government brought in autonomous organizations of conservancy supply to replace government involvement, the situation was better (Molle & Renwick, 2005).

Problems of government-driven conservancy supply institutions do not just exist in Sri Lanka but in some other developing countries. Most conservancy supply programs in developing countries driven by government just considered the general construction but lacked effective management (Ostrom, 1990, pp.250-260). Government-driven conservancy supply institutions in those countries could not be effectively implemented. Although some programs could increase the effectiveness of conservancy supply on some extent, the effective duration and range of institutional arrangements was still limited (Lundqvist, 1986, 61-71).

2.3 RURAL WATER CONSERVANCY SUPPLY IN AGRICULTURAL-BASED DEVELOPING COUNTRIES AND SOCIALIST COUNTRIES

This part will review rural water conservancy supply in some agricultural-based developing countries and socialist/former socialist countries. Compared with developed countries, many developing countries rely more on agriculture for economic development but normally lack technology, capital and effective institutions to offer conservancy services. Socialist/former socialist countries meet institutional problems for conservancy supply since most of them applied government-driven conservancy supply institutions. This part tries to find out general features and problems of conservancy supply in developing countries and socialist countries. It will also briefly introduce China’s rural water conservancy supply achievements in the collective era.

2.3.1 Rural water conservancy supply in agricultural-based developing countries

Many developing countries have been in the process of industrialization and modernization. They still rely on traditional agriculture for economic development. Conservancy supply is one of the most significant approaches which farmers can use to keep agricultural productivity. However, poor economic situation, outdated technology, fragmented land ownership and

inefficient management bring many problems to the conservancy supply in developing countries and lower its effectiveness.

Rural water conservancy supply system is extremely important for a developing countries' sustainable development and even significantly affects their economic and political situations. The best case to support the argument is Afghanistan. Until the 1970s, major crops in Afghanistan were wheat, pomegranate, cotton and grapes. Although Afghanistan was not rich then, local squires and farmers could afford and manage conservancy supply system effectively to grow those crops. However, the war between the USSR and Afghanistan destroyed one third of the farmland and two thirds of the villages in Afghanistan. Over one third of rural water conservancy supply system had been destroyed in the war (Goodson, 2005). After the war, Afghanistan has been caught in a warlord's melee for many years.

Neither the government nor farmers had abilities to reestablish the rural water conservancy supply system. Without the conservancy supply system, the traditional agriculture could not be sustained in Afghanistan. In order to keep daily life, Afghan farmers have opted for poppy as their main crop. Compared with wheat, poppy has a much shorter growth cycle and almost needs no artificial irrigation but can bring high economic profit (Goodson, 2005). In arid areas without conservancy supply system, growing poppy became the only choice for Afghan farmers. In 1991, Afghanistan became the world's largest producer of opiate drugs. In 1994, 3416 tons of opium were produced in Afghanistan, accounting for 52% of global production with more than 1 million people in Afghanistan directly engaged in opium cultivation (De Beurs & Henebry, 2008). Lacking effective conservancy supply system not only changed Afghanistan's crop planting structure and farmers' traditional lifestyle but also brought huge political and social challenges to the country and the international society.

As many developing countries do not have sound market economic institutions and effective public goods supply system, their rural water conservancy services meet big problems in many areas. Banerjee and Duflo found that in developing countries in South Asia and Southeast Asia such as India, Laos and Cambodia, over 80% of the poor families cannot get water conservancy supply support. Ownerships of water conservancy infrastructures are always shared by government and collective organizations (Banerjee & Duflo, 2011, pp.137-139). However, the government and social groups do not have clear division of rights and responsibilities in supplying conservancy

services. It means that any investment in rural water conservancy supply programs may not get return (2011, p.139-145). Therefore, nobody is incentivized to invest in water conservancy supply facilities and infrastructures in rural areas. Property rights problems clearly reduce the possibilities for conservancy supply programs to get investment and therefore affect the effectiveness of rural water conservancy system.

Therefore, in countries with a poor economic development condition or a weak government authority, conservancy supply still follows the traditional approach that conservancy services are mainly supplied by self-organized cooperatives. Normally, local squires are responsible for managing conservancy supply issues and farmers follow arrangements and supply labors and materials for accurate conservancy construction and maintenance.

The case of the Philippines can offer information about self-organized conservancy supply cooperatives in developing countries. The Philippines is one of the major agricultural countries in Southeast Asia (Fujiie et al, 2005). Not until 1390, the Philippine Archipelago appeared the first country. However, the geographical structure of archipelago and backward productivity made its government unable to offer conservancy supply for different islands' agricultural development (Araral, 2009). Before the US colonial government established the first official support conservancy supply program in 1923, self-organized conservancy supply method was the only conservancy supply method in the Philippines (Araral, 2005). Until 1982, there were about 5700 self-organized conservancy supply systems operated by squires and farmers all over the country, which covered 45% of the whole irrigated area in Philippines (Siy, 1982, pp.8-14).

Farmers established self-organized cooperatives for conservancy supply. Through farmers' interactions, coordination and compromise, those cooperatives made conservancy supply rules, elected organization leaders, maintained drains and other facilities and protected institutions themselves (Araral, 2009). All the self-organized conservancy supply organizations applied and revised institutional arrangements based on their unique natural conditions and historical experience (Keesing, 1962, p.34-40). Hence, conservancy supply institutions in different cooperatives varied from each other. Even until 1979, there were over 686 different types of conservancy supply institutions in the Ilocs Norte island of the Philippines (Siy, 1982, p.23-27).

Structures and institutional arrangements of self-organized conservancy supply organizations are similar. Conservancy supply cooperatives are mainly

established by farmers and local squires who need water for growing crops especially rice (Araral, 2009). As developing countries like the Philippines do not have enough capital and advanced technology, conservancy supply is based on simple and traditional approaches which have been lasted for centuries. Conservancy supply in those countries is labor-intensive (Siy, 1982, pp.84-87).

The biggest advantage of self-organized conservancy supply cooperatives is that local squires and farmers have accumulated rich experience about local natural conditions and water demand, engineering and techniques to establish and maintain conservancy supply system and how to coordinate different members' interests (Groenfeldt & Svendsen, 2000, pp.15-21). Local knowledge helps farmers to offset certain technical deficiencies and keep the normal operation of small-scale local conservancy supply system (Siy, 1982, p.46-52).

All the farmers who participate in local self-organized conservancy supply cooperatives naturally have the right to get water for irrigation. The water amount that farmers can get is proportional to the area of land they own. Out of the concern for equality, each farmer is allocated both farmland with good irrigation and poor irrigation. The institutional arrangements can reduce farmers' possible loss in serious droughts (Groenfeldt & Svendsen, 2000, pp.23-25). Normally, conservancy supply cooperatives will use the harvest of the farmland which located at the end of the conservancy supply system as the payment of cooperative leaders' works. It is believed that this arrangement can make cooperative leaders have stronger motivation to supply enough water and maintain drains well (Coward, 1979).

Farmers who join local self-organized conservancy supply cooperatives also have the right to elect the cooperative leader and relevant staff. Having a strong cooperative leader is the necessary prerequisite for the effective operation of the conservancy supply organization in developing countries (Araral, 2005). Those cooperative leaders should get the support from the majority of farmers since they need to mobilize and encourage farmers to participate in dangerous and heavy works of establishing and maintaining conservancy supply system (Araral, 2009). Otherwise, they will encounter difficulty in carrying out their works. Even with the majority of farmers' support, leaders still cannot use their personal prestige to ask farmers to take hard labor works for the conservancy supply (Scott, 2008, p.32-40). All the self-organized conservancy supply cooperatives have detailed institutional arrangements to give power to cooperative leaders to reward or punish farmers for conservancy construction or maintenance.

In addition to their legal rights as self-organized conservancy supply cooperative members, farmers also have to take relevant responsibilities to offer free labors and materials for local conservancy construction and maintenance. The statistical data in the Philippines showed that farmers have to do 65 days of volunteer works on average for conservancy cooperatives (Siy, 1982, pp.90-92). Major materials for farmers to establish and maintain rural water conservancy supply programs in developing countries are bamboo, wood, sand, soil and stones (Shively & Martinez, 2001). They all need to be prepared by farmers themselves. When cooperatives organize construction or maintenance, all the cooperative members are divided into different small teams and each team is responsible for a part of the constructing or maintaining work (Kikuchi et al, 2003). The arrangement is not only to prevent farmers from being lazy and make them supervise with each other but also to encourage the competition among different teams to increase the working effectiveness (Siy, 1982, pp.93-95). Similar effective institutional arrangements also can be found in the Chattis Mauja conservancy supply program in Nepal (Ostrom, 1990, pp.184-189). In general, asking farmers to bring materials and take volunteer labors in conservancy supply is effective in developing countries. Self-organized conservancy supply cooperatives could normally organize hundreds to thousands farmers to offer thousands of hours of voluntary labors to establish and maintain local conservancy supply programs without cash payment.

However, farmers still use different ways to resist institutional arrangements and be lazy in conservancy construction and maintenance. It is not because farmers do not understand the importance of establishing and maintaining conservancy supply system, there are some deep reasons (Scott, 2008, pp.102-106). On the one hand, class antagonism makes farmers resist squires' arrangements even they are effective at the technological and institutional level. On the other hand, farmers would like to be free riders in conservancy construction and maintenance and put more time and energy to grow crops on their own land. Self-interest stops farmers' active participation in conservancy supply construction and maintenance (Scott, 2008, pp.129-135).

The most obvious shortage of rural water conservancy supply in developing countries includes low technical level and weak organizational mobilization ability to deal with conservancy supply issues (Kikuchi et al, 2003). Although local self-organized conservancy supply cooperatives in most

countries could establish and maintain small-sized and medium-sized conservancy supply programs, they have neither enough capital and advanced technology to establish modern conservancy facilities with high technical requirements nor effective organizational mobilization ability to mobilize tens or even hundreds of thousands people to establish large-scale conservancy supply infrastructures (Kikuchi et al, 2003). Institutional arrangements in local conservancy supply cooperatives are also hard to be applied in other areas since those arrangements closely connect with local knowledge that is not suitable for other areas (Hussain & Hanjra, 2004). In general, traditional self-organized conservancy supply cooperatives in developing countries can offer basic conservancy supply services for agricultural development but hard to promote the modernization of conservancy construction and maintenance.

2.3.2 Rural water conservancy supply in socialist countries

In developing countries, socialist/former socialist countries have a better social organizational structure and a stronger ability to organize and mobilize tens or thousands of people to participate in conservancy supply programs. They can also use the national power to bring in capital and new technology to deal with the conservancy supply issues. Influenced by ideology and mode of production, all the socialist countries apply government-driven rural water conservancy supply institutions (Saiko & Zonn, 2000). Those institutions on the one hand can support the establishment and maintenance of large-scale modern conservancy supply programs. On the other hand, government-driven rural water conservancy supply institutions also caused many problems and negatively affected the effectiveness of conservancy supply (Minashina, 2009).

The former Soviet Union was the biggest socialist country in the world. Other socialist countries all learnt economic and social development experience from the USSR. Government-driven rural water conservancy supply institutions in the USSR also have been applied by socialist countries such as China (Zhang, 1957). Therefore, studying rural water conservancy supply institutions in the USSR is helpful to understand conservancy supply issues in socialist countries.

According to Yoneishavski, the academician of the USSR Academy of Sciences, before the socialist revolution, there were only a few rural conservancy systems existing in the Russian Empire (including the Central Asia) (Zhang, 1957). There were only 4 million acres of farmland (including 3 million acres in the Central Asia) could get conservancy services before the October revolution. Only one government official and two technical staff

members were in charge of conservancy supply issues of the 4 million acres of farmland in the whole Russian Empire. They mainly relied on the help from local squires who managed local conservancy administrative issues based on their experience and habits without professional knowledge (Pankova, 2008). The arrangement caused low effectiveness of conservancy supply in the whole country. Most of the old conservancy supply systems were simple and traditional. Many of them were even established in the middle ages. Irrigation drains were long and too curved. Most of drains silt sediment and there were too many tiny drains which caused unnecessary water waste (Zhang, 1957).

The October revolution and the establishment of the USSR changed the situation. The new regime and leaders believed that the traditional conservancy supply institutions were ineffective and represented the backward productivity which must be abolished (Pankova, 2008). The Soviets also believed that market-driven rural water conservancy supply institutions in capitalist countries could only solve part of the problems in conservancy supply management (Grigoryev, 1952). They believed that private land ownership and market-driven institutions would release the self-interested nature of human beings in rural water conservancy supply and made the cooperation and coordination impossible in establishing and maintaining modern conservancy supply programs (Lewis, 1962). Only the government-driven rural water conservancy supply institutions can coordinate interests from different people and make the comprehensive and appropriate use of water and land resources.

After the October revolution, the USSR took the land reform and the conservancy supply reform. It established the government-driven rural water conservancy supply system. All the new conservancy supply institutions based on the principle of the planned economy. In 1927, the USSR fixed original broken drains and achieved planned conservancy supply. The planned conservancy supply services existed in coordinating different collective farms' water use at first and expanded to water use within collective farm (Grigoryev, 1952). Planned conservancy supply not only increased the effectiveness of rural water conservancy supply by reducing water waste and leakage but also avoided unnecessary conflicts between individual farmers.

Conservancy supply plans in the USSR were adjusted according to the development of collective agriculture and production increasing requirements. Conservancy supply plans were made by administrative officials and carried out by professional engineers. As rural water conservancy supply in the Soviet Union was organized and managed by both government officials and

professionals, conservancy supply institutions covered aspects from management to techniques (Micklin, 1978). Government-driven rural water conservancy supply institutions in the USSR generally include water management regulations, facility maintenance arrangements, water diversion institutions, water distribution institutions and water use institutions (Minashina, 2009). Since the USSR was a big country with various natural conditions, conservancy supply plans in different regions also varied.

Rural water conservancy supply in the USSR had three obvious features. Plans, modern machines and the Stakhanov movement worked together to keep the effectiveness of conservancy supply (Markus, 1936). The establishment and development of rural water conservancy supply programs in the USSR was normally based on national Five-Year Plans. In the Stalin era, the USSR had significantly increased the investment in conservancy supply (Zhang, 1957). Developmental plans coordinated rural water conservancy supply with agricultural development and industrial development; compared with other socialist countries, the USSR enjoyed high mechanization, which was one of the most obvious features and the biggest advantage of conservancy supply (Pankova, 2008). Before the establishment of the Soviet Union, Russian and central Asian farmers took about 100 days per year to deal with rural water conservancy supply issues without any machine. The collective land ownership made the mechanized irrigation in collective farms possible. In 1952, 95% of the conservancy supply work could be done by machines. Conservancy supply works were no longer major jobs for Soviet farmers (Grigoryev, 1952). The Stakhanov movement, which allowed workers and farmers to compete with each other and allowed them to make technological innovations to increase working efficiency, was also helpful for conservancy supply (Bedeian & Phillips, 1990). The movement encouraged farmers, professionals and local government officials to participate in conservancy supply issues actively and look for ways to promote supply effectiveness.

The USSR had made great achievements in rural water conservancy supply issues. During the first Five-Year plan period (1928-1932), the USSR fixed all the broken drains and tried to establish modern conservancy supply systems all around the country (Pankova, 2008). During the second Five-Year plan period (1933-1937), the USSR established planned conservancy supply institutions and a series of large-scale conservancy supply programs in the Eastern Europe and the Central Asia (Zhang, 1957). During the Second World War, the USSR mainly focused on increasing the effectiveness of conservancy

supply facilities and adjusted water management agencies to optimize conservancy supply management system. In the 1950s, the USSR basically achieved mechanization of conservancy supply (Micklin, 1978).

From 1918 to 1956, the USSR government had invested a total of 25 billion rubles in rural water conservancy supply (Minashina, 2009). In the first two Five-Year Plans, the increased area of irrigated farmland established with national capital was 45 times of that in the Russian Empire era (Pankova, 2008). Just in 1940, the increased area of irrigated farmland was 250,000 hectares. Until 1955, the total length of irrigation drains in the USSR was over 400,000 kilometers and there were over 100,000 large and medium-sized conservancy buildings such as reservoirs, pump stations and sluices all around the country (Lewis, 1962). In 1955, the USSR completed the modernization of conservancy supply systems in most collective farms covering about 3,042,000 hectares of lands. The government planning and involvement of conservancy supply issues helped the USSR to reduce the number of conservancy supply programs from 280,000 to 5,8000 while the irrigated area of each conservancy supply program increased 27.9 hectares of land on average (Abdullaev et al., 2010). Since the modernization and update of conservancy supply system adjusted micro land use structure, 2% of the land was saved as farmland again (Zhang, 1957).

The USSR established modern rural water conservancy supply systems in the Central Asia and Caucasus and significantly promoted local economic and social development (Saiko & Zonn, 2000). People in the Soviet Union no longer relied on natural conditions for agricultural production. The Soviet mode released the potential of land use in arid and semi-arid areas (O'Hara, 1997). However, government-driven rural water conservancy supply institutions in the USSR also caused serious problems and negatively affected long-term sustainable development.

Since the 1970s especially after the 1980s, the advantages of Soviet government-driven rural water conservancy supply institutions were no longer obvious (Minashina, 2009). Compared with the 1970s, in the 1980s, irrigated area per capita in Soviet Central Asia reduced from 0.27 km^2 to 0.26 km^2. And the number reduced to 0.19 km^2 in the 2000s. Irrigation water amount per capita reduced from 4730 m^3 in the 1970s to 4500 m^3 in the 1980s and 2530 m^3 in the 2000s (Siebert et al, 2010). Large-scale irrigation agriculture in Central Asia destroyed the original ecological structure and changed the composition of soil. Modern conservancy supply system, advanced machines and new

technology all could not change the situation (Pankova, 2008). Cotton farming organized by the Soviet government in the Central Asia consumed a lot of water. It not only caused soil salinization but also dried up the Aral sea directly (O'Hara, 1997).

Besides above problems, the biggest challenge of government-driven rural water conservancy supply institutions was the collapse of the USSR (Pankova, 2008). In the USSR era, even in the era of Gorbachev, when the country met serious economic deterioration, the Soviet central government still spent much money keeping the normal operation of rural water conservancy supply in different regions (Micklin, 1988). Moscow offered financial subsidy to remote areas in the Central Asia desert and Caucasus mountains (Micklin, 1987). Since the USSR collapsed in 1991, the Soviet political system and conservancy management departments also collapsed at the same time (O'Hara, 1997). In the 1990s, basic infrastructures and facilities of rural conservancy supply were seriously broken. Without a powerful centralized government, newly independent Central Asian countries and Caucasus countries had neither capital nor resources to operate or reestablish the effective rural water conservancy supply system (Powell, 2012). Worse, planning and establishing conservancy supply system, the USSR government just considered maximizing supply effectiveness rather than geographic location. When the USSR collapsed, new national borders cut many conservancy supply programs into different pieces (Minashina, 2009). As it was difficult for countries to reach agreements on the conservancy supply issues due to conflicts of interests, many cross-border conservancy programs were abandoned (Saiko & Zonn, 2000).

The Soviet mode had been widely spread to and applied by all the socialist countries (Pankova, 2008). The effectiveness and problems of government-driven rural water conservancy supply institutions in other socialist countries were similar to the USSR's or even worse since the USSR had much better economic situations and technological conditions than other socialist countries (Theesfeld, 2004).

In general, Soviet government-driven institutions were helpful to establish modern rural water conservancy supply system and increase the effectiveness of conservancy supply within a short period (Minashina, 2009). Meanwhile, normal operation of those institutional arrangements needed a huge amount of construction investment and maintenance costs (Pankova, 2008). Macro conservancy planning made by the government was also easy to ignore environmental issues and sustainable development. Many socialist regions met

man-made ecological disasters (Saiko & Zonn, 2000). Government-driven rural water conservancy supply institutions could not keep working effectively in a long time dimension.

2.3.3 China's achievements of rural water conservancy supply in the collective era

As the biggest developing country and socialist country in the world, China shares similarities with other developing countries and socialist countries in rural water conservancy supply. However, rural water conservancy supply in China also has some unique features. In general, China has made great achievements for rural water conservancy supply in the collective era while there were still some problems.

Before 1956, local squires (mainly before 1949) and local civic leaders (mainly from 1949 to 1956) were major powers to manage and lead the traditional rural public goods supply such as rural roads, water conservancy and rural schools (Duara, 1983, pp.63-67; Tsai, 2002).[5] The legitimacy of squire governance came from the traditional Confucian thought and squires/ local civic leaders' personal prestige and influence[6] (Duara, 1983, pp.65-67). Although this public good supply method no longer exists, local leaders' strong influences on public goods supply still play significant roles in modern society (Duara, 1991, pp.23-26).

Since the mid-1950s, China had achieved the socialist transformation of the economy. The centralized government supply approach became the major public goods supply method in rural China (Ministry of Finance, 1994, pp.36-38). During this period (from the middle 1950s to the late 1970s), the government dominated in rural water conservancy supply, rural roads supply, rural schools supply and other public goods supply (Yuan, 2008). Government supplying of public goods was seen as one of the Chinese Communist Party (CCP)'s successful social experiments in rural China (Wu, 2007).

In the collective era, all of the rural public goods were treated as Samuelsonian pure public goods (1954). Without enough public expenditure to supply material resources, government mobilized a large amount of human labour for public constructions (Yang, 1996, pp.99-103). Although government-driven supply methods did achieve in establishing a modern rural public goods supply system, the central planning system wasted labour and resources in infrastructure constructing and maintaining programs. The general

[5] China has finished its socialist transformations (three major transformations) in 1956.
[6] Squires got the respects from villagers and served for the villagers in public issues.

economic effectiveness of the centralized public goods supply was not as high as government propaganda claimed (Jin & Qian, 1998).

In such a circumstance, the PRC central government and Politburo of the CPC Central Committee paid highly attention on rural water conservancy supply issues and regarded conservancy construction as one of the cores of agricultural development in the collective era. Establishing modern conservancy supply system and reducing negative influences from floods and droughts' were written into the Common Program of the Chinese People's Political Consultative Conference (Pan, 2002). In November 1949, two months after the establishment of the PRC, the Ministry of Water Resources held a national conference to discuss the main task and construction plans of conservancy issues in the new era. The national conference decided that the basic principle of conservancy construction and management was to stop negative impacts of floods and droughts and to establish modern conservancy supply system to support agricultural development (Wu, 2007). The recovery and establishment of conservancy supply programs should follow plans and consider the urgency and local economic situation (Sun, 2000, pp.1614-1617).

Under the leadership of the Communist Party and the central government, China started the largest rural water conservancy construction ever. In the first 3 years of the PRC, despite difficult financial and economic conditions, the central government still invested 700 million Yuan RMB in rural water conservancy construction (Pan, 2002). The investment was over 10% of the total national investment in basic infrastructures (Fan, 1988, p.43-46). Within 3 years, the State Council and the Ministry of Water Resources organized maintenance for 42000 kilometers embankments of major rivers and started to establish conservancy construction programs to change floods raging situations in the Yangtze River Basin, the Yellow River Basin and the Huaihe River Basin etc. (Fan, 1988, pp.52-56). For example, Zhou Enlai, the then prime minister, was in charge of the conservancy construction program in the Huaihe River Basin himself. The whole program established 13 reservoirs, 17 water control facilities (like water gates and pump stations) and finished many other construction and maintenance works. The establishment of the Huaihe River Basin conservancy construction program helped 60 million people and 220000 square kilometers of farmland to avoid the risk of serious floods (Wu, 2007). Besides, 60-million-Mu farmland in the Huaihe River Basin could get water for irrigation from the conservancy supply program. From 1949 to 1952, the CCP, the central government and local governments organized a total of 20 million

people to participate in conservancy supply recovery and construction works. Earthenware of those programs was over 1.7 billion cubic meters, which equaled to digging 10 Panama Canals or 23 Suez Canals (Dong, 1996, pp.272-275). The construction and maintenance of rural water conservancy supply programs from 1949 to 1952 reduced the threat of serious drought in many areas of China. In 1949, over 100 million Mu farmland suffered from floods. From 1950 to 1951, farmland suffering from floods declined from 60-million Mu to 21-million Mu. In 1952, only 16-million-Mu farmland still suffered from floods (Sun, 2000, pp.1531-1535).

From 1953 to 1957, China started its first Five-Year Plan and kept investing much money and labors for rural water conservancy supply programs. In the first Five-Year Plan era, the central government totally invested 2.67 billion Yuan RMB on conservancy construction and maintenance (Sun, 2000, pp.1620-1621). Many large-scale conservancy supply programs were also under consideration or construction by the central government in the first Five-Year Plan era. The major conservancy program to promote conservancy situation in the Yellow River Basin- the Sanmenxia Water Conservancy Program was started to be built in 1957 (Pan, 2002). Miyun Reservoir, the major conservancy construction program to deal with conservancy issues in the Haihe Basin, also had been put into conservancy construction plan in 1957 (Sun, 2000, pp.1622-1625). Besides major conservancy construction programs, small-scale rural water conservancy supply programs organized and established by local governments and farmers had significant development. Until 1956, the whole China had expanded 87.64-million Mu irrigated areas and controlled soil erosion area of more than 110-million Mu (Chinese Academy of Social Sciences, pp.672-675). Conservancy construction achievements of the first Five-Year Plan era significantly promoted the effectiveness of agricultural production.

From 1958-1962, China had implemented its second Five-Year Plan. During 5 years, China both made great achievements in conservancy supply and met serious problems (Pan, 2002). Many large-scale conservancy construction programs, which had been planned, entered the construction phase in the second Five-Year Plan period. The most obvious case was that the Miyun Reservoir was under construction from 1958 to 1960. In 1958, Zhou Enlai himself viewed the predetermined location of Miyun Reservoir and made the final decision to constructing the reservoir. Since July 1958, 206,000 farmers from 28 different counties, over 10,000 soldiers and thousands conservancy

engineers and technical staff had participated in the construction work of the Miyun Reservoir (Wu, 2007). Even Mao Zedong, Liu Shaoqi, Zhu De and other central leaders went to the Miyun Reservoir construction site to work with ordinary workers (See Figure 2.1). Their actions set examples for local officials and farmers (Sun, 2000, pp.1637-1641). It was a spiritual encouragement to show top CCP leaders' support for conservancy construction and maintenance programs.

Figure 2.1 Mao Zedong joined collective works of water conservancy program in Beijing[7]

The whole construction work of the Miyun Reservoir finished in September, 1960. Even nowadays, more than 11 million people benefited directly from the reservoir in Beijing and Hebei Province (Hong & Xing, 2010).

From 1958 to 1966, the central government invested over 13.79 billion Yuan RMB in the construction of rural water conservancy supply system (Liu & Wu, 1984, pp.153-157). However, unrealistic plans and inappropriate constructions wasted resources and caused failures of conservancy construction programs. Since the central government encouraged local governments to establish conservancy programs, local officials saw conservancy construction achievements as their political achievements to get career promotions (Pan, 2002). The situation in Chang'an district (used to be Chang'an county), Shaanxi Province, was a good example. In 1958, the Chang'an County government aimed to increase 2,232 motor-pumped wells, 880 artesian wells, 5,000 deep

[7] Available at: Xinhua.net http://news.xinhuanet.com/book/2004-04/15/content_1420673.htm, recruited in the 31th, May, 2015.

wells, 200 drains and 900 reservoirs and relevant facilities and projects within the year[8]. The Chang'an County hoped to rely on motor-pumped wells in the plain area and rely on reservoirs in the mountain area to achieve bumper harvests, even if there were serious natural disasters such as drought over 100 days or flood over 300cm[9]. However, the county even could not achieve the aim in the 1980s. Similar situations were common to see from the late 1950s to the late 1970s all around the country.

Although China established large-scale conservancy programs such as the Hongqi Canal in the 1960s, left-leaning thinking and the Cultural Revolution broke the normal construction and maintenance of conservancy programs in the 1960s and 1970s. From 1966 to 1976, farmers became the major power to organize, manage, construct and maintain different conservancy programs. Official water departments had been cancelled in the Cultural Revolution which seriously broke the conservancy supply management system in the collective era (Wu, 2007).

In general, from 1949 to the late 1970s, China made great achievements in conservancy constructions and generally established modern rural water conservancy supply system. The construction and maintenance of conservancy supply programs offered the basic protection for agricultural development (Tang & Li, 2005). Before the establishment of the PRC, there were only 6 large reservoirs, 13 medium reservoirs and 1200 small-scale rural water conservancy supply programs all around the country. The total water storage capacity was 20 billion cubic meters. From 1949 to 1976, the whole country established 302 large reservoirs, 2110 medium reservoirs and about 83,000 small-scale rural water conservancy supply programs. The total storage capacity increased to 420 billion cubic meters (Sun, 2000, pp.1668-1672). The relatively comprehensive modern rural water conservancy supply system established in the collective era became the basis of agricultural modernization and significantly increased agricultural productivity (Wu, 2007). However, problems of conservancy supply issues in the collective era also could not be ignored. Government-driven rural water conservancy supply institutions in China significantly affect the sustainable development of conservancy supply institutional arrangements in the reform era and the new socialist countryside era (Pan, 2002). Government-driven rural water conservancy supply institutions in the collective era caused resource waste, program failures and serious environmental problems.

[8] Source from China Agricultural News, 1958, vol. 22.
[9] Ibid.

2.4 SUMMARY OF LITERATURE AND DISCUSSION

This chapter reviews literature of classic theories of institutionalism, offers cases of different operational modes of rural water conservancy supply institutions and gives rural water conservancy supply cases in developing countries and socialist countries.

There are three major types of rural water conservancy supply institutions. The government, market and self-organized cooperatives all can offer conservancy supply services in rural areas. Classic theories of government-driven public goods supply, market-driven public goods supply and polycentric public goods supply offer analytical framework to explain different conservancy supply institutions in the real world. Different rural water conservancy supply institutions with different property rights configurations have different features, advantages and disadvantages. They can bring different influences on the effectiveness of rural water conservancy supply.

Agricultural-based developing countries and socialist countries meet more problems of rural water conservancy supply than other countries. On the one hand, they lack capital, technology and appropriate organizational structure to supply effective conservancy services; on the other hand, conservancy supply institutional arrangements in those countries cannot offer effective long-term incentives to keep the effectiveness of conservancy supply (Kikuchi et al, 2003). Besides, current literature of rural water conservancy supply in developing countries and socialist countries seldom combines classic theories of institutionalism and empirical cases. There is few empirical literature discussing rural water conservancy problems in the post-communist period. Classic theories of institutionalism also did not offer direct and effective solutions to conservancy supply problems from the theoretical perspective.

Although China has made great achievements of rural water conservancy supply in the collective era, there is few literature discussing rural water conservancy supply issues in the post collective era. The existing literature about rural water conservancy supply in developing countries and socialist countries offers few information to support the analysis of the institution change of conservancy supply in rural China since the 1980s.

There is a research gap to study rural water conservancy supply issues in the market reform era and new socialist countryside era in China. How water conservancy supply institutions have affected the effectiveness of water conservancy supply in rural China is still under exploration. Therefore, this study tries to apply classic theories and analytical framework of

institutionalism into the analysis of rural China's conservancy supply cases in the post collective era from the empirical perspective. This study not only offers empirical materials (such as data, archives and interviews etc.) to present the decay and revitalization of rural conservancy supply in the post collective era but also focuses on institutional arrangements and institutional change's influence on rural water conservancy supply's effectiveness. This study has both theoretical and practical meanings to fill the research gap of rural China's water conservancy supply in the post collective era in existing literature.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter will discuss the research methodology of this study. It will define concepts to be applied in the research. Research questions and analytical framework will be formulated. It will explain what cases have been selected and why they have been selected to achieve research purposes. This chapter will also describe interactions between formal and informal institutions, and interactions between different actors within informal institutions. How to apply theories to case studies, data types, sources and how they can be utilized into empirical cases and relevant interview information of this research will also be stated in this part clearly and comprehensively.

3.1 KEY DEFINITIONS

Rural water conservancy supply system (RWCS): The rural water conservancy supply system is made of different farming irrigation and drainage projects, small and medium scale irrigation areas, irrigation water source projects, small and medium reservoirs, ponds, cellars, wells, pumping stations and other water diversion projects used for solving farmland irrigation and drinking water problems in rural areas[10]. The basic aim of the rural water conservancy supply system is to adjust and improve water status of farmland and regional irrigation situations to respond to the needs of the agricultural stability, development and high production (Huang et al., 2005; Wang, 2007). The main tasks include adjusting spatial and temporal distribution of water resources through water storage, inter-basin water transfer etc. and adjusting water status of farmland by irrigation and drainage projects.

Rural water conservancy supply institutions: China's rural water conservancy supply institutions include different conservancy related institutions rather than a single institution. Therefore, this research uses a plural form to describe those institutions. Rural water conservancy supply institutions include four sub-institutions related to rural water conservancy allocations, conservancy service supply, conservancy infrastructures' construction and maintenance, and conservancy supply programs' use rights and ownerships. The institutions cover conservancy supply engineering, conservancy supply

[10] This definition is based on the official concept of small scale rural water conservancy system *(Xiao Nong Shui*, 小农水) from Chinese Ministry of Water Resources attached website of *Rural water resource in China.* Relevant Chinese sources are available online: http://ncsl.mwr.gov.cn/index.html.

organizations, conservancy supply financial support/investment and conservancy facilities' property rights configurations and so on.

Formal conservancy supply institutions: Formal conservancy supply institutions are institutions about the allocations of conservancy supply programs, stakeholders and conservancy supply methods, establishment and maintenance of conservancy supply programs and property rights of conservancy supply presented in formal official documents and plans. Formal rural water conservancy supply institutions mainly come from government policies, regulations and political leaders' public speeches. The government and laws supervise and protect the implementation of formal conservancy supply institutions. Formal regulations about above aspects in National agricultural development plans and No.1 Central Documents made by the CCP's Central Committee or the central government, national conservancy conference working reports, national conservancy development plans and rural water conservancy management approaches made by the Ministry of Finance, the Ministry of Water Resources, the Ministry of Agriculture, local conservancy management measures, local conservancy investment management approaches, local conservancy development support plans and other policies and regulations made by provincial and municipal governments and relevant official departments are formal conservancy supply institutions in this study.

Informal conservancy supply institutions: Informal rural water conservancy supply institutions are values, cultural tradition, attitudes, actions, folk deals, mouth agreements, spontaneous regulations and informal norms about the allocations of conservancy supply programs, stakeholders and conservancy supply methods, establishment and maintenance of conservancy supply programs and property rights of conservancy supply made and obeyed by stakeholders such as farmers, village leaders, businessmen and other non-government individuals and social groups. Informal conservancy supply institutions come from folk agreements between different actors to invest, maintain and use conservancy supply facilities, farmers' attitudes and norms to invest and participate in conservancy supply, financial organizations and private investors' attitudes and actions to invest conservancy supply programs, professionals' actions and attitudes to supervise and supply conservancy services, different actors' interactions about conservancy supply and other informal constrains of conservancy supply. Informal conservancy supply institutions have been formed gradually through long-term interactions of the

stakeholders. Informal conservancy supply institutions have indirect and recessive influences on the long-term effectiveness of the conservancy supply.

Social groups: The division of social groups in this study is inspired by Susan Whiting's (2006) research on institutional change in rural China. In this research, social groups include five different categories of stakeholders who have close relationships and direct interests in the rural water conservancy supply: farmers, village leaders, professionals, financial organizations and private investors. Since local government officials and staff normally follow official conservancy supply policies to get possible political promotion in most times, specific cases and interviews with them will be presented and discussed in later chapters. Together, different social groups choose to cooperate (or not cooperate) with each other and with the local government based on their specific interests (Zhang, 1996, pp.2-8). Their actions and behaviours lead to the change of rural water conservancy supply institutions if individuals or social groups find that they can gain more by changing existing institutional arrangements. Conflicts or cooperation among different social groups have direct and indirect influences on the effectiveness of rural water conservancy supply.

Conservancy supply property rights: Conservancy supply property rights are property rights and ownerships of conservancy infrastructures (such as reservoirs, dams, drains, pump stations and so on), conservancy facilities (such as electric pumps, sluices, transformers and so on) and water use and distribution rights. The property rights and ownerships of conservancy supply in this study mainly include the rights to own conservancy supply facilities/infrastructures and use conservancy supply facilities/infrastructures, the responsibilities for conservancy construction and maintenance, the rights to benefit/profit from using or operating a conservancy supply system, the rights to distribute and use water, the responsibilities to pay money or labours for using water et al.

The collective era: The collective era was from the mid-1950s to the late 1970s. During that time period, the Chinese government took planned economy and supplied public goods uniformly.

The market reform era: The market reform era was from the 1980s to the 1990s. During that time period, the Chinese government took the market reform and tried to supply public goods by market approach.

The new socialist countryside era: The new socialist countryside era is from the 2000s to nowadays. During that time period, the Chinese government takes public goods supply reform and agricultural production reform in rural regions.

Rural public goods supply approaches become diversified and different social groups can participate in public goods supply by various methods.

Common-pool resources: Based on classic theories, common goods/common-pool resources have features of rivalry and non-excludability (Gordon, 1954; Brann & Foddy, 1987; Héritier, 2002, pp.20). All the people who can access the common goods/common-pool resources share the same rights to use it. Meanwhile, each individual can only consume his or her unique resource unit (Ostrom, 1990, pp.6). The individual's use cannot exclude others' consumption (Brewer & Kramer, 1986). Although conservancy supply services are widely treated as common-pool resources globally, in China, conservancy supply services were treated as pure public goods in the collective era and private goods in the market reform era. Only in China's new socialist countryside era do conservancy supply services have both features of rivalry and non-excludability and thus can be treated as common goods/common-pool resources.

Government-driven conservancy supply institutions: The government especially the central government of China and the CCP's Central Committee dominated rural water conservancy supply from the 1950s to the 1970s. Conservancy supply services were treated as pure public goods and supplied uniformly by the government in the collective era. Formal institutions in this era included central government's policies, political documents from the government and the CCP and top leaders' speeches and instructions about conservancy development, construction and maintenance. Informal institutions included farmers' self-interested traditions to avoid collective work and focused on their small pieces of plots (*Ziliudi*, 自留地), and farmers and some village leaders' informal agreements to reallocate collective land et al. Since the government used its strong authority and political power to push forward the development of rural water conservancy supply, the government and farmers had tense relationship which harmed the long-term sustainable development and the effectiveness of government-driven rural water conservancy supply institutions. The government-driven conservancy supply institutions can be seen as the application of Samuelson's pure public goods supply theory in rural China.

Market-driven conservancy supply institutions: Since the 1980s, China established market-driven conservancy supply institutions. The central government applied many market-based formal institutions such as privatization and outsourcing to offer rural water conservancy services. At the same time,

social groups took advantage of the informal institutions to become free riders or speculators of conservancy supply infrastructures/facilities. Since there were no strong dominate conservancy service suppliers, many conservancy infrastructures and facilities established in the collective era lacked necessary maintenance and were broken in the market reform era. Market-driven institutions led to disorder and ineffectiveness of rural water conservancy supply and even caused "tragedy of the commons" problems. Self-interest motivations of the government and social groups in the market mechanism also led to unclear conservancy property rights configurations and non-cooperative interactions in conservancy supply. The government and social groups had slack relationships in market-driven rural water conservancy supply institutions which affected the normal operation of the conservancy supply institutions and reduced supply effectiveness.

Polycentric rural water conservancy supply institutions: Polycentric rural water conservancy supply institutions in rural China include a set of conservancy supply institutions such as collective shareholding system, private contracting conservancy system with user pay and market-oriented conservancy supply operation by a third party etc. formed by both the government and different social groups. Polycentric conservancy supply institutions offer diversified rural water conservancy supply methods. Diversified rural water conservancy supply methods (*Duoyuanhua Nongtian Shuili Gongji*, 多元化农田水利供给) such as developing autonomous organizations, diversifying supply bodies and supply models, encouraging farmers to vote for public goods supply methods have become hot spots of the public goods supply reform in the new socialist countryside era[11] (Wong, 2009). The biggest advantage of the polycentric institutions lies in the involvement of various conservancy supply participants that offer rich local knowledge and information of people's real needs. Polycentric conservancy supply institutions can be seen as the application of Elinor Ostrom's polycentric theory in rural China.

3.2 RESEARCH QUESTIONS

According to the classic theories of institutionalism and empirical rural water conservancy supply institutions in different countries and regions, rural water

[11] The vote here means applying the "*Case-by-case Approval System*"(*Yishi Yiyi*,一事一议). Since the rural tax reform, government abolished township and village's power to collect fees. Whether collecting fees for rural water conservancy supply, fundamental infrastructures and public utilities, and how to use the money is decided by villagers. Villagers volunteer to join the meeting for the specific issues and vote to agree or not.

conservancy supply could be dominantly supplied by government, market or self-organized cooperatives. Different kinds of rural water conservancy supply institutions have different features (Cowen, 1992, pp.23). pp.The experience in developing countries and socialist countries showed that those countries met more challenges in offering effective conservancy services especially after the USSR collapsed since the collapse of the USSR brought significant political and economic changes in those countries (Theesfeld, 2004). Although China made great achievements of rural water conservancy supply between the 1950s and the 1970s, the collapse of the government-driven institutions in the late 1970s and the launch of the market reform since the 1980s negatively affected the effectiveness of rural water conservancy supply.

3.2.1 Case selection

The existing literature focused on a single kind of rural water conservancy supply approach within a certain period. Since rural water conservancy services are typical public goods in rural China and their supply methods have experienced several changes, conservancy supply issues in rural China are more complicated than what existing literature has stated. Therefore, rural water conservancy supply can be used as the case to explain the institutional mechanism of rural public goods supply in China. However, no scholars have empirically presented how the rural water conservancy supply system collapsed in the market reform era and how to reestablish in the new socialist countryside era in China since the 1980s. How institutional arrangements and changes have affected the effectiveness of rural water conservancy supply in the post collective China is still not clear.

Besides, according to Coase (1960), Demsetz (1970, 1974) and Lin's (1989; 1990) arguments, property rights are significant factors to affect the economic performance and the effectiveness of public goods supply. Appropriate property rights ownerships and distributions can positively encourage owners' enthusiasm to invest and establish necessary facilities in their owned properties (Snidal, 1979; Fischel, 2003). Since property rights distribution in developing countries and socialist countries always involves the government, it is hard to rely on market economic analysis to understand property rights' functions in public goods supply issues in those countries (Zhou, 2000). There was also no literature discussing empirically how property rights issues changed when socialist countries collapsed or significantly changed their conservancy supply institutions (Zhou, 1995). In order to understand changes, problems and new situations of rural China's conservancy supply in the post collective era, this

study tries to use empirical materials to analyze conservancy supply issues.

This study selects water conservancy supply in rural China in the market reform era (from the 1980s to the 1990s) and in the new socialist countryside era (since the 2000s) as two major cases to do the analysis. On the one hand, rural water conservancy supply system in China experienced low effective problems and collapsed in the 1980s and the 1990s but also experienced the reestablishment and revitalization in the 21st century. The cases can fill the research gap of lacking empirical study of conservancy supply in rural China in the post collective era and present detailed information of the decay and revitalization of rural water conservancy supply since the 1980s. On the other hand, rural water conservancy supply institutions from the 1980s to the 1990s were market-driven institutions while conservancy supply institutions became polycentric institutions in the 21st century.

The two institutions are quite different from the government-driven institutions. The two major cases can explain similarities and differences between the market-driven and polycentric institutional arrangements in conservancy supply. They can also explain how property rights configuration and institutional changes have affected the effectiveness of rural water conservancy supply.

In general, selecting water conservancy supply in rural China in the market reform era (from the 1980s to the 1990s) and water conservancy supply in rural China in the new socialist countryside era (since the 2000s) as two major cases can achieve the research purpose of understanding how different institutions have affected rural water conservancy supply's effectiveness in China's post collective era.

3.2.2 Major research questions and sub-research questions

Based on relevant literature review and above statements, this study will address the following research questions. The key research question is that how institutional arrangements and change have affected the effectiveness of water conservancy supply in rural China in the post collective era.

Operationally, the study will raise two sub-questions. First, how have water conservancy supply institutions operated and collapse in the market reform era (from the 1980s to the 1990s). This question will explain problems and ineffectiveness of market-driven rural water conservancy supply institutional arrangements since the market reform era. Second, how polycentric rural water conservancy supply institutions operate in the new socialist countryside era. This question is helpful to understand the reestablishment and revitalization of

effective rural water conservancy supply system in recent years (see Figure 3.1).

The two sub-questions can fit into the classic theories of market-driven public goods supply approaches and polycentric public goods supply approaches well.

The essence of reform and opening up is marketization and privatization (Zhou, 1995). In the market reform era, rural water conservancy supply services and many other public goods were treated as private goods and were mainly in charged by individuals or non-government sectors. Most public goods in this era were mainly supplied by the market. The phenomena can be explained by Coase's theory that public goods should be supplied by market to improve the economic performance and reduce transaction cost (Coase, 1960; 1974). Meanwhile, the reality has shown that the market mechanism could not manage conservancy supply effectively especially for property rights related issues. The marketization and privatization of conservancy supply services in the market reform era caused the crisis of modern rural water conservancy supply system.

In the 21st century, water conservancy supply services in rural China were treated as common goods/common-pool resources and supplied by government, individuals or non-government sectors. The new situations are consistent with Ostrom's polycentric public goods supply theory (Ostrom, 2010). Polycentric conservancy supply institutions offer new institutional arrangements and possible solutions to deal with conservancy property rights issues, conservancy investment, labours and conservancy constructions and maintenance. Diversified conservancy supply approaches encourage different participants' enthusiasm to join in conservancy supply and increase supply effectiveness (Ostrom et al, 1994, pp.117-120).

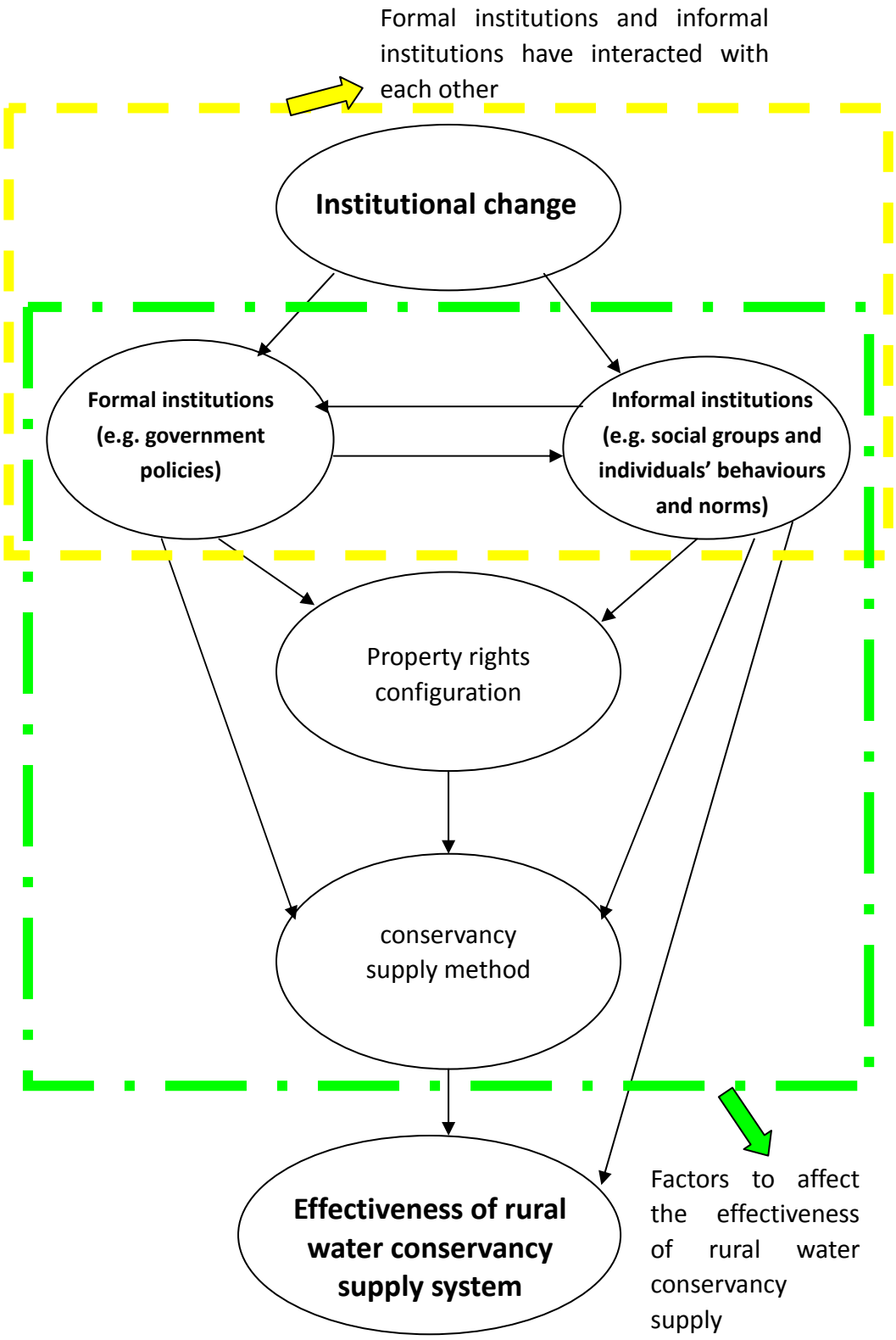
In general, the two sub-questions can guide the analysis of rural water conservancy supply in the market reform and in the new socialist countryside era. Main concepts, major arguments and analytical framework of the classic theories will be borrowed and applied in this study and will be used to answer the major research questions and two sub-questions. Meanwhile, since China has its unique national conditions, the empirical analysis and case studies which used to answer research questions cannot copy western classic theories and existing literature directly but have to make appropriate adjustments based on rural China's reality to make a better fit between classic theories and reality.

Besides applying classic theories in the empirical analysis and case studies

to answer research questions, this research will focus on some detailed information to answer the key research question and two sub-questions. How new rural water conservancy supply institutions established in the market reform era and the new socialist countryside era; how rural water conservancy supply institutions change in two different eras; whether conservancy supply institutions are effective or nor in two eras; how conservancy property rights distribute (conservancy supply rights configuration, facility/infrastructure use rights and benefit distribution of major conservancy supply facilities/ infrastructures) are four aspects which will be focused in this study to answer research questions. The information of the four aspects in both the market reform era and the new socialist countryside era will be checked and analyzed in later chapters.

3.2.3 Research framework

The empirical analysis and case studies in the market reform eras and the new socialist countryside era will be done within the general research framework. The following figure shows the general research framework of this study.



Key research question: How have institutional arrangements and change affected the effectiveness of rural water conservancy supply in the post collective era?

Figure 3.1 Research Framework

Figure 3.1 shows that formal institutions made up of government policies and regulations and informal institutions made up of social groups' norms and behaviours can affect each other. They both could affect property rights distribution and the supply method of rural water conservancy services. Institutional change has direct and indirect effects on property rights configurations. Property rights configuration methods and some other factors such as policies and traditions all have influences on supply methods and effectiveness of rural water conservancy services.

According to North, when external conditions (technological and natural conditions) are stable, institutional arrangements can significantly affect economic performance (1990, pp.144-147). The empirical study of rural water conservancy supply can provide evidence that different institutional arrangements in the post collective era lead to different property rights configurations and different conservancy supply methods[12]. Institutions can significantly affect the effectiveness of rural water conservancy supply.

As government officials did not join in accurate works of constructions and daily managements of rural water conservancy supply programs directly, formal institutions made by them could have indirect impacts on the effectiveness of rural public goods supply through commands and policies. Since farmers and other social groups and individuals involve rural water conservancy supply issues directly, their traditions, norms, behaviours and actions have direct influences on the effectiveness of conservancy supply. Compared with existing research, this study will pay more attention to the detailed operation and changes of water conservancy supply in the post collective era from the empirical perspective. This study recognizes that formal institutions and informal institutions are different in the market-driven institutional environment and polycentric institutional environment in the post collective era. Different institutional arrangements can bring different influences on the effectiveness of rural water conservancy supply. Institutions are major reasons to cause the decay and revitalization of rural water conservancy supply in China's post collective era. This is the main theme of this study.

3.3 DATA SOURCES AND COLLECTION

Since this is an empirical study, the collection of data and cases become

[12] Agriculture in Central and Western China in this research is stable relying on the rural water conservancy supply. Crop types, irrigation patterns and climatic conditions are very stable and similar in these regions. Therefore, this research just considers institutional factors rather than external conditions.

significant. This part will introduce information about fieldwork, data, and interviews.

3.3.1 Fieldwork place

In order to carry out the research, I selected the locations of fieldwork in Central and Western China with similar conditions which are representative.

All the fieldwork places are located in the Central and Western China around or not far from the Qinling-Daba Mountain (秦岭-大巴山脉). Natural and agricultural conditions of those locations belong to the same type[13]. All the fieldwork places rely on conservancy system for agricultural water and have not experienced major technical changes of water conservancy supply since the 1980s. The climate and environmental conditions of all the fieldwork places are stable and similar (such as rainfall, temperature, similar terrain, similar main crop species) in a long-term time period. All the places are easy to collect information and access the local society.

I chose Xiangzhou district (襄州区, it was called Xiangyang County, 襄阳县) in the city of Xiangyang, Hubei province（湖北省襄阳市襄州区）, as the main location of fieldwork. Xiangzhou district is in the middle part of China and the major terrain is plain. It is one of the major agricultural areas in China. Xiangzhou district has stable climate and rainfall. It is near the Han River and mainly relies on rural water conservancy supply system to keep agricultural productivity. The technology of water conservancy supply has no significant change in this area since the PRC founded (relying on a few machines and huge amount of human labours). Xiangzhou district has 13 towns and 2 sub-districts. The total population is 1.03 million (Xiangzhou Government, 2011). Xiangzhou district has large geographical area and sufficient populations to provide enough cases and sources for the research work. Most importantly, my home is located in the city of Xiangyang, not far away from Xiangzhou district, facilitating my research for a period of time. My family and friends have offered vital support for me to access relevant government departments and the local society.

[13] All the regions in this research which I took fieldworks have two harvest seasons. Those areas normally grow one season's rice and a season of wheat/cole or other crops. The additional time normally fallow or grow vegetables.

Figure 3.2 The map of Xiangzhou district (within the red line)

Source: Google map.

Xiangzhou district's situations can meet the requirements for studying rural water conservancy supply institutions, that is, stable technological and natural conditions. I am also familiar with local societies and have networks. Therefore, I have done the fieldwork mainly in Xiangzhou district.

In order to make comparison and prove conservancy supply institutional issues are similar in Central and Western part of China, I also have done fieldworks in some other places. Interviews and fieldworks have been done in Xunyang County, Ankang City, Shaanxi Province (陕西省安康市旬阳县), Chang'an District (it was called Chang'an County), Xi'an City, Shaanxi Province（陕西省西安市长安区）, Lingbao City (it was called Lingbao County), Sanmenxia City, Henan Province（河南省三门峡市灵宝市）and Xinzhou District (it was called Xinzhou County), Wuhan City, Hubei Province（湖北省武汉市新洲区）as the supplement fieldwork areas. All the interviews, questions and surveys were the same in different fieldwork places. Those areas offered useful information equally for this research. I have also collected archives, official documents and interview high level government officials and scholars in Xiangyang City, Wuhan City, Xi'an City and Beijing City et al.

3.3.2 Data sources and applications

In order to have good explanations and detailed descriptions of institutional

settings and institutional change of rural water conservancy supply, this research adopted the qualitative research method for the empirical study. Data sources of the research can be divided into two types: text data and interview data.

The text data is collected from fieldwork places and some relevant cities. The data includes basic natural, historical, social and economic information such as the regional area, regional economic development situation, population, basic natural and economic-social environmental situations, and agricultural development and so on.

China Statistical Yearbook offers general economic and social development information for this study such as GDP per capita, population, agricultural products price, disposable income per capita and financial and economic situations in rural China. *China City Statistical Yearbook* and *China Environmental Statistical Yearbook* offer detailed information of economic and social development and specific rural environment information from the provincial and maniple level. *China Rural Statistical Yearbook* focuses on agricultural, economic and social data in rural China. Information such as main grain output per capita, agricultural disaster areas, numbers of agricultural machinery and rural investment amount et al. can be found in the yearbooks. Although macro economic and social information those statistical yearbooks offered does not have direct links with rural water conservancy supply issues, the information can reflect economic and social changes' influences on rural water conservancy supply in the market reform era and the new socialist countryside era. Beside, the data also can show different rural water conservancy supply institutions' effects on rural development in the post collective era and offer evidence of rural water conservancy supply institutions' effectiveness from the macro level.

However, there are also some limits of the data from statistical yearbooks. On the one hand, most statistical yearbooks just include macro data of the whole region, the whole province or even the whole country. Macro information from statistical yearbooks cannot be used directly in the empirical cases of this study. On the other hand, the time period that most statistical yearbooks covers is from the 1990s to the 2010s. There are just a few statistical yearbooks covers the time period of the 1980s. Therefore, the data in most statistical yearbooks cannot offer comprehensive information since the reform era for further analysis.

In order to utilize the data in the empirical cases, this study also collects relevant data (similar data as collected in statistical yearbooks) of detailed

agricultural, economic and social development at the municipal, county and township level in fieldwork places. Local government, agriculture bureau, statistics bureau, development and reform commission, party school, local archives and other official departments in fieldwork places supply detailed data about natural and social conditions, agricultural and economic development for the accurate analysis of empirical cases in this study. The minor data not only can be applied in the empirical analysis directly but also can reflect local economic and social conditions. The data is helpful to offer indirect support to prove the decay and revitalization of rural water conservancy supply in the market reform era and the new socialist countryside era in fieldwork places. The detailed information at the county and township level and macro data from statistical yearbooks also can confirm each other to prove the reliability of this study.

Information about rural water conservancy supply has also been collected. I have tried my best to collect historical and current information of irrigated area, effective irrigated area, irrigating water amount, depletion of water conservancy system, funding and human labour for conservancy works et al.

China Rural Statistical Yearbook and *China Conservancy Statistical Yearbook* offer data of numbers of reservoirs, the length of drains, numbers of conservancy machinery, financial aid/support and conservancy investment, conservancy construction and maintenance situations, irrigation related data and other data which direct link with rural water conservancy supply. Besides the macro data from relevant official statistical yearbooks, this study also have collected detailed data from local agriculture bureaus, water conservancy bureaus and local archives in fieldwork places to get municipal, county and township level conservancy supply data.

The information can directly show rural water conservancy supply conditions in fieldwork places and the whole country since the reform era. The data offers intuitive materials about the decay and revitalization of conservancy supply in the post collective era. Achievement, problems and changes of rural water conservancy supply since the reform era also can be reflected by the specific conservancy supply data. The information offers significant materials for the analysis of two empirical cases and make the argument become more rich and credible.

Many of the central and local governments' water conservancy policies, regulations, documents and government leaders' official speeches in different time periods have also been collected as the representatives of formal

institutions. It can show original settings of official policies in different eras.

Xinhua News, Renmin News, China News, websites of Ministry of Water Resources and Ministry of Agriculture, websites of the State Council and local governments offer historical and current official documents, regulations and policies of agricultural development and rural water conservancy supply. Significant national documents about rural water conservancy supply such as No.1 Central documents, national conservancy development plans, national conservancy conference work reports all can be accessed by the public through the internet. Academic journals and books also provide formal institutions of rural water conservancy supply and relevant analysis from the academic perspective. I also try to find accurate conservancy supply policies and regulations from local governments, local agriculture bureaus, water conservancy bureaus and local archives in fieldwork places. Those local documents include rural water conservancy management measures, rural water conservancy investment management approaches, local conservancy supply work annual report, local conservancy development plans, local agricultural working report and other relevant documents and policies in different eras. Those documents and policies cover aspects of conservancy supply distribution methods, conservancy investment and benefit, use rights and ownerships of conservancy supply infrastructures and facilities, conservancy construction and maintenance responsibilities, water use rights and water fees and so on.

Those conservancy supply documents and policies especially local conservancy supply policies and documents are significant materials of formal institutions of rural water conservancy supply in this study. They are significant parts of the two major empirical cases. Contents of those policies and documents can show differences of formal rural water conservancy supply institutional arrangements in fieldwork places in the market reform era and the new socialist countryside era. Those documents will also be used to analyze the effectiveness and changes of conservancy supply institutions in the post collective era.

To supplement, interviews are significant to this research. Interviews offer most information of informal institutions especially information about different social groups. Government officials, village leaders, farmers, private investors, bank staff and professionals are interviewed in this research with the purpose of learning their opinions about rural water conservancy supply in different time periods and what have affected their behaviours in conservancy supply. Interviews of different people also have provided materials to explain

interactions, conflicts and compromises among different actors within social groups. Interviews can offer a lot of useful materials which cannot be found in statistical yearbooks, official documents or academic papers. Interviews are helpful to understand the real situations, problems and achievements of the operation and effectiveness of rural water conservancy supply institutions in different eras at the minor level. In general, those interviews are meaningful to offer deep explanations and mechanism of cooperative and non-cooperative interactions between formal and informal institutions and interactions between different actors within informal institutions.

3.3.3 Interview information

The major method of selecting interviewees took the snowballing method since knowledge and information of rural water conservancy system has strong professionalism and independence. The snow-ball selecting method has been proved easy to access interviewees, respond actors' changes in interviews and collect enough information (Doreian & Woodard, 1992). Other selecting methods such as random selecting method are hard to find suitable interviewees and hard to focus on specific research targets. Therefore, random selecting method was only used in selecting farmer interviewees.

In order to make a neutral and effective selection of interviewees, I have controlled the demographic characteristics. Since this research covers a long period, interviewees those who have lived in interview districts for over ten years' time (must be adults). Over 2/3 of the interviewees were over 50 years old on October 1st 2015 (in order to cover the whole time period of the research). All the interviewees are familiar with rural water conservancy supply issues and their supply (government officials or staff were those who have ever charged of the rural water conservancy issue or worked for the water department/station, farmers were long-term engaged in irrigated farming, financial staff members were the ones who have treated at least two or more cases about rural water conservancy financial operations). Local water departments, organizational departments and financial organizations in Xiangzhou district and other fieldwork places provided name lists and records which offered huge information to guarantee interviewees were suitable. I normally selected the suitable people from the official name lists first and then asked their personal information and their experience to determine whether they can meet the criteria. If so, the formal interview would follow. I also asked interviewees to recommend similar interviewees after formal interviews. Interview results have shown that the name lists and the preliminary screen tests worked well. My

friends in relevant organizations also helped me to select the unbiased, knowledgeable interviewees.

I have used above method to select 182 interviewees in the groups of local government leaders and staff (21 people), conservancy professionals (7 people), Scholars (5 scholars), village leaders (31 people), farmers (110 people), bank staff (6 people) and private investors (2 people) in Xiangzhou, Xunyang, Chang'an, Lingbao and Xinzhou in two years' time. Since private investors and bank staff were hard to access, I have tried my best to interview all the 8 interviewees that I could meet. More information about interviewees can be found in Appendix I[14].

To keep the information from interviews accurate and unbiased, this research normally interviewed each interviewee twice to make the information without mistakes and confusion. I also compared the information from different social groups, information from interviewees in different regions, information from interviewees and official archives to avoid possible bias from different perspectives. Local scholars' research and similar research in other regions were also helpful for my own research.

Interviews of this research covered several parts. The first part was about personal information. Name, age, profession, settlement time, incomes (some people) and other personal information will be asked. The second part was about conservancy development related questions in different era. Interviewees offered their information about the actual irrigating water amount, irrigation channels, irrigated areas and other indexes which were used to measure the effectiveness of rural water conservancy supply in different era. The third part was about people's values and attitudes of rural water conservancy supply. Questions like people's attitudes and actions to water conservancy supply in different eras and whether there were some disagreements and conflicts in conservancy supply issues have been asked. People's expectations and worries of rural water conservancy supply have also been checked. The fourth part was about social groups' behaviours and norms in different periods. In this part, questions focused on relationships and interactions between formal institutions and informal institutions, and interactions between different actors within informal institutions. Relationships among local government, village leaders, farmers and other social groups are checked. Local governments' attitudes and actions to village leaders and farmers and their support to conservancy supply programs have been asked; conflicts and cooperation between village leaders

[14] Detail personal information is not shown due to privacy reasons and interviewees' requests.

and farmers were also asked. Other questions such as the rural changes brought by social-economic development and reforms have also been asked to support the analysis. More details can be found in Appendix II.

CHAPTER 4 RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS AND CONSERVANCY SUPPLY IN CHINA'S PRE-REFORM ERA

This chapter will give a generic explanation of rural water conservancy supply institutions and the description of rural water conservancy supply in the pre-reform era in rural China. The first part of this chapter will describe what rural water conservancy supply institutions are. It will state macro matters and accurate institutions about rural water conservancy supply methods, stakeholders in conservancy supply, detailed arrangements of rural water conservancy supply and how they can be offered. The second part of the chapter will illustrate rural water conservancy supply in rural China in the collective era. It will bring the background information of rural water conservancy supply before the market reform era.

4.1 THE GENERIC EXPLANATION OF RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

Rural water conservancy supply institutions are collections of composite concepts. The institutions cover all aspects of rural water conservancy supply. In China's practice, it is seldom to use a specific policy or institution to state rural conservancy issues in macro policy documents. Rural water conservancy supply institutions are always mentioned as a whole. Therefore, when talking about rural water conservancy supply institutions, this study uses the plural form.

Normally, rural water conservancy supply institutions are regulations, agreements, deals and norms about aspects of conservancy programs' allocations in different areas, divisions of works and responsibilities of stakeholders in different supply methods of conservancy services, the construction and maintenance of conservancy infrastructures and property rights related issues of conservancy supply. Rural water conservancy supply institutions can cover most engineering, organizational, financial/investment and interest distribution issues of conservancy supply. This part will point out major contents of rural water conservancy supply institutions and different ways to implement conservancy services.

4.1.1 Conservancy programs' allocations in different areas

The most significant aim of rural water conservancy supply system is to coordinate the unbalanced temporal and spatial distribution of water resource and supply enough water for agricultural development. Therefore, rural water conservancy supply institutions need to decide allocations of conservancy supply programs in different areas.

Since establishing rural water conservancy supply programs need huge investment of capital, materials and human labours, individuals are hard to own their independent conservancy supply system. Normally, a rural water conservancy supply program can satisfy the needs of using water of farmland within a certain area. A rural water conservancy supply program is always shared by different agricultural units (Pan, 2002). However, the distance from farmland to conservancy facilities and the layout of conservancy supply facilities can affect the result of conservancy services and agricultural production (García-Mollá et al, 2014). Therefore, where to construct conservancy supply programs and how to plan the layout of relevant facilities become a theme of rural water conservancy supply institutions.

There are three major methods for rural water conservancy supply institutions to allocate conservancy supply programs in different areas. The first way is that conservancy supply programs especially major infrastructures and facilities allocate and establish mainly based on natural conditions and engineering considerations. Those situations are normally seen in areas which had long history to use conservancy supply system, areas have weak organizational abilities and backward technological/financial conditions or areas use self-organized autonomous organizations to supply conservancy services. With technological, financial and other limitations, Valencia, the Philippines and some other places established and allocated conservancy supply programs next to natural rivers, lakes and drains with limited facilities and artificial buildings (Ortega-Reig et al, 2014). Besides those reasons, self-organized autonomous organizations in those areas also have followed the tradition to allocate rural water conservancy supply programs based on natural conditions. Customs and habits in those regions have been significant parts of rural water conservancy supply institutions to allocate and establish conservancy supply programs (Pérez-Sánchez, 2017). Most participants of conservancy supply in those regions agree and accept that conservancy supply system should allocate based on natural conditions. Although this approach may not bring the highest effectiveness of conservancy supply, there are also

not many disputes about allocations of conservancy supply programs.

The second conservancy supply programs' allocation approach is based on the market economy. In the market economic circumstance especially in areas with private land ownership and industrialized agricultural production such as the US and many parts of the Europe, landlords, agricultural corporations and farmers with large amount of farmland could significantly affect rural water conservancy supply institutions and the allocation of conservancy supply programs (Ostrom, 2010). Economic effectiveness and the agricultural productivity become the core of conservancy supply institutions. In order to show the market economic characteristics, conservancy supply institutions in those regions normally allow landlords and agricultural corporations establish conservancy supply programs with priority to their own interests (Martí, 2005). This allocation approach is market-dominated. Although this approach could obviously increase the effectiveness of conservancy supply in some areas controlled by landlords or agricultural corporations, it also could lead to the imbalance of conservancy supply and reduce the effectiveness of conservancy services in some other areas on some extend.

The third conservancy supply programs' allocation approach is government-dominated. In some agricultural-based developing countries and former socialist countries/socialist countries such as Sri Lanka, the USSR and China, the government dominates and plans allocations of conservancy supply programs. The central government in those countries offers financial and policy support to allocate and establish conservancy supply programs in different areas (Wu, 2007; Micklin, 1987). The major aim to apply government-dominated allocation approach is to supply effective conservancy services to most farmland and increase the general agricultural productivity. In practice, this allocation approach has proved that it indeed promote the effectiveness of conservancy supply in agricultural-based developing countries and former socialist countries/socialist countries in general (Molle & Renwick, 2005). However, information asymmetry limits the effectiveness of government decisions. Most central governments in those countries lacked local knowledge to allocate all the conservancy supply programs effectively (Hussain & Hanjra, 2004). Therefore, government-dominated allocation approach of conservancy supply programs could also bring negative influence on the long-term effectiveness of conservancy supply.

Due to different technological and institutional conditions, it is hard to say which allocation approach of conservancy supply programs is the best.

Different allocation approaches of conservancy supply programs have their applicable scope. Only comprehensively considering the accurate environmental, geographic, technological and institutional situations of different regions and countries, the allocations of conservancy supply programs can be effective.

4.1.2 Division of works and responsibilities of stakeholders in different supply methods of conservancy services

Rural water conservancy supply institutions regulate and control stakeholders' divisions of works and their actions in conservancy supply. The institutions normally state rights and responsibilities of different stakeholders. Since there are many different stakeholders involving in rural water conservancy supply, they play different roles in the rural water conservancy supply system. Stakeholders' actions and behaviours in conservancy supply are decided by interest that they can get. Different conservancy supply methods might bring different interests to stakeholders and affect their behaviours and actions in supplying conservancy services. In practice, the government, farmers, village leaders, financial organizations/private investors and professionals are major stakeholders in rural water conservancy supply.

In the government-driven rural water conservancy supply institutions, the government dominated conservancy supply services. In such institutional circumstance, the government is the core of rural water conservancy supply system. The central government is mainly responsible for conservancy policy making and local governments are mainly responsible for policy implementation. Both the central government and local governments give direct financial subsidy and administrative support for conservancy construction and maintenance. The cases of the USSR and Sri Lanka have shown that the government dominated major aspects of conservancy supply in socialist/former socialist countries and some agricultural-based developing countries (Hussain & Hanjra, 2004). The government's domination has been proven helpful to change the backward situation of conservancy supply in those countries, obviously support the construction of conservancy infrastructures and rapid increase the effectiveness of conservancy supply within a short time period (O'Hara, 1997). Local government officials and conservancy professionals who belongs to official institutes involve in detailed conservancy plans and constructions in the government-driven rural water conservancy supply institutions. They use executive orders to control and manage other stakeholders to achieve the government's conservancy supply

aims. The examples in China and Sri Lanka show that conservancy professionals and their institutes can be seen as a part of the government's administrative system (Molle & Renwick, 2005; Wu, 2007). They seldom have independent and objective opinions about conservancy supply and development (Meinzen-Dick & Bakker, 2001); Village leaders have duties to establish links between the local government and different social groups. It is the responsibility for village leaders to use administrative power to deal with accurate organizational and management works of conservancy construction and maintenance. In the government-driven rural water conservancy supply institutions, village leaders normally represent official interests and the well of the higher-level government (Pan, 2002). Village leaders seldom get private interests especially economic interests through conservancy construction and management works. Compared with other conservancy supply institutions, village leaders in government-driven conservancy supply institutions have stronger administrative power to manage conservancy supply issues (Meinzen-Dick & Bakker, 2001). They are also executors of government administrative policies; similarly, official financial organizations also follow government's administrative commands and policies to offer financial services to conservancy supply programs. They have few autonomy to make investment decisions for conservancy supply programs and are not allowed to make economic profit from such investment. In socialist countries like the USSR and China (pre-reform era), financial organizations are also parts of the executive body of the government-dominated rural water conservancy supply system (Abdullaev et al., 2010). Private investors are forbidden to participate in conservancy supply and get economic interests through investing conservancy supply programs in some socialist countries in the government-driven institutional circumstance. Farmers are major labours to construct and maintain conservancy infrastructures. Many farmers in the USSR, China (pre-reform era), Sri Lanka (from the 1950s to the late 1980s) and the Philippines do volunteer works for conservancy construction and maintenance. However, few of them can get appropriate economic interests such as salary as payback (Araral, 2009). Farmers' volunteer works for conservancy supply have been seen as the compulsory parts of the collective working system in the government-driven institutions in some socialist countries/agricultural-based developing countries (Abdullaev et al., 2010).

In the market-driven rural water conservancy supply institutions, the market and private sectors dominate conservancy supply services. The market

mechanism is the basic principle of conservancy supply services. All the stakeholders try to maximize their interests in this institutional circumstance. The central government and local governments in such institutional circumstance nominally manage conservancy supply services in the macro level. However, there is few compulsory regulations to support the implementation of the institutional arrangements. Both the central government and local governments seldom involve in accurate conservancy supply management works and give little direct financial subsidy and administrative support for conservancy supply. The government offers more freedom to the market and asking other stakeholders to take more responsibilities to implement market-driven conservancy supply institutions. In some areas in Spain and the Philippines, conservancy supply is not the compulsory duty of the government. Local autonomous organizations or private corporations mainly dominated conservancy supply services (Sánchez-Rubio, 2008; Garrido et al, 2006; Kikuchi et al, 2003). The government and officials focus more on economic profits from urbanization and industrialization rather than profits from agricultural development and conservancy supply. When China implemented the market reform in the early 1980s and the USSR collapsed in the 1990s, they both changed the focus to economic development and reduced attention to conservancy supply (Jin & Qian, 1998; Minashina, 2009); Conservancy professionals' major responsibility in the market-driven rural water conservancy supply institutions is to in charge of the operation of conservancy facilities and infrastructures. Since some of they cannot get enough financial support from the government, conservancy professionals are allowed to get economic interests from operating conservancy infrastructures and collect water fees to feed themselves. In such institutional circumstance, conservancy professionals in some countries such as Sri Lanka (in the late 1970s) pay more attention to make money from conservancy supply services but seldom participate in planning, constructing and maintaining accurate conservancy supply programs (Uphoff & Wijayaratna, 2000). Official financial organizations and private investors are allowed to join in commercial activities of conservancy supply programs in the market-driven institutional circumstance. However, in some developing countries, their economic interests from investing conservancy supply programs are not officially protected. In many socialist countries and developing countries, official financial organizations and private investors are under the control and supervision of the government with limited freedom of investment (Banerjee & Duflo, 2011,

pp.87-90). In the market environment, the nature of pursuing economic benefits also drives most private investors and financial organizations to give up conservancy investment. As it is hard to make direct economic interests within a short time period (Banerjee & Duflo, 2011, pp.112-115); Farmers and some private corporations are main forces to invest, manage and maintain conservancy supply programs in the market-driven rural water conservancy supply institutions. In most times, they have to rely on their own capital and labours to keep the normal operation of conservancy infrastructures and facilities on their land without necessary help and support from the government or other social groups. In some developing countries, landlords and private corporations with large-scale farmland and capital can manage conservancy supply issues well by themselves while normal peasants are hard to do so without necessary support and help (García-Mollá et al, 2014); Village leaders are only responsible for basic organizational works of conservancy supply in the market-driven institutions. They do not have mandatory force to distribute water or gather resources and labours for the construction and maintenance of large-scale conservancy supply programs (Molina et al, 2006).

In the polycentric rural water conservancy supply institutions, both the government and different social groups participate and play significant roles in rural water conservancy supply. There are diversified conservancy supply methods in this institutional circumstance. Different stakeholders all have legal rights to seek for their interests within the institutional framework. Diversified interests make it possible for different stakeholders to clear their positions to increase the effectiveness of conservancy supply. Like in Spain, farmers' autonomous conservancy supply organizations can cooperate with private corporations or professional organizations to get more irrigation water to increase the effectiveness of local conservancy supply (Torregrosa & Sevilla, 2010). The central government especially agricultural and water departments are mainly responsible for making administrative and financial policies to support the development of conservancy supply. Local governments are in charge of accurate project approval and supervision. The government neither involve too much in the accurate construction and maintenance of conservancy supply programs nor shirk the responsibility to offer conservancy supply services. The case in Valencia shows that this arrangement on the one hand allows stakeholders get necessary support and help from the government. On the other hand, the limited involvement of the government prevents excessive intervention from the government (Ortega-Reig et al., 2014); Conservancy

professionals mainly offer professional suggestions for conservancy construction and maintenance. They also participate in supervising other stakeholders' actions in conservancy supply. As most of them can get enough fixed salary from the government or official institutes, conservancy professionals do not have direct economic interests in conservancy supply. Therefore, they can be objective to keep the effectiveness of conservancy supply system. The cases in Valencia, Murcia, Orihuela of Spain and some parts of Sri Lanka since the 1980s has shown that the appropriate involvement and objective attitudes of conservancy professionals are helpful to increase conservancy supply effectiveness (Pérez-Sánchez, 2017; Molle & Renwick, 2005). Both financial organizations and private investors have legal rights to invest conservancy supply programs and get appropriate economic interests through investment. Meanwhile, commercial investment behaviours of financial organizations and private investors for conservancy supply are under the supervision of other stakeholders (conservancy professionals, local government officials, village leaders and farmers). Any commercial actions which may hurt the effectiveness of conservancy supply are not permitted in the polycentric rural water conservancy supply institutions. The case in Valencia has shown that anyone who resisted the basic principle of conservancy supply and reduced the effectiveness of conservancy supply would get the punishment from the whole autonomous conservancy supply organization (García-Mollá et al, 2014); Village leaders are mainly responsible for coordinating different stakeholders' interests and supervising stakeholders' actions and behaviours in conservancy supply. They are in charge of general organizational and management works of conservancy supply and keep connections of different stakeholders. However, they do not have mandatory force to organize accurate conservancy construction and maintenance (Martí, 2005); Farmers are both labours and investors in conservancy supply services in polycentric conservancy supply institutions. They can choose to deal with conservancy supply issues themselves or cooperate with other stakeholders to maximize their interests. Diversified choices allow farmers have more options to put capital and labours in conservancy supply investment. The polycentric institutions also strengthen farmers' rights and interests among stakeholders. In Valencia, Murcia and Orihuela, Spanish farmers chose to establish autonomous organizations to help with each other to maximize their interests (Torregrosa & Sevilla, 2010). The reality has shown that autonomous organizations established by farmers can supply appropriate institutional arrangements to

protect individual farmers' interests and distribute irrigation water fairly.

In general, the division of works of stakeholders in different types of conservancy supply service is a significant parts of conservancy supply institutions. Supply methods and relevant institutional arrangements can significantly affect stakeholders' interests in conservancy supply. Stakeholders' behaviours and actions can bring various influences on the effectiveness of conservancy supply services. As stakeholders have different divisions of works in different types of conservancy supply services, there are different standards to judge whether stakeholders' actions and behaviours are effective or not in accurate institutional environment.

4.1.3 The construction and maintenance of conservancy infrastructures

The construction and maintenance of conservancy infrastructures is the most significant part of conservancy supply institutions in the physical level. The construction and maintenance of conservancy infrastructures can directly affect the effectiveness of conservancy supply. Therefore, conservancy supply institutions make statements and regulations about the construction and maintenance of conservancy supply programs, infrastructures and facilities.

For the construction of conservancy supply system, the government, the market sector and autonomous organizations all can take the responsibility for conservancy construction. Normally, the central government involves the construction of large-scale conservancy supply programs in both developed countries and developing countries especially in socialist/former socialist countries. Private sectors and autonomous organizations neither have enough technology, capital nor can organize large amount of labours to construct large-scale conservancy supply programs (Sánchez-Rubio, 2008). For example, rural water conservancy supply project in Tennessee, the USA, Tibi Dam construction in Alicante, Spain, conservancy construction and the plan of remodeling the nature in Aral Sea area in the former USSR and the conservancy construction and remediation in Huaihe River Basin in China are all dominated by the central government of the country. Only the central government of a country has enough capital, labour and technology to deal with large-scale conservancy supply programs. However, the central government of a country seldom participate in the accurate construction of middle and small-scale conservancy supply programs.

Instead, in the government-driven conservancy supply institutions, the central government always make macro conservancy development plans, offer

policy and financial support for conservancy construction and ask conservancy professionals and local government officials to organize and manage the accurate conservancy constructions. Even in socialist countries and agricultural-based developing countries like the USSR, China and Sri Lanka, the central government did not involve in accurate conservancy constructions at the local level (Hussain & Hanjra, 2004). The local government officials and some conservancy professionals are in charge of daily management and organizational works of rural water conservancy constructions. Farmers in socialist countries and developing countries are responsible for accurate concrete construction works and hard labour works.

In the market-driven institutions, accurate conservancy construction works at the local level are mainly dominated by the market. In some developed countries in Europe, the North America and East Asia, private corporations/investors, landlords and some farmers are in charge of the construction of accurate conservancy supply programs on their land (Banerjee & Duflo, 2011, pp.37-41). They use their own capital to invite conservancy professionals to demonstrate constructions plans and invite other farmers/labours or even professional construction companies for engineering and constructing works of conservancy supply programs. All the construction works follow the market principle and stakeholders complete all the transactions in the market institutional circumstance.

In the polycentric conservancy supply institutions, farmers' autonomous conservancy supply organizations are in charge of the accurate construction of conservancy supply system. The executive committee and organization leaders of autonomous conservancy organizations in Spain, Sri Lanka, the Philippines and some other countries have the rights to make conservancy construction plans, collect capital and resources from organization members and organize farmers (autonomous organization members) to participate in conservancy supply constructions (Garrido et al, 2006). Normal farmers in autonomous organizations are major labours to prepare necessary materials and deal with accurate concrete construction works (Araral, 2005). Farmers and their autonomous organizations manage accurate conservancy construction works themselves without help from local governments and other stakeholders.

Although the regulations of the maintenance of rural water conservancy supply system are also significant parts of rural water conservancy supply institutions, there is a few clear and independent regulations about conservancy maintenance. Regulations and statements about the maintenance of

conservancy supply programs are normally seen as the supplement of construction and daily management in conservancy supply institutions.

There are three major ways to supply maintenance services for conservancy infrastructures and facilities. In the government-driven rural water conservancy supply institutions, local governments supervise and organize the maintenance of conservancy infrastructures and facilities. Local government officials mainly make maintenance plans and offer administrative and financial support for the accurate maintenance. In socialist countries and some developing countries such as the USSR, China and Sri Lanka, local government officials ask village leaders to organize labours and materials and manage the accurate conservancy maintenance (Siebert et al, 2010; Molle & Renwick, 2005). Farmers are responsible for labour works. Farmers normally do volunteer works for conservancy maintenance.

In the market-driven rural water conservancy supply institutions, stakeholders (farmers, landlords and private corporations) who operate the farmland and establish conservancy supply system on the land are normally responsible for conservancy maintenance (Torregrosa & Sevilla, 2010). Those stakeholders use their own capital to manage and organize the maintenance of conservancy infrastructures and facilities. They could get labours, necessary materials and new equipment from the market for the conservancy maintenance.

In the polycentric conservancy supply institutions, farmers' autonomous organizations are mainly responsible for the maintenance of conservancy supply infrastructures and facilities. The maintenance of conservancy supply system in a significant work of many autonomous conservancy supply organizations. Autonomous conservancy supply organization leaders and commissioners in Spain and the Philippines have to arrange sufficient labours and materials for the maintenance of conservancy infrastructures and facilities such as dredging drains, reinforcing dam and updating equipment (Shively & Martinez, 2001). Farmers in autonomous conservancy supply organizations are responsible for offering free labours to keep the smooth implementation of maintenance works.

4.1.4 Property rights related issues of conservancy supply

The core of conservancy supply institutions is the arrangement of conservancy supply property rights. Property rights configuration situation can affect stakeholders' motivation and investment enthusiasm in conservancy supply. It can significantly affect the long-term effectiveness of conservancy supply.

Therefore, clear and effective conservancy supply property rights attribution and configuration is the key to increase the effectiveness of conservancy supply.

Property rights related issues of conservancy supply include different aspects. The ownership of conservancy supply facilities/infrastructures and use rights of conservancy supply facilities/infrastructures, the rights to benefit/profit from using or operating a conservancy supply system, the rights to distribute and use water all belong to property rights related issues. Rural water conservancy supply intuitions regulate how to distribute and allocate conservancy property rights. There are several approaches to distribute and allocate conservancy property rights in different institutional environment.

The first aspect of conservancy supply property rights is the ownership of conservancy supply facilities/infrastructures and the rights to use conservancy supply facilities/infrastructures. In the government-driven rural water conservancy supply institutions, in socialist countries/former socialist countries like China and the USSR and some agricultural-based developing countries like Sri Lanka, the government owns most conservancy facilities and infrastructures. The government provides use rights of conservancy facilities/infrastructures to villages and other agricultural producing units and allows them to use those facilities/infrastructures (Micklin, 1988). Meanwhile, the use rights belong to the collective rather than individual farmers. Farmers in those countries cannot use conservancy supply facilities/infrastructures freely without the permission of the village leader or the producing unit (Hussain & Hanjra, 2004). In the market-driven rural water conservancy supply institutions, property owners in the Europe and North America (individuals and corporations) who have the ownership of farmland and conservancy supply facilities/infrastructures also have the rights to use conservancy supply facilities/infrastructures (Pérez-Sánchez, 2017). Ownership and use rights of conservancy supply facilities and infrastructures in the market-driven rural water conservancy supply institutions normally belong to the same people/corporations. In the polycentric rural water conservancy supply institutions, the ownership and use rights of conservancy supply facilities and infrastructures are normally separated. There are different approaches to allocate ownership and use rights of conservancy supply facilities and infrastructures in the polycentric institutions (García-Mollá et al, 2014). Local governments, corporations, autonomous conservancy supply organizations and individuals all can be owners of conservancy supply facilities and infrastructures (Siebert et al, 2010). Through

the market or spontaneous trading actions, those owners can transfer the use rights of conservancy supply facilities/infrastructures to individual farmers or agricultural corporations who need conservancy supply services.

The second aspect of conservancy supply property rights is the rights to benefit/profit from using or operating a conservancy supply system. In the government-driven rural water conservancy supply institutions, since the ownership of most conservancy supply facilities and infrastructures belong to the government, any individuals or economic organizations cannot make economic benefit/profit from operating conservancy supply system. The government treats conservancy supply services as basic public services in rural areas (Jin & Qian, 1998). Most socialist countries and some developing countries in Southeast Asia do not make direct economic profit from conservancy supply services (Molle & Renwick, 2005). The central government and villages/farmers share extra agricultural products gotten from effective conservancy supply services (O'Hara, 1997). In the market-driven rural water conservancy supply institutions, economic benefits/profits from using or operating a conservancy supply system belong to owners of conservancy facilities/infrastructures. Owners have rights to get economic interests through offering conservancy supply services to others (Molina et al, 2006). They have absolute legal rights to deal with their conservancy supply facilities/ infrastructures. In the polycentric conservancy supply institutions, the rights to get economic benefit/profit from using or operating a conservancy supply system also belong to owners of conservancy supply facilities/infrastructures. However, autonomous conservancy supply organizations, individual farmers and corporations also can participate in conservancy supply by various approaches and share economic interests with owners of conservancy supply facilities/infrastructures (Ortega-Reig et al, 2014). Individuals and corporations who plant crops have rights to deal with agricultural products that benefit from conservancy supply services.

The last aspect of conservancy supply property rights is about the rights to distribute and use water. Irrigation water is the basic product of a conservancy supply system. How to distribute and use water is a significant part of property rights related issues in conservancy supply. In the government-driven rural water conservancy supply institutions, local governments and officials can decide how to distribute and use water. Officials in the USSR and China (pre-reform era) use administrative commands to allocate certain amount of water to each village for irrigation. Farmers and village leaders have no rights to change the allocated

water amount (Micklin, 1987). In the market-driven rural water conservancy supply institutions, any individual farmers or agricultural corporations can buy water from the open market. Once crop growers make deal with owners of a conservancy supply system, crop growers can get certain amount of irrigation water with agreed price. In Alicante (Spain), some other places in the Europe, Sri Lanka (since the 1980s) and China (in the 1980s and 1990s), stakeholders trade water use rights through market transactions. Laws in those countries protect both owners of conservancy supply facilities/infrastructures and water users' rights in water trade (Sánchez-Rubio, 2008). In the polycentric conservancy supply institutions, water users coordinate and compromise with owners of conservancy supply facilities/infrastructures to distribute and use irrigation water. They use both market and administrative ways to coordinate how to allocate water and how to distribute interests. Autonomous conservancy supply organizations in the South and Southeast Asia countries like Bangladesh, the Philippines, Laos and some parts in Malaysia distribute and use water through coordination among each other (Banerjee & Duflo, 2011, p.59-61).

4.2 RURAL WATER CONSERVANCY SUPPLY IN RURAL CHINA IN THE COLLECTIVE ERA

In the collective era, rural China established modern water conservancy supply system and infrastructures. Rural water conservancy supply had experienced rapid development and had made great achievements in the collective era. However, there were also many problems of the government-driven rural water conservancy supply institutions. Without sustainable development plan and effective institutional arrangements, the government-driven rural water conservancy supply system collapsed in the late 1970s.

4.2.1 The origin of modern rural water conservancy supply system

Mao Zedong ever instructed that water, soil, fertilizer, seeds and other four factors were keys to improving agricultural productivity[15] (Guo, 2009). Mao's argument offered the general guideline of agricultural policies from the mid-1950s to the late 1970s. Water conservancy system was put to the primacy (Mao, 1955). Mao mentioned many times of the importance of rural water conservancy system in different occasions (Wu, 2007).

[15] It was from the *eight words agricultural constitution* (*Nongye Bazi Xianfa*, 农业八字宪法) made by Mao which aimed to find key points to increase agricultural productivity.

Mao did find the important functions of water conservancy system in agricultural productions through his own experience as a revolutionary leader who had close links with farmers and rural areas. The modernization of rural water conservancy system was a good and scientific way to improve agricultural productivity in that era (Ministry of Finance, 1994, pp.150-153). Besides that, water conservancy supply programs normally needed strong leadership, a lot of labours and huge amount of collective works, which could be used to represent the strong communist power and its advantages. Constructing rural water conservancy system was recognized as the spirit that human beings can conquer the nature (*Ren ding Seng tian*, 人定胜天) (see Figure 3.1) (Guo, 2009). It could meet with Mao's personal political preference and interests (Lin, 1989). Therefore, establishing rural water conservancy programs became a main theme of agricultural infrastructure constructions since the mid-1950s (Wu, 2007).

Figure 4.1 The propaganda poster of the eight words agricultural constitution [16]

The establishment of modern rural water conservancy supply system and government-driven conservancy supply institutions changed the traditional agricultural producing mode and reduced agriculture's reliance on the nature (Luo, 2006, pp.23-26). Modern rural water conservancy conservancy supply system significantly increased agricultural productivity (Pan, 2002). From the 1950s to the 1980s, the government-driven conservancy supply institutions were generally successful that the central government and local governments in Chia dominated the construction of many conservancy supply infrastructures and

[16] The photo is available at：http://www.ekoooo.com/html/huaijiuzhongguo/wengehaibao_zhaotie/nvxing/2010/0414/1875776.html, recruited in the 15th, March, 2015.

facilities.

4.2.2 The government-driven rural water conservancy supply institutional arrangements

In the collective era, conservancy supply intuitional arrangements were dominated by the government. The central government of China made macro plans and dominated allocations of conservancy supply programs. The central government used Conservancy Construction Five Plans, Central Conservancy Working Conference Document, Five-year Plans for Agricultural Development and other macro policy documents regulated the allocation of large-scale conservancy supply programs all over China. Local governments especially county governments and township governments made guidelines themselves based on macro documents for the allocation of conservancy programs within the administrative regions (Pan, 2002). In practice, conservancy professionals could offer their professionals advices for the allocation of different programs while government officials made final decisions (Wu, 2007). In general, the institutional arrangements gathered rich resources and established many modern conservancy supply programs in rural areas. Many farmlands in Eastern and middle part of China got effective conservancy services and increased the general agricultural productivity. Meanwhile, since government officials lacked professional knowledge and had problems of information asymmetry, their decisions also caused serious problems and waste.

Before the reform era, the division of works and responsibilities of stakeholders in conservancy supply was government-dominated. The government controlled all parts of conservancy supply. In the government-driven institutional circumstance, the central government was mainly responsible for making macro agricultural and conservancy development plans and local governments were supervising and controlling accurate conservancy issues. Agricultural and conservancy related documents made by the central government regulated that governments should offer both financial and administrative supports for the development of conservancy supply (Tan, 1958). County and township governments used executive orders to implement local conservancy development plan in the pre-reform era (Tang & Li, 2005). Local government officials and village leaders had strong authority to organize farmers and professionals to participate accurate conservancy construction and maintenance works. Village leaders were also responsible for checking farmers' performance in conservancy supply since farmers were major forces in conservancy construction works. Village leaders were loyal executors of official

policies and higher-level governments' commands (Pan, 2002). In the collective era, official banks and financial cooperatives were only organizations to supply financial services for conservancy supply programs. Those organizations offer financial services based on local governments' needs and commands without self-determination.

Local government officials and village leaders organized and managed accurate conservancy supply construction and maintenance works in the collective era. County and township government followed macro plans made by the central government to establish and implement their own conservancy development plans. In order to show their active working attitudes, local government officials and village leaders normally improved design and construction standards of conservancy supply programs and adde farmers' labour work amount (Yang, 2011). Sometimes, they even use administrative approaches to force and organize large-scale farmers to participate in conservancy construction and maintenance works (Wang, 2007).

For property rights related issues of conservancy supply institutions in the collective era, the country, local governments and local official water departments were owners of most conservancy supply facilities/infrastructures. They had absolute rights to distribute and arrange the use of different conservancy supply facilities/infrastructures to villages and agricultural producing units. Since most conservancy supply facilities/infrastructures belonged to the public, profits and benefits from using or operating the conservancy supply system also belonged to the public. In the collective era, the government mainly used rural water conservancy supply system to supply public services rather than making economic profits (Jin & Qian, 1998). The government also planned, controlled and managed the use of water to increase agricultural productivity. Official water department officials used administrative commands to make water use plan and allocate certain amount of water to each village for irrigation (Micklin, 1987).

4.2.3 Advantages and achievements of the government- driven rural water conservancy supply institutions

The new political and administrative system and the new leadership team in rural China offered basis for the development of the government-driven rural water conservancy supply system. New conservancy supply institutions were supported by the central government and the CCP (Mao, 1955). They offered enough capital and strong organizational structure to establish the modern rural water conservancy supply system. New institutions had stronger organizational

capacity and higher operational efficiency than traditional conservancy supply institutions (Wu, 2007). The government-driven conservancy supply institutions were suitable for developing large-scale modern rural water conservancy supply system in rural China especially with the strong support from top leaders and the central government.

Firstly, national power significantly encouraged the establishment and fast development of modern rural water conservancy supply system in the collective era. Since the PRC was founded, top leaders and the central government paid high attention to the development of rural water conservancy supply system (Tan, 1957). Investing rural water conservancy supply programs could meet top leaders' political preference and interests. Local governments and officials also followed and implemented those institutions for their own political interests.

Mao Zedong made *the eight-word agriculture constitution*[17] to point out the importance of developing a modern rural water conservancy supply system in China. Liu Shaoqi and other leaders also supported Mao's idea (Tan, 1958). On August 29th, 1958, *the Central Conservancy Working Instruction* was published [18], which stated that rural China's water conservancy supply development should follow three basic principles: developing small-and medium-scale conservancy supply programs; establishing water storage-based programs and relying on people's communes and farmers to construct conservancy supply programs. The instruction mentioned that by 1957, over 57% of farming land in China had established rural water conservancy supply system. The *Central Conservancy Working Instruction* mentioned that it was possible to take another two years to cover all the farming land in China by the government-driven rural water conservancy supply system. *The instruction* and *the eight-word constitution* became the *Bible* of developing government-driven rural water conservancy supply system (Wu, 2007).

In the early summer of 1958, Mao and his colleagues held water conservancy work meetings both in Xiangyang and Zhengzhou to plan the development of rural water conservancy supply system (Wu, 2007). Through the meetings and relevant documents, the central government and top leaders reached the consensus to increase input to establish and develop modern rural water conservancy supply system. Establishing and maintaining rural water conservancy supply programs and infrastructures had been the core of

[17] It mentioned that officials and farmers should pay attention in the aspects of soil, fertilizer, conservancy, seeds, close planting, pest control, management, tools (*Tu, Fei, Shui, Zhong, Mi, Bao, Guan, Gong,* 土、肥、水、种、密、保、管、工) to increase agricultural productivity.

[18] Available at: people.com.cn http://cpc.people.com.cn/GB/64184/64186/66665/4493236.html, recruited in the 25th, May, 2015.

agricultural development work thereafter (Wu, 2007).

The central government also made institutions and offered financial, technological and engineering support for the rural water conservancy supply system. Although *the Central Conservancy Working Instruction* mentioned that constructing rural water conservancy supply system mainly relied on local governments and farmers, it was also the priority of the central government and top leaders. The central government also used rural water conservancy programs to judge officials' political achievements. Since rural China lacked modern technology and machines for conservancy supply programs, the central government asked the Ministry of Water Resources to send experts, working groups and necessary machines such as excavators (just a few places can get the help of machines) to different areas to support rural water conservancy constructions (Wu, 2007). It was similar in the local level. Local officials also mentioned that they were following the *Central Conservancy Working Instruction* and *the eight-word agriculture constitution*. Although some conservancy development aims were unrealistic, it still objectively encouraged the development of rural conservancy supply in the collective era.

Secondly, administrative authority from local governments and village leaders was helpful to mobilize, organize and even force farmers to join in the construction and maintenance of modern rural water conservancy supply system. According to *the Central Conservancy Working Instruction,* the establishment and maintenance of conservancy supply programs and relevant facilities were mainly relying on farmers' labours and limited machines. The government-driven conservancy supply institutions used administrative authority to overcome problems of lacking machines and capital (Hirschman, 1970, pp.3-8). Since there were many conservancy supply programs established in the collective era, officials' commands and communist spirit had been proved as significant tools for the establishment and fast development of modern rural water conservancy supply system[19]. In the late 1950s, volunteer work (coerced work) and work points system became a part of formal conservancy supply institutions that all the farmers had to obey and participate in conservancy construction works (Luo & Liu, 2005). Farmers' participation offered enough labours for the fast development of conservancy constructions.

The administrative authority of the government significantly supported the establishment and maintenance of many large-scale conservancy supply programs by organizing farmers effectively. Almost 80% of all the labours then

[19] The Central Conservancy Working Instruction, available at: http://cpc.people.com.cn/GB/64184/64186/66665/4493236.html, recruited in the 13th, May, 2015.

aged 16 to 60 (both male and female) interviewed in this research (until 1980) were ever coerced to join the constructions of local rural water conservancy system in turn[20] (Source from interview materials). For example, in Xinzhou district (used to be Xinzhou County, now belongs to Wuhan City), the government organized farmers to maintain a 30m wide, 15m deep and over 43km long river and construct a new 14.3km long artificial river with the same width and depth to connect the Yangtze River and different lakes to offer conservancy services for nearly areas (China News, 2012). This program was supported by the then Prime Minister Zhou Enlai and his assistant Li Xiannian[21]. In order to construct this big project, the Xinzhou county government coerced almost all the labours over 15 years old to join the program in turn (Source from Xinzhou County Conservancy Archives Compilation[22], Vol 3, pp.76-90). The construction works lasted over 2 years (the major program lasted from 1970 to 1972 and all the work finished in 1974) and the average population on the construction site was over 50,000 per day[23] (Wang & Wang, 2013). Without strong administrative authority, the government was not possible to organize such huge amount of farmers to join in the large-scale conservancy supply construction and maintenance works effectively and got obvious construction achievements.

Thirdly, the collective social and political atmosphere also played positive roles to support the establishment and fast development of modern rural water conservancy supply system. The development of political involution in rural China helped the establishment of collective political and social atmosphere. The government's intervention in rural issues had been spread from the material level to the spiritual level. The national will to establish modern rural water conservancy supply system liked mental stimulants to push people to join conservancy supply infrastructures' construction and maintenance. Official media, propaganda, top leaders' speeches and activities strengthened the collective social and political atmosphere in the pre-reform era (Pennebaker, Paez & Rim, 2013, pp.163-165).

As the collective atmosphere made farmers more active and had motivations to join in construction and maintenance works of conservancy supply, common interests existed between the government and farmers (Parsons,

[20] The age may slight different in different places.
[21] Available at: Chinanews: http://www.chinanews.com/cul/2012/08-21/4121051.shtml, recruited in the 17th, May, 2015.
[22] Internal documents, not open to the public.
[23] This calculation was from the local officials and farmers who had ever joined the constructions. The total labours for the program were about 200,000 people per day in Xinzhou, Macheng, Hong'an, Huanggang and Xishui five counties.

1964, pp.86-88). The whole nation, from the central government to local governments, from top leaders to ordinary farmers had high enthusiasm and paid attention to think about establishing modern water conservancy system in rural China to improve agricultural productivity from the 1950s to the 1970s (Moon, 1992).

Compared with other time periods, farmers and local officials were proud of joining conservancy constructions and believed their works had made great contributions for conservancy supply and China's agricultural development in the collective era (Mushtaq et al, 2006). Although the collective social and political atmosphere also caused problems of conservancy supply, it brought more positive impact than negative impacts. Since farmers, village leaders and some local officials got their political and social statuses promoted and benefited from the new regime in the land reform era in the early 1950s, they trusted the CCP and its government-driven institutions (Pye, 2006, pp.56-62). Through their experience, local officials, village leaders and farmers understood that works for establishing modern rural water conservancy supply system were good to agricultural development and the development of *the great socialist country* (Mushtaq et al, 2006). Besides, the Youth League and Women's Federation members and other new organizations supported by the CCP also became pioneers to propagate and attend labour works for conservancy program constructions (Pennebaker, Paez & Rim, 2013, pp.183-185). The collective social and political atmosphere shaped an image of the future of rural area which made Chinese people feel excited. It pushed and encouraged people to join in conservancy supply programs and ignore the pain and hard labour work for conservancy supply (Pennebaker, Paez & Rim, 2013, pp.14-21).

In general, many villages in eastern and middle part of China established their wells, irrigation drains and other conservancy supply infrastructures during the collective era (Pan, 2002). On average, over 80% of farmlands in the plain regions and over 60% of farmlands in the hills had been covered by the modern conservancy supply system by the late 1970s in those villages (Wu, 2007). The overall irrigated area as percent of arable land was 23.25% in 1953 and 47.60% in 1975 all over China (Fan et al, 2002, pp.21). From 1953 to 1980, the average annual growth rate of government investment on rural water conservancy system in agricultural infrastructure constructions was about 7% (the peak point was about 8.2%) (China Statistical Yearbook, 2002).

Therefore, in the collective era, the government dominated conservancy supply and used administrative approaches to organize farmers and other social

groups to participate in conservancy supply. The government-driven rural conservancy supply institutions achieved original aims to establish the modern rural water conservancy supply system and improve conservancy supply effectiveness according to above data. However, the government-driven institutional arrangements also led to many problems and serious waste which affected the long-term effective operation of the rural water conservancy supply system.

4.2.4 Problems of the government-driven rural water conservancy supply institutions

The government-driven rural water conservancy supply institutions had problems which left hidden dangers for the sustainable development of the newly established modern rural conservancy supply infrastructures and programs in the collective era. Those problems caused the collapse of the whole set of government-driven rural water conservancy supply institutions in the late 1970s.

The biggest problem was that macro conservancy supply development plans were totally dominated and controlled by the central government and a few top leaders. Conservancy supply plans in the collective era could represented the interests of a few political leaders while hard to represent most farmers' interests on some extent. The central government and top leaders set excessively ambitious aims which were far away from reality and hard to be achieved within a short time period. Local officials, village leaders and farmers were all executors of the ambitions. Mao and his colleagues were overoptimistic about human labours and spiritual power but overlooked the financial and engineering difficulties to establish water conservancy supply system (Zhang et al, 2004). They hoped the rural water conservancy system could cover most of farmlands in China by 1958[24]. However, even today, this aim has not been achieved yet. More, in order to show their political consciousness, local governments and officials raised conservancy supply construction targets which were even higher than the central government's requirements (Wu, 2007).

The ambitions caused serious results. Although local officials, village leaders and farmers had high enthusiasm to join the conservancy supply construction works in the early stage of the government-driven rural water conservancy supply era, many projects failed due to lack of financial investment and necessary technical support while some so-called *successful programs* also

[24] It was from Mao's speech in the Zhengzhou central government water conservancy meeting.

brought negative results (Guo, 2009). *The Central Conservancy Working Instruction* mentioned that local governments should adopt rural water conservancy supply programs to local conditions. However, in actual operation, officials did not get clear ideas of developing suitable rural water conservancy supply infrastructures and facilities but just carried out institutions of the central government blindly (Yang et al, 2003). Many local leaders and officials thought that water conservancy was equal to reservoirs. Therefore, they organized farmers to construct reservoirs, which caused the salinization of farmlands and reduced agricultural productivity (Pan, 2002). Liu Shaoqi criticized and tried to stop such radical approaches in *the Seven-thousand People Congress* in 1962. He agreed to reduce developing speed and consider more about the reality and people's needs (Zeng, 2000). However, since Mao was the top leader and had the absolute authority, conservancy supply approaches should satisfy his political preference and interests. His bounded rationality would not be easily changed by others (Ling, 1996, pp.90).

Besides that, too many resources and labours were put into rural water conservancy supply programs, leading to serious waste in the construction site and reducing agricultural productivity. From 1958 to 1960, China was in *the Great Leap Forward*. During that time period, most farmers were organized to smelt iron and steel and construct rural water conservancy supply systems[25]. Meanwhile, since local officials and farmers lacked professional knowledge about conservancy construction, many of the programs failed and large amount of funding, human capital and natural resources were wasted (Ling, 1996, pp.154-158).

Regardless of the fact that the establishment of modern rural water conservancy supply programs helped China's agricultural development, the government relied too much on human labours and communist spirits (Pan, 2002). The government offered little financial and technique support and caused the failure of many conservancy supply programs. The government-driven rural water conservancy supply institutions in the collective era had shortages of wasting money, time, labour and resources. Those institutional arrangements resulted in negative consequences for the long-term sustainable development of conservancy supply and agricultural development (Tang & Li, 2005). It was good that the government-driven institutions could mobilize and organize a large amount of people to join in conservancy construction effectively. However, just considering a few top leaders' political preference and interests, setting up aims

[25] Source from the People's Daily of the April 4th, 1959.

far beyond the reality without effective incentive mechanism to farmers and village leaders made the government-driven conservancy supply institutions finally collapse.

CHAPTER 5 THE STAGNATION OF MODERN RURAL WATER CONSERVANCY SUPPLY SYSTEM: THE ERA OF THE MARKET-DRIVEN RURAL WATER CONSERVANCY SUPPLY

This chapter will introduce the market-driven rural water conservancy supply institutions in rural China from the early 1980s to the late 1990s[26]. In order to solve problems of the government-driven institutions, the central government applied formal institutions based on the market mechanism such as privatization and outsourcing to offer rural water conservancy services. However, social groups did not play positive roles to implement formal market-driven conservancy supply institutional arrangements. The development of rural water conservancy supply system in the market reform era therefore stagnated. Problems of division of works and responsibilities, problems of conservancy maintenance institutional arrangements and unclear property rights configuration reduced the effectiveness of the modern rural water conservancy supply system.

This chapter will briefly introduce the establishment of market-driven rural water conservancy supply institutions first. Then this chapter will state the institutional framework and major arrangements of those institutions. The actual institutional operation situations will be offered in the later part. Reasons that caused the stagnation of rural water conservancy supply development will also be discussed. A model of the institutional operation of rural water conservancy supply in the market reform era will be introduced to support the analysis. The last part is the summary of the failure of the market-driven rural water conservancy supply institutions.

[26] The market-driven institutions set individual/family rather than the collective as the agricultural producing unit and encouraged to use market approaches such as free economy, competition, privatization or marketization to solve economic problems including offering rural public goods supply. The market plays the basic role in economic development while the state plays the role of macro-control. The market-driven institutions formally established in 1983 in many places since the household contract responsibility system formally established in that year.

5.1 THE ESTABLISHMENT OF THE MARKET-DRIVEN RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

The low effectiveness of rural public goods supply methods in the collective era could not support the long-term operation of the government-driven institutions. The development of rural water conservancy supply stalled in the 1970s. Nobody could offer enough capital or organized huge labours to construct or maintain rural water conservancy supply programs (Tang & Li, 2005). Worse, the Cultural Revolution caused the paralysis of economic development and political tensions in the 1970s in rural China, which did not allow the government to take effective measures to adjust conservancy supply institutions within the government-driven institutional framework (Wu, 2007).

From the early 1970s, Zhou, Deng and some other top leaders had prepared to adjust institutional arrangements within the framework of government-driven institutions. However, due to reasons such as obstructions of conservative officials and ideological considerations, the adjustments were not successful (Wu, 2007). Since the government-driven institutions could no longer last in the late 1970s, top leaders, local officials and different social groups tried to find new institutions to solve rural China's conservancy supply problems. The details of the establishment of new institutions can be found in Figure 5.1 (the number is following the time series).

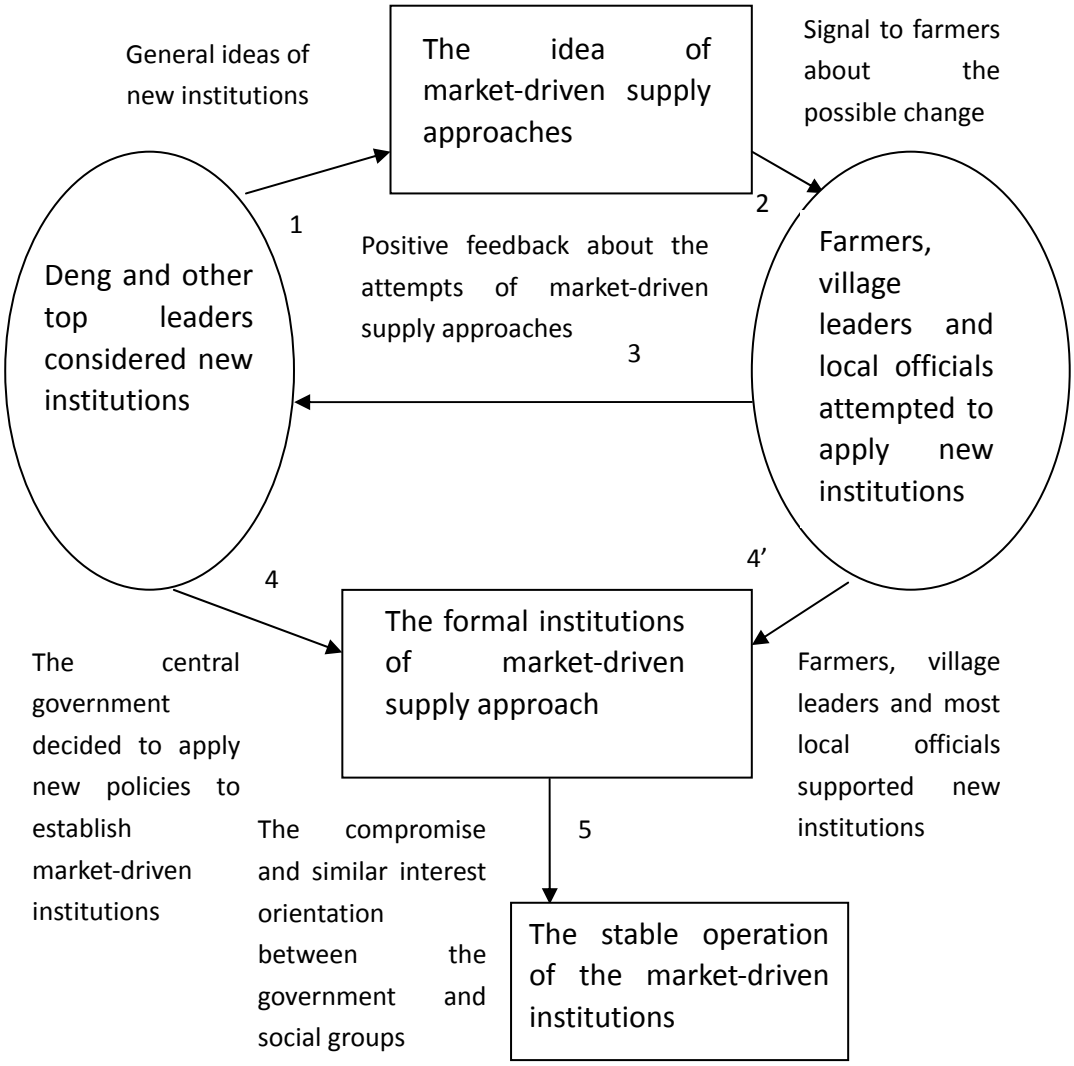


Figure 5.1 The establishment of the market-driven rural water conservancy supply institutions

After Mao's death in 1976, Deng and other top leaders got the chance to defeat pro-Mao conservative leaders and got success. Then pragmatists started to carry out their plans to make the institutional change (Tao, 2004). Upon becoming the new leader of China in the late 1970s, Deng Xiaoping agreed and accepted some attempts of market-driven informal institutions and encouraged local leaders such as Zhao Ziyang and Wan Li to establish market-driven approaches for agricultural producing officially in their governed provinces (Zhang & Liu, 2009). Since Zhao and Wan achieved huge success in allocating the collective land and relevant facilities to individual farmers and allowing farmers to arrange agricultural producing themselves, Deng and the central government leaders made up their minds to push forward the reform toward the establishment of formal market-driven institutions (Shui & Veeck, 2012). The signal from the top level encouraged local officials, village leaders and farmers

to explore new ways to solve problems in rural China.

According the path-dependence theory, human beings will rely on what choices they have made to choose future path (North, 1990, pp.124-127). Since the government's control and intervention had caused serious negative influences on rural China in the Cultural Revolution and other political movements, farmers no longer accepted coerced collective work and unified product distribution methods in establishing new institutions (MacFarquhar, 1997, pp.302-313). Since family-based property rights distribution methods were proved successful in the early 1950s all over China and in the early 1960s in some areas, they became first options to establish new institutions though they also had some shortages (Chen, 1993, pp.475-476). Family/individual-based producing methods and market-driven institutions shaped the basis for China's later economic growth (Oi, 1992). People had enthusiasm to work on their contracted land and significantly improved major crops' productivity without being lazy and slack in agricultural works. Once villages like Xiaogang got success of market-driven agricultural producing methods, farmers and leaders in other villages applied similar institutions (Lin, 1991). Those attempts of market-driven agricultural producing methods offered positive feedback for the central government to make policies to establish and further develop formal market-driven institutions.

In the early 1980s, the market-driven institutions were formally established and thereafter have been spread to different aspects all over China (Yang et al, 2003). Those institutions led to the rapid development of agriculture productivity within a short time (Lin et al, 1996). The ideas of market mechanism were widely accepted by officials and farmers (Lin, 1991). The government, farmers and other social groups established the new market-based cooperative relationship to deal with various issues, including the provision of rural water conservancy services and facilities.

In general, the market-driven institutions reallocated land use rights and offered more freedom for farmers and other social groups to release their potentials and enthusiasm of increasing agricultural productivity in rural areas in the early 1980s (Sun, 2003, pp.42-45). Correspondingly, the market-driven conservancy supply institutions also separated and reset different stakeholders' roles in conservancy supply and reallocated property rights of conservancy facilities and infrastructures. Social groups such as farmers' federations[27], financial organizations and private corporations played increasingly significant

[27] Farmers' federation here means the autonomous organizations made by farmers to deal with producing and daily matters rather than formal official organizations.

roles in conservancy supply in the reform era.

5.2 THE INSTITUTIONAL FRAMEWORK AND ARRANGEMENTS OF MARKET-DRIVEN RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

In the market economic environment, the market was playing the most significant role in economic and social development (No.1 Central Document, 1983; 1984). The central government controlled economic and social development at the macro level and allowed the market mechanism to adjust economic operation (Lin, 1988). Through the No.1 Central Document in 1982, 1983 and 1984, Minutes of the National Rural Work Conference in 1982 and Decision of the Central Committee of the CCP on Further Strengthening Agriculture and Rural Work in 1991, the central government formally established the household contract responsibility system. The government separated responsibilities of public goods supply including establishing and maintaining conservancy supply infrastructures and facilities to local governments, villages and individual farmers (No.1 Central Documents, 1982-1985). In the reform era, the market mechanism dominated intuitional arrangements of conservancy supply (Summary of Rural Water Conservancy Supply Development in the 1990s in Xiangyang County, 2002). Construction and maintenance of conservancy supply system followed the principle of maximizing economic benefits.

The four major aspects of formal conservancy supply institutions-allocations of conservancy supply programs in different areas, division of works and responsibilities of stakeholders, the construction and maintenance arrangements of conservancy infrastructures and property rights related issues of conservancy supply have had obvious changes in the reform era. The new market-driven formal institutions were established to replace old government-driven ones. The new institutions hope to increase the effectiveness of conservancy supply and promote stakeholders' enthusiasm to participate in construction and maintenance works of conservancy supply (No.1 Central Document, 1984).

Since there were a few large-scale conservancy supply programs newly established in the reform era, the central government of China no longer made new macro development plans and dominated accurate construction and maintenance works of large-scale conservancy supply programs (Archives of Xiangyang County Water Station, 1987, vol35). The central government no

longer controlled the allocations of new conservancy supply programs (Decision of the Central Committee of the CCP on Further Strengthening Agriculture and Rural Work, 1991). Local governments especially county governments and township governments which invested new conservancy supply programs got rights to allocate conservancy programs within their administrative regions (Archives of Xiangyang County Water Station, 1992, vol47). On the one hand, this arrangement hoped to reduce the bias and problems caused by lacking local knowledge. On the other hand, this institutional arrangement hoped to give more autonomy to local governments, villages and farmers who direct participate in conservancy supply and rely on the system.

The division of works and responsibilities of stakeholders in conservancy supply in the reform era followed the market mechanism. The central government no longer managed conservancy supply issues and asked local governments to manage conservancy supply appropriately by market approaches (No.1 Central Documents, 1983;1984). Local governments especially county and township governments should take major responsibilities to put administrative resources and capital to invest and manage rural water conservancy supply system (Summary of Rural Water Conservancy Supply Development in the 1990s in Xiangyang County, 2002). However, in the reform era, local government officials and village leaders lacked motivations and authority to organize farmers and professionals to participate in accurate conservancy construction and maintenance works since managing conservancy supply was no longer their major working task (Liu et al, 2013). Some village leaders with strong personalities and authority could organize farmers to maintain and manage conservancy supply system while some other village leaders could not deal with conservancy supply issues effectively (Ling, 1999, pp.67-72). In the market reform era, official banks and financial cooperatives were no longer totally controlled by the government. Based on institutional design, most banks, financial organizations and private investors should supply financial services for conservancy supply programs (No.1 Central Document, 1985). However, financial organizations and investors could not make much economic profits within a short time period through investing and offering loans to those programs (Tang & Li, 2005). Conservancy professionals during this time period no longer offered specific knowledge and advices for the construction and maintenance of conservancy supply. Since most conservancy professionals lost financial support from the government, they mainly sold irrigation water to feed themselves and keep the basic operation of some

conservancy infrastructures and facilities (Annual Summary of Xiangyang County Water Station, 1990). The new division of works and responsibilities of stakeholders aimed to clarify positions and interests of different stakeholders in conservancy supply in the reform era and reduced problems and low effectiveness caused by unclear division of works and shirking responsibilities (Wang, 2007). The new institutional arrangement hoped to encourage more individuals and social groups to participate in conservancy supply and reduce financial and administrative burdens of the government.

As constructing conservancy supply facilities and infrastructures needs huge labours and capital investment but cannot bring direct economic interests within a short time period, major works of conservancy supply in the reform era were maintaining existed facilities and infrastructures that established in the collective era (Summary of Rural Water Conservancy Supply Development in the 1990s in Xiangyang County, 2002). The government transferred duties of maintaining conservancy supply facilities and infrastructures to villages, farmers and those who needed to use the conservancy supply system (Wang, 2012). In the market-driven rural water conservancy supply institutions, based on the institutional design, local government officials and village leaders should be responsible for organizing and managing accurate conservancy supply construction and maintenance works (Archives of Lingbao City Water Department, 1986, vol33). Farmers should follow commands of government officials and village leaders to participate in maintaining large scale conservancy supply programs and relevant facilities and infrastructures on their contracted land (Wang, 2007). Banks and other financial organizations could offer financial support for the maintenance works of rural water conservancy supply system (Tam, 2013, pp.76-79). Different stakeholders should be responsible for different parts of conservancy maintenance works based on the market mechanism (Tang & Li, 2005). The new institutional arrangement aimed to use the market mechanism to replace government administrative commands to deal with conservancy maintenance works in the reform era. Major works of conservancy supply changed from constructing new programs to maintaining existed facilities and infrastructures showed that the government aimed to let conservancy supply development return to a rational path and reduce official investment to increase economic profits and supply effectiveness (Pan, 2002).

For property rights related issues of conservancy supply institutions in the reform era, the government tried to use market mechanism to reallocate property rights of conservancy supply infrastructures and facilities (No.1 Central

Documents, 1984;1985). Local governments were no longer only owners of conservancy supply facilities and infrastructures. The government separated ownerships of some conservancy facilities and infrastructures to individual farmers together with land use rights. Some other conservancy supply infrastructures and facilities belonged to different villages or water departments/institutes controlled by conservancy professionals (Summary of Rural Water Conservancy Supply Development in the 1990s in Xiangyang County, 2002). Each stakeholders could only use their owned conservancy supply facilities and infrastructures due to property rights allocation reasons (Internal Meeting Record of Xiangyang Regional Government, 1985, April, 6th). Therefore, the ownership and use rights of a whole conservancy supply system were divided into different parts controlled by different stakeholders. However, there was no clear mechanism for different stakeholders to cooperate with each other to keep the effective operation of the whole conservancy supply system in the market reform era; since the ownership and use rights of the conservancy supply system had been divided into different parts in the reform era, the rights to benefit/profit from using or operating conservancy supply infrastructures and facilities also belonged to different stakeholders who had ownerships (Internal Meeting Record of Xiangyang Regional Government, 1985, April, 6th). As conservancy supply in the market reform era was market-driven, different stakeholders were trying to maximize their economic interests by using and getting benefit from conservancy supply infrastructures and facilities. Meanwhile, this institutional arrangement ignored the public feature of conservancy supply system and caused new problems (Ke, 2010); although farmers had rigid demands of using irrigation water for agricultural producing, the rights to distribute and use water in the reform era mainly controlled by stakeholders who controlled conservancy supply infrastructures and facilities (Annual Summary of Xiangyang County Water Station, 2003). Farmers needed to buy water from pump stations, reservoirs or some other agents and pay administrative fees to relevant stakeholders for using irrigation water (Wang, 2007). The new institutions of conservancy supply property rights aimed to clear and reallocate property rights of the conservancy supply system and tried to use modern property rights theory to solve property rights problems in the collective era. The new institutions hoped to use market-driven property rights allocation modes to further encourage stakeholders' enthusiasm to participate and invest conservancy supply programs and increase the effectiveness of conservancy supply from the institutional level.

In general, the institutional framework and arrangements of market-driven rural water conservancy supply institutions have had significant changes in the market reform era. The new institutions aimed to use market-driven approaches to solve government-driven conservancy supply problems and increase conservancy supply effectiveness. Economic profits and personal/group interests became the priority of the development of conservancy supply. The new market-driven rural water conservancy supply institutions brought both changes and problems for conservancy supply in the market reform era.

5.3 THE STAGNATION OF RURAL WATER CONSERVANCY SUPPLY

The actual operation of the market-driven rural water conservancy supply institutions was not as good as the institutional design expected and had some problems. The market-driven rural water conservancy supply institutions were established to aim to solve conservancy supply problems in the collective era and increase conservancy supply effectiveness. The reform since the late 1970s had changed economic and social development mode in rural areas. Although agricultural productivity and farmers' living standard had improved much in the early 1980s, the supply of rural water conservancy services did not get any substantial improvement. The market-driven rural water conservancy supply institutions brought few positive changes. On the contrary, the development of rural water conservancy supply in rural China had been almost stagnant from the 1980s to the 1990s. The stagnation of the development of rural water conservancy supply system had long-term negative influences on agricultural productivity and economic development in rural China.

5.3.1 General problems in rural China in the reform era

In the reform era, the best time for farmers was the 1980s and especially the early 1980s. Cao Jinqing also argued that in the early 1980s, the Chinese government made a huge concession to farmers (2000, pp.48-53). The central government established market and family-based institutions. The purchase price of crops increased by 100% to 150% from 1977 to 1983 while the sale price of crops in cities did not have significant increase (Cao, 2000, pp.37-43). The central government used its financial transfer to pay for the increased price of crops. Cao argued that from 1978 to 1980, the central government transferred 20 billion RMB per year to farmers as crop price subsidies. The central government used subsidies of crop price to encourage farmers' enthusiasm to

grow crops and improve farmers' living standards (2000, pp.37-46). Many farmers built new houses and had much better lives. Therefore, the 1980s was the golden age for Chinese farmers.

Compared with their huge success of improving agricultural productivity and increasing farmers' incomes in the early and mid-1980s, market-driven institutions in rural China had encountered serious problems since the late 1980s and especially in the 1990s. Lin argued that marginal benefits of agricultural output of China in 1988 were even lower than those in 1982 (1991). The data also showed that the productivity of crops in Xiangzhou district had kept reducing from 1987 to 1999 by 2.38% per year (Xiangfan Statistical Yearbook, 2001).

Problems in rural China were referred to as *San nong problems* (三农问题)[28]. In 2000, Li Changping, a township leader in Jianli County (监利县), Hubei Province, wrote a letter to the then prime minister Zhu Rongji, stating that in rural China, lives of farmers were very hard, the countryside was so poor and agriculture was in danger (*Nongmin Zhenku*, 农民真苦; *Nongcun Zhenqiong*, 农村真穷; *Nongye Zhenweixian*, 农业真危险), which shocked the top leadership[29]. In general, there were some problems in rural China in the 1990s.

First, in the 1990s, farmers' lives became more difficult than the 1980s. Compared with the 1980s, most farmers' incomes from agriculture did not have significant increase since crop price was kept stable since the late 1980s. However, farmers' costs for seeds, fertilizers, pesticides and human labours were increasing (Kennedy, 2007). Farmers also had responsibilities of paying various taxes and fees. Therefore, the improvement of farmers' living standard stopped in the 1990s. Some farmers' living standard was even lower than that in the 1980s (Kennedy, 2007).

Second, the tax reform in 1994 increased problems for local governments to fulfill their obligations. The percentage of tax income of the central government in China's financial system kept reducing in the entire 1980s and this number reduced to 13% in 1994 (Cao, 2000, pp.40-45). The 1994 tax reform that aimed to solve the problem of low tax income of the central government was successful (Wong, 2000). Meanwhile, the tax reform also increased problems and poverty in rural China. The central government took money from taxes that were easy to collect while left rest taxes that were hard to collect to local

[28] The *San nong* problems are problems of agriculture, countryside and farmers (三农问题指农业，农村，农民问题).

[29] Available at: Tencent News, Sept.27, 2009, http://news.qq.com/a/20090927/000760.htm, recruited in the 10th, December, 2015.

governments (Chung, 1994). Therefore, compared with the 1980s, local governments met more serious financial problems in the 1990s. Local governments were hard to offer enough money to supply rural public goods.

The third problem was that in the 1990s, local governments experienced a fast expansion, which also increased rural China's poverty. Since the Chinese government established the market-driven institutions in the 1980s, new official departments had been built to manage relevant issues (Chung, 1994). Meanwhile, the government did not dissolve old government departments. The central government did not provide enough money to the entire bureaucratic system and allowed local governments to collect money from farmers for the operation of village autonomous organizations and some official departments (Cao, 2000, pp.85-89). Official organizations at the village level were autonomous nominally. Farmers therefore had to pay public expenditure and do volunteer works for the normal operation of the village[30] (Sun, 2003, pp.76). The 1994 tax reform also did not solve the problem (Chung, 1994). Therefore, local governments asked farmers to pay for new organizations and officials. Some village leaders argued that in the 1990s, these common phenomena added heavy burdens to farmers. Although some village leaders did not like the added fees, they had to collect fees from farmers since their salaries were from the collected fees (Wong, 2000). Both Cao and Sun argued that the expansion and requirements from local governments led to conflicts between the government and farmers in rural area in Central and Western China (Sun, 2003, pp.10-12; Sun, 2004, pp.15-18; Cao, 2000, pp.85-89).

The fourth problem was that the collapse of the people's commune also brought serious problems in rural China. Over 75% of the interviewees in this research who were over 60 years old until October 1st, 2015 (41 people) believed that though in the 1970s, the people's commune limited farmers' enthusiasm, interests and agricultural productivity, the government-driven institutions carried out rural public goods supply effectively in most time to offer rural water conservancy supply services, compulsory education and basic healthcare (Summary of interview materials). Meanwhile, since 1978, the collapse of the people's commune system had eliminated collective welfare (Ling, 1999, pp.45-51). Although governments still encouraged farmers to establish and

[30] Farmers' responsibilities for the collective were mainly the payment to the village (provident fund, public welfare fund and management fees) and for the town (education surcharge, family planning fee, militia training fees, civil administration fees and local transportation fees). It is summarized as *Santi Wutong* (三提五统) in Chinese. Farmers were aksed to join the collective programs. One thing different from the collective era was that if farmers did not want to join the work, they could pay money instead.

maintain facilities and infrastructures for public goods supply, farmers and their families did not have enough labours and money to do so (Luo et al, 2007). Especially since the 1990s, local governments could just offer the macro plan of rural public goods supply and collect taxes and fees from farmers but could not supply any necessary support (Shui & Veeck, 2012).

In the market-driven institutions, since stakeholders cared about their incomes rather than the collective interests, most burdens were thrown to farmers (Lin, 1991). Many farmers chose to resist village leaders and township leaders to keep their own interests (Sun, 2003, pp.113-116). Some of them even violently fought for themselves (Wang, 2007). This made conflicts between local officials, village leaders and farmers in rural China more serious.

Besides *San nong problems*, population loss also has been a serious problem in rural China since the 1990s. In the 1990s, many farmers chose to work in coastal areas in Southern and Eastern China as peasant workers. They earned much higher salary in Southern and Eastern China than farming in their hometowns (Gaetano & Jacka, 2004, pp.5-8). Heavy economic burdens of farming and low income caused huge population loss in Central and Western China (Song et al, 2014). It decayed rural China in the late 1990s.

5.3.2 The government and conservancy supply vacuum in rural China

Effective rural water conservancy supply system was significant for improving agricultural productivity and stabilizing the CCP government's political authority[31]. Therefore, the central government and top leaders supported the development of modern rural water conservancy system and the government-driven conservancy supply institutions in the collective era. However, since the late 1970s reform, rural China established market-driven institutions in agricultural producing and rural public goods supply. The government reduced its involvement in conservancy supply in the market-driven institutional framework. Most institutional arrangements in the reform era were market-driven, social groups became major power to supply conservancy services. Lacking the guideless and support from the government caused many institutional arrangements deviated from the original design.

Archives in Xiangyang County (Xiangzhou District) Water Station showed that local governments established the radical market-driven rural water conservancy supply institutions to ask individual farmers/families to be

[31] According to Mao's speech in Zhengzhou Meeting in 1958. More details could be found in chapter 4.

responsible for conservancy supply infrastructures on their contracted land in the 1980s (Annual Summary of Xiangyang County Water Station, 1985). Individual families could use conservancy facilities on their contracted land freely but also had to take the responsibility of maintenance (Annual Summary of Xiangyang County Water Station, 1987). The institutions also proposed that the individual controlled conservancy facilities could be used by the collective or nearby farmers freely if there was an emergency.

The aim of those conservancy supply institutions was to transfer property rights of the collective conservancy supply facilities to individuals and clear division of works and responsibilities of different stakeholders in the market reform era. It hoped to increase the effectiveness of rural water conservancy supply by privatizing rural water conservancy supply system (Tang & Li, 2005).

However, the actual operation of the institutional arrangements in Xiangzhou District was not that good. Only water wells were distributed to different families while other conservancy facilities were left behind. Nobody would like to take the burden of maintaining rural water conservancy supply facilities and infrastructures (Working Report of Distributing Conservancy Supply Infrastructures and Facilities from Xiangyang County Water Station, 1986). The report also stated that some farmers just cared about whether there was enough irrigating water in their contracted land but never cared about where the water came from.

Although many farmers understood the importance of water storage, drains and electronic pumps, they had no desire to invest huge capital and labours to maintain the facilities (Wang, 2012). Reservoirs and other large-scaled conservancy facilities could not be divided into different pieces were seen as burdens and abandoned by both farmers and local governments (Pan, 2002). Local governments like Xiangzhou district (Xiangyang County) government passed the duty of rural water conservancy supply to farmers by separating use rights and ownerships of conservancy supply infrastructures and facilities. However, unlike land use rights, farmers were not interested in the distribution of property rights of rural water conservancy system since it meant more duties than profits for them (Yang, 2011).

Besides Xiangzhou district's institutional arrangements, market-driven rural water conservancy supply institutions in Lingbao City in Henan Province and Chang'an district and Xunyang County in Shaanxi Province showed different situations. Compared with Xiangzhou district's radical market approaches, Lingbao, Chang'an and Xunyang originally aimed to keep the

collective authority in supplying rural water conservancy services for the public and apply soft market approaches in conservancy supply. Archives and interviews in Lingbao showed that the local government still tried to control the construction and maintenance of rural water conservancy supply system (Archives of Lingbao City Water Department, 1986, vol33). The local government in Lingbao still asked farmers to participate in conservancy supply programs while if farmers did not want to spend time and labour in conservancy supply programs, they could pay money to instead. If farmers would like to spend more time and labours for conservancy supply programs than official requirements, they could get money as salary (Archives of Lingbao City Water Department, 1986, vol33). The new relationship between farmers and the local government in Lingbao about rural water conservancy supply was the market-driven employment relationship.

Meanwhile, this institutional arrangement also had its shortages. An internal meeting summary of the CCP Xunyang County Committee recorded the situation (Internal Meeting Summary of the CCP Xunyang County Committee, 1985, November, 13th). In the late 1970s to the early 1980s, especially when the market-driven institutions were not widely taken, farmers followed the county government's new institutional arrangements to join collective works for rural water conservancy supply. Farmers took cautious attitudes and coordinated with the local government about new institutions of rural water conservancy supply in the early 1980s. However, once farmers recognized rural water conservancy supply institutions would not get back to the collective status and governments could no longer coerce them to join collective conservancy supply works, they did not follow the government's conservancy supply institutions since they could get more paybacks in other aspects (Internal Meeting Summary of the CCP Xunyang County Committee, 1985, November, 13th).

Original institutional designs of above market-driven rural water conservancy supply institutions both aimed to clear property rights distribution and division of works and responsibilities of different stakeholders to increase conservancy supply effectiveness by market approach (Yang, 2011). However, the Chinese central government had reduced its control and intervention in conservancy supply. Although the central government stated that "the collective and local governments still took responsibilities of offering public goods and service"[32], without the administrative and financial support from the central government, local governments and village leaders did not have strong political

[32] No.1 Central Document in 1984.

force and necessary funding to organize and mobilize farmers to join in collective conservancy supply works (Zweig, 1997, pp.280-282). Therefore, the market-driven conservancy supply institutional arrangements met problems in actual operation.

Since market-driven rural water conservancy supply institutions caused local governments lost their dominated positions in rural water conservancy supply, there had been power vacuum of rural water conservancy supply in the market reform era. Some local government officials had noticed the problem of lacking dominated power and power vacuum[33]. Based on official's points from an internal meeting record of Xiangyang regional government[34], though the central government clearly regulated that local governments and the collective should still be in charge of the development of rural water conservancy supply, nobody implemented the institutions carefully. Because both government officials and village leaders have noticed that conservancy supply in rural China was no longer one of their major tasks and could not bring them direct political promotion or economic profits[35] (Internal Meeting Record of Xiangyang Regional Government, 1988, March, 21st).

In general, since the reform era, there was power vacuum in conservancy supply and it caused problems to affect the actual operation of market-driven rural water conservancy supply institutions. From the central government to local government officials changed their focuses to urban areas and reduced their management and investment in rural areas (Khan et al., 1993). Officials and village leaders did not have strong motivation to manage conservancy supply issues since rural water conservancy supply was no longer the key point of local development. The power vacuum in conservancy supply also made township and village leaders loss strong authority and resources as they had in the collective era. They had no ability to hold the situation and manage conservancy supply programs effectively in the market reform era. The tax reform in 1994 further weakened local governments' authority and financial abilities to

[33] Unlike economic development issues in China, rural water conservancy supply issues are hard to bring benefit for officials' personal interests or political promotion in most times. Therefore, local officials have no motivations to resist the central government and superiors for rural water conservancy supply issues. In most time, officials followed the central government's policies or open one eye and close one eye for conservancy supply issues to maximize their own interests. A few officials might have their own thought and policies about rural water conservancy supply. Meanwhile, it does not affect the macro situation.

[34] Xiangyang regional government was the highest government in Xiangyang area since 1953. It was canceled in 1983 and combined with city areas to establish the new Xiangfan City government. Xiangfan City changed its name to Xiangyang City in December 2010.

[35] Xiangzhou district (Xiangyang County) is very close to the central area of Xiangyang City. Therefore, besides agricultural producing, its development strategy also focused on industrialization and urbanization. Chang'an, Lingbao and Xinzhou's situations were similar.

implement market-driven institutions to organize rural water conservancy supply (Chung, 1994). The withdrawal of the government in rural China left power vacuum in conservancy supply in the reform era. Although social groups tried to use market-driven approaches to fill the power vacuum to keep the normal operation of new institutional arrangements, they could hardly replace governments' functions in rural water conservancy supply. Through the era from the early 1980s to the late 1990s, the problem of power vacuum in rural rural water conservancy supply had not been solved. Power vacuum caused institutional change and the collapse of market-driven rural water conservancy supply institutions.

5.3.3 Liberal political and social atmosphere in conservancy supply[36]

The legitimacy of market-driven institutions were officially protected in the 1980s[37]. Since the Chinese government formally established market-driven institutions, the importance of the market has been widely aware by different social groups. Most people in China became beneficiaries of the market-driven institutions in the early 1980s (Zweig, 1997, pp.43-47). The market-driven approach was seen as the omnipotent medicine to solve all the problems in rural areas. The huge economic success also encouraged people to apply market-driven institutions in rural water conservancy supply (Oi, 1999, pp.45-48). Liberal political and social atmosphere brought both positive and negative influence on the operation and expansion of market-driven rural water conservancy supply institutions.

On the one hand, liberal political and social atmosphere encouraged local officials to apply market-driven approaches to solve rural water conservancy supply dilemma. Using market-driven approaches to solve conservancy supply problems had been seen as political correction in the 1980s.

On internal meeting record of Xiangyang Regional Government showed that most local government officials supported to use market-driven approaches to deal with conservancy supply problems in the early 1980s. Based on the record, in April 1985, leaders of Xiangyang Regional Government discussed the method of supplying rural water conservancy services (Internal Meeting Record

[36] The concept of liberal here means that limiting government's power in the economic life and supporting the free market competition. The supporters believe governments should give maximum freedom to individuals, and protect their economic interests and private personal property. The government should supply minimum welfare and public goods to the people. The liberal thought echoes Coase's arguments about economic performance.

[37] No.1 central documents 1984 and 1985.

of Xiangyang Regional Government, 1985, April, 6th). Although some local leaders still supported continuing the government-driven institutions to offer conservancy services at first, when some others stated that developing market-driven institutions and offering more freedom to farmers belonged to formal institutions which supported by the central government, those who supported the government-driven institutions gave up their ideas (Internal Meeting Record of Xiangyang Regional Government, 1985, April, 6th).

Objectively, the government-driven rural water conservancy supply institutions indeed had some advantages despite of problems. However, officials who supported the market-driven conservancy supply institutions raised the topic to a height of political consciousness. If local officials did not support the market-driven institutions, it meant that they might have risks to be recognized as the opponents of the central government's reform policies (Lin, 1989). Since the Cultural Revolution just finished, everyone was afraid of making political faults. Therefore, most local officials chose to follow the liberal political and social atmosphere (Chen, 2009). Based on the document, a total of 11 local officials at the meeting ever mentioned that they agreed to use the government-driven institutions to deal with water conservancy supply issues while all of them gave up their opinions due to afraid of making political troubles (Internal Meeting Record of Xiangyang Regional Government, 1985, April, 6th).

The above case showed that a liberal political and social atmosphere had significant influences on local governments in applying market-driven rural water conservancy supply institutions. In the 1980s, liberal thoughts dominated in some rural areas' economic and social development and the application of market-driven institutions was seen as the symbol of the reform and opening-up actions (Ho, 2017). Therefore, local government officials mainly support the application and expansion of market-driven rural water conservancy supply institutions in the reform era to ensure political correctness.

On the other hand, the liberal atmosphere seriously affected farmers and professionals' attitudes and actions in rural water conservancy supply. Due to liberal political and social atmosphere, government-dominated policies and programs were easy to be disliked and resisted by farmers in the market reform era (Hu & Wang, 2002). Since farmers got autonomy to deal with their contracted land, they put more labour and capital in other aspects rather than water conservancy construction and maintenance since investment in other aspects could bring them more direct interests (Huang et al, 2005). Some

farmers argued that they had rights to deal with their contracted land and production materials freely and the central government protected their rights. No one could coerce them to participate in conservancy supply programs anymore (Huang et al, 2006). Liberal thoughts became the excuse for farmers to reject collective works of maintaining conservancy supply programs and relevant conservancy investment and maintenance on their contracted land.

The liberal political and social atmosphere also encouraged farmers to move to other places or change their jobs (Zweig, 1997, pp.58-62). It increased problems of the operation of market-driven rural water conservancy supply isntitutions. Since the 1990s especially after the 1994 tax reform, the heavy financial burdens forced farmers to give up maintaining existing water conservancy facilities to reduce cost. Many farmers even abandoned their lands to move to urban areas (Ke, 2010). However, rural water conservancy system always linked with different families. Those who followed their own rights to abandon water conservancy facilities on their contracted land made their farming neighbours hard to get effective conservancy supply services (Luo, 2006, pp.55-58). An internal report from Xiangzhou district mentioned that in the plain region, one family that abandoned water conservancy facilities on the land would influence three different families on average. In 1991, the number of peasant farmers working in coastal area was just 1978. The number increased to 213,456 in 1999 of the whole county (Summary of Rural Water Conservancy Supply Development in the 1990s in Xiangyang County, 2002).

The moving of huge population and poor maintenance of rural water conservancy facilities almost destroyed half of the rural water conservancy supply infrastructures in Xiangzhou district (Annual Summary of Xiangyang County Water Station, 2003). Xinzhou's situation was similar with Xiangzhou while situations in Lingbao, Xunyang and Chang'an were even worse. Although many farmers became rich through working and doing business in coastal regions of China, the market-driven rural water conservancy supply institutions were not implemented well. The low effectiveness of rural water conservancy supply system increased difficulties of agricultural producing and rural lives in Central and Western rural China in the 1990s (Cao, 2000, pp.172-175). Lives of those farmers who chose to stay became much harder than before.

Besides farmers, the liberal atmosphere also significantly affected rural water conservancy professionals. Since the reform era, conservancy professionals were no longer highly valued by the government since the government paid more attention to urban and industrial development (Luo,

2006). Conservancy professional skills could not produce direct economic profit in the market economy. Some professionals even could not rely on their formal jobs to live a good life. Therefore, many professionals in conservancy institutions and water resource department used their authority to make economic profits through their controlled conservancy facilities[38] (Annual Summary of Xiangyang County Water Station, 1990).

One typical case was in Xiangzhou district. Yujiahu Pump station (余家湖泵站) was responsible for offering irrigating water from the Han River to nearly farmlands. Meanwhile, only in the irrigating season (normally from spring to early summer; the time would be slightly different due to the weather and different crop types) the pump station could collect money from farmers for using conservancy water. However, if any of the farmers did not pay water fees, the pump station would reject to offer water to all the farmers (Archives of Xiangyang County Water Station, 1992, vol47). Since conservancy services of the pump station almost covered everyone's contracted land, few free-riders negatively affected the effectiveness of conservancy supply in the whole area.

The local government coerced the pump station to offer conservancy water freely and used the public expenditure to pay the water bill in some serious drought years (Archives of Xiangyang County Water Station, 1992, vol47). In other years, conservancy professionals in the pump station totally followed the market mechanism to collect money and supply water. Even though they had better understanding than farmers and officials about the time and amount of offering irrigation water, they rejected to offer water if they did not collect water fees (Archives of Xiangyang County Water Station, 1992, vol47).

The then chief of the pump station in the 1990s mentioned that from the establishment of the pump station in 1973 to the early 1980s, the pump station belonged to local water resource department directly. It meant that the pump station got staff' salary, maintaining fees and all the necessary funding from the government. Relevant maintaining labour works were done by the beneficiary villages gratuitously (Archives of Xiangyang County Water Station, 1992, vol47). From 1973 to 1984, professionals offered water freely to nearby villages according to the weather and their professional knowledge. Meanwhile, the pump station became institutional organization (*Shiye Danwei*, 事业单位) in 1985. The local government reduced its support for the pump station and pushed

[38] Institutions here meant *Shiye Danwei* (事业单位). The institutions had similar treatment and organizational structures as government departments. However, they did not belong to government department series. The funding and treatment was lower than that of the government. Many of the institutions were reformed and pushed to the market since the 1990s.

the pump station to the market (Archives of Xiangyang County Water Station, 1992, vol47). The majority income of the pump station was from selling irrigation water while the station can only get significant maintenance and construction fees from provincial and local governments since 1985 (Archives of Xiangyang County Water Station, 1992, vol47). However, local governments only offered the maintaining funding for three times (1988, 1992 and 1997). The funding was just enough to make the basic operation of the station. Since the pump station had to make money to feed itself and its staff, it focused on selling water (Archives of Xiangyang County Water Station, 2003, vol74).

Many villages and the pump station had ever made deals to reduce water price and offer water first and pay fees later. However, some other villages rejected to pay water bills since they argued that they also joined the construction of the station in the 1970s (Archives of Xiangyang County Water Station, 1992, vol47). The chief of the pump station mentioned that since the station lacked money for its operation, over half staff rejected to work in the late 1990s (Archives of Xiangyang County Water Station, 2003, vol74). Lacking professional maintenance further reduced pump station facilities' effectiveness. If pump station staff compromised with farmers who rejected to pay their water bills, more farmers might be free-riders to get free irrigation water. In the market reform era, conservancy professionals also followed the market mechanism to live. Although the liberal atmosphere kept conservancy professionals' private interests, it affected conservancy professionals' real functions in the normal operation of market-driven rural water conservancy supply institutions.

In general, conflicts between the professionals and farmers were serious in the market reform era since conservancy professionals wanted to charge from farmers while farmers wanted to use irrigating water freely to reduce producing cost (Wang, 2007). Many farmers unsatisfied with conservancy professionals and established minor conservancy facilities such as water wells on their contracted lands (Ge, 2010). It increased the decadence of conservancy supply programs controlled by conservancy professionals and also increased farmers' repeated investment.

Although governments noticed the low effectiveness of professional conservancy institutes, government officials thought that the low effectiveness was due to liberal thoughts had not been applied appropriately and conservancy institutes and their staff had not been fully market players (Wang, 2007). Therefore, some top leaders believed that the best way to solve the problem was to cancel conservancy organizations' institutional status and totally push them to

the market (Yep, 2004).

Hence, Hubei province took the "*Qizhan Basuo* (七站八所) reform" from 2003 to 2004[39]. The reform further implemented the liberal political and social atmosphere in conservancy supply. The new institutions regulated that each of the professional conservancy organizations could only get limited money as administrative fees from the government and had to collective money from the market through their professional skills and services (He et al, 2016). Meanwhile, the result of the reform did not well. Both conservancy professionals and farmers felt their interests be hurt from the reform. Farmers thought water stations and pump stations had totally been conservancy professionals' tools to make money while professionals argued that they could not make enough money to feed themselves and kept the normal operation of their organizations in the market (Ge, 2010). The failed reform not only increased conflicts between professionals and farmers but also further reduced the effectiveness of rural conservancy supply.

Therefore, although the liberal political and social atmosphere showed the macro development trend in the 1980s and 1990s and brought economic and social achievements in China, it brought negative influences on the effectiveness and normal operation of rural water conservancy supply system. Liberal ideas had been the consensus of many people about rural water conservancy supply though those people held different motivations. Any individual who resisted the liberal atmosphere and market-driven institutions was seen as conservative and was excluded by others. Blindly touting the role of the market to weaken governments' functions had shown the fatal flaw in rural water conservancy supply and the sustainable development of agriculture in the 1990s.

5.3.4 Self-interest nature and short-sightedness views of farmers

Self-interest nature and short-sightedness views of farmers also affected the implementation and normal operation of market-driven rural water conservancy supply institutions. Chinese farmers neither care much about public issues nor social and political development. What they care much is the agricultural productivity of their own land (Huang, 1989, pp.21-23). With a self-interest motivation, Chinese farmers worked hard on their own land with bearing harsh treatments in the past thousands of years (Huang, 1989, pp.13-15). The situation had changed since the PRC founded (Huang, 1989, pp.16-17). The CCP

[39] *Qizhan Basuo* (七站八所) meant professional institutions supported by government such as conservancy station, financial station, agricultural machine station and so on. The number of seven and eight just represented there were many institutions and not an accurate number.

government tried to change farmers' habits and encourage farmers to pay attention to rural political and social affairs (Oi, 1999, pp.91-93).

Since the reform era, China established market-driven institutions allowing farmers to focus on their own interests. Although the institutions increased agricultural productivity to some extent, problems of self-interests and short-sightedness seriously affected the normal operation of rural water conservancy supply system in the reform era. There were over 90% of farmers who joined interviews of this research mentioned that they did not want to invest rural water conservancy facilities and infrastructures by themselves (Summary of Interview Materials). The investment of each 100 Yuan RMB on conservancy supply facilities/infrastructures could only get 113-126 Yuan RMB as pay back while investing 100 Yuan RMB on fertilizer could get 138-151 Yuan RMB as pay back (Luo, 2006, pp.117-122). Therefore, many farmers did not want to invest and maintain rural water conservancy supply system. Most farmers' focused on how to use least money and shortest time to increase most productivity of their land and improve their lives. They had neither time nor ability to think about the long-term sustainable development of agriculture (Wang, 2012). Although most farmers understood the importance of conservancy supply for agricultural development, they were reluctant to invest huge labours, capital or time on it.

The self-interest nature and short-sightedness of farmers stopped them from investing or maintaining rural water conservancy facilities on their contracted land or continually join public conservancy supply programs for the area which the contracted land belonged to (Wang, 2012). Some farmers thought that even in the worst situation, they could still grow crops without conservancy supply system (Luo & Liu, 2005). The minds of many farmers still stopped at the stage of the collective era. Some farmers still believed that even if they did not participate in the construction and maintenance of conservancy supply programs, the government would never leave them behind and would take other methods to supply conservancy facilities and services just like in the collective era (Liu et al, 2013). Therefore, few farmers spent their limited labours and money on implement market-driven rural water conservancy supply institutions.

However, farmers never thought that governments no longer took the responsibility of supplying rural water conservancy services but left the duty to farmers in the market reform era. Even until 1987, some farmers in Xiangzhou district had clearly known the government would not organize and arrange rural water conservancy supply, and they had to rely on themselves to solve

conservancy supply problems, farmers still had illusions that the government would change market-driven institutions and offer effective conservancy service for them (Archives of Xiangyang County Water Station, 1987, vol35).

Compared with their own labours, farmers treasured more about their land and money to invest conservancy supply facilities on their contracted land from the 1980s to the 1990s. If they had to maintain conservancy supply facilities on their land, most farmers chose to put their labour on the contracted land rather than money (Li, 2007). They would just like to spend their labours to maintain the existing conservancy facilities for their own use such as water wells rather than establishing new conservancy supply facilities such as electric pump or drains which would spend money or take up land (Liu et al, 2013). Farmers did not think that capital investment on conservancy programs could get direct paybacks in a short time. They preferred to use their limited money to invest programs which could bring them quick and safe paybacks (Long, 2014). Although the conservancy supply institutions in the collective era had problems, they could supply more effective conservancy services than farmers' individual works on their contracted land. The effectiveness of most farmers' conservancy works on their contracted land was 30% lower than professional conservancy projects on average (Luo & He, 2008).

Since the development of rural water conservancy supply system fell into the low effective and stagnated state, farmers could not get enough conservancy services and irrigation water from obeying market-driven rural water conservancy supply institutions. Some farmers would follow their interests to solve problems by breaking market-driven conservancy supply institutions (Luo & Liu, 2005). However, actions those farmers took hurt the public and others' interests and brought negative influence on the long-term sustainable development of rural water conservancy supply system (Wang, 2012).

Since the 1980s, there had been farmers to be free-riders of the public rural water conservancy system. Some farmers broke conservancy facilities which belonged to the collective or water stations to get irrigation water for their contracted land (Archives of Xiangyang County Water Station, 1992, vol47). In the early 1980s, most of the conservancy facilities established in the collective era in rural China still worked well (China Water Resources Yearbook, 1991). Those facilities offered most irrigation water and solving waterlogging problems. Meanwhile, those conservancy facilities lacked effective management (Liang, 2010, pp.112-113). In order to get more free water, some farmers broke reservoirs and drains to guide water to their contracted farmlands (Archives of

Xiangyang County Water Station, 1992, vol47). At first, farmers just dug a hole or a small guide drain to steal water in the evening and covered the broken places in the morning. Later, when farmers found their relatives, friends and neighbours did the same thing, destructive actions became more open and unscrupulous (Archives of Xiangyang County Water Station, 1992, vol47).

Worse, in the 1990s, when some farmers broke public conservancy facilities to get water to their contracted land, they seldom thought of repairing the broken place carefully (Liu et al, 2013). At the same time, they rejected to join official maintenance of those conservancy programs. Farmers' behaviours caused irreversible damage to those conservancy supply facilities established from the 1950s to the 1970s (Luo & He, 2008). Once reservoirs and drains which made up of soils and stones were broken, they were hard to be repaired but collapsed easily by heavy rain (Ge, 2010).

However, farmers did not care about the damage of using public conservancy supply facilities illegally. They just cared about immediate conservancy demands and benefits (Archives of Xiangyang County Water Station, 2003, vol74). Therefore, many facilities were seriously broken in the 1990s. Working effectiveness of those facilities reduced year by year. Interviews in Xiangzhou district showed that over 90% of the rural conservancy supply facilities established in the collective era worked much less time than the expected life (Annual Summary of Xiangyang County Water Station, 2003). The statistical data from the water station in Xiangzhou district showed there were 74 rural reservoirs in the district and 560km major drains that still worked in 1980. The numbers reduced to 67 and 490km in 1985, and 32 and 240km in 1998[40].

In general, on the one hand, farmers heavily relied on rural water conservancy supply infrastructures which established in the collective era to offer conservancy services in the market reform era. On the other hand, farmers broke and damaged those rural water conservancy supply facilities without putting necessary capital and labours to fix and maintain them due to self-interest nature and short-sightedness views. Therefore, in many rural areas, the effectiveness of rural water conservancy supply reduced to an unacceptable level in the late 1990s. Farmers' self-interest nature and short-sightedness views negatively affected the implementation and normal operation of market-driven rural water conservancy supply institutions.

[40] Calculation from *Annual Summary of Xiangyang County Water Station* (襄阳县水利局年度工作总结) from 1978 to 2003.

5.3.5 The powerless of financial and private organizations[41]

Since the market-driven institutions were established in the early 1980s, China has become more open to accept diverse economic forms. Autonomous organizations, private investors, private corporations and professional organizations have appeared in rural economic lives. Local official financial organizations also had more autonomy to offer financial support to rural development (Liang, 2010, pp.76-77). Meanwhile, many social groups appeared with the purpose of speculation rather than offering professional and supportive public goods and services in rural economic lives.

The literature seems to suggest that it is common that official financial organizations and private investors invest in rural public goods supply (Foster & Rosenzweig, 2001). Based on the original institutional design of market-driven rural water conservancy supply institutions, financial organizations and private investors should supply enough financial support for the development of conservancy supply system based on the market mechanism. However, in China, from the 1980s to the 1990s, financial problems became a limit of rural water conservancy system's maintenance and construction. Both official organizations and private investors avoided offering investment for rural water conservancy supply programs in the market reform era (Huang et al, 2006).

Official and private financial organizations preferred to invest commercial programs that could bring higher economic interests. Since the 1980s, both local governments and village leaders, even some individuals, came to the cooperative to get financial support for economic development and private business (Brandt et al, 2004). Normally, large commercial projects supported by the local government or county/township leaders were easy to get financial support. Basic infrastructure construction for industrial/business development or transportation projects were also supported by the local government since those programs could promote local economy and be regarded as leaders' political achievements (Shrestha et al, 2011). Even individuals with business achievements or connection with local leaders could also get money from rural credit cooperatives (RCC) or the the Agricultural Bank of China (ABC) (Huang, 2005).

There had not been formal institutions about who could get the loan and how the loan would be used in the 1980s. Meanwhile, there were hidden rules in the financial organizations and private investors (Jia & Huang, 2011). Some

[41] The official financial organizations here mean the four state-owned banks especially the Agricultural Bank of China and rural credit cooperatives. The private financial organizations here mean private investors and their financial firm's prototypes that some of which were illegal in China.

programs could get the loan from financial organizations while others could not. Whether the loan or investment could be gotten back safely was the most significant factor (Jia & Huang, 2011). Besides that, although some commercial programs had high risks, the local government or leaders also used government credit as the guaranty or the local government used administrative influence to coerce financial organizations to offer the loan for commercial programs (Jin & Qian, 1998). Because those programs were possible to bring high economic profits or obvious political achievements for local government officials. For government officials who wanted to get political promotion in the reform era, the best way was to get political and economic achievements about social and economic development (Luo et al, 2007). Using money from banks and rural credit cooperatives could reduce local governments' financial burdens and possible risks (Luo et al, 2007). Therefore, over 80% of the loans from the Xinzhou County Rural Credit Cooperative in the 1980s went to programs with government background (Archives of Xinzhou County Rural Credit Cooperative, 1991, vol102).

Private investors and organizations held similar opinions. In the early 1980s, not many people had enough money to run their own business. Meanwhile, as social and economic development proceeded, since the mid-1980s, some *Wanyuanhu* and someone who had government or bank's networks started to run private lending and investment companies[42] (Krusekopf, 2002). Unlike the state-owned banks and rural credit cooperatives which had to follow the government's commands or advices, private investors and their organizations just considered economic paybacks and possible risks (Kelliher, 1992, pp.55-57).

In the 1980s, most private investors avoided using their money to invest in public goods programs since many of them did not have that much money to invest and they thought it was not possible for them to get the investment back (Liang, 2010, pp.67-70). Some private investors had ever tried to help their village to fix problems of conservancy facilities in the 1980s and 1990s. They followed the market mechanism to sign contract for the maintaining program with market price (Liang, 2010, pp.125-131). However, when private investors finished the work, village leaders and villagers normally refused to pay. The village leaders and some elder people in the village always used the excuse that private investors were much richer than others and they should help the village

[42] *Wanyuanhu* (万元户) means in the early and middle 1980s, the families which became rich earlier than others and had a family wealth worth 10000 Yuan RMB.

without any paybacks and made donations to the collective to achieve the common prosperity as what Deng Xiaoping said[43] (Liang, 2010, pp.125-131).

Rural water conservancy supply needs huge investment but cannot bring economic paybacks in a short time. Farmers might also take free-riding to break those conservancy supply facilities. Therefore, it was highly risky for financial organizations and private investors to invest in those programs in the 1980s and the 1990s. Financial organizations and private investors neither had the desire nor abilities to invest conservancy supply programs.

Worse, none of local governments, village autonomous organizations and officials used their credits as the guaranty to help rural water conservancy supply programs to get loans from financial organizations or private investors (Luo et al, 2007). It meant that financial organizations and private investors had to take all the risks themselves for investing conservancy supply programs (Kanbur & Zhang, 2005). This situation further combated financial organization and private investors' investment enthusiasm. They would rather pay more attention to industrial and urban infrastructures' development which could bring them more fame and economic interests.

There was no effective way for official financial organizations or private investors to get back their cost and make profits from investing in rural water conservancy supply programs in the market reform era. Governments also could not coerce financial organizations and private investors to do so since they needed to follow the market mechanism (Unger & Chan, 1999). Financial organizations and private organizations were helpless to change the stagnation of rural water conservancy supply's development though they helped rural China's economic and social development in other aspects.

5.4 INSTITUTIONAL ANALYSIS OF RURAL WATER CONSERVANCY SUPPLY IN THE MARKET REFORM ERA

Compared with conservancy supply programs' location places, division of works and responsibilities, the root problem of market-driven rural water conservancy supply institutions lie in the market-driven property rights configuration methods of rural water conservancy system and unclear and ineffective arrangements of maintenance works. The market-driven rural water

[43] Deng Xiaoping had ever said that we could allow some people to get rich first and let those people help others to get common prosperity. Deng made the opinion in the Oct.23, 1985 when he met with the delegation of the United States. Similar opinion was also given in the Mar.28, 1986 when he met the New Zealand prime minister.

conservancy supply institutions could not offer effective institutional arrangements and incentive mechanism to encourage the government and social groups participating in rural water conservancy supply (Ostrom et al, 1992). According to Nash, since there were not any effective constraints between different actors, actors would consider their own interests rather than others' interests to choose their strategies (1951). Both the government and social groups tried to maximize their own interests in conservancy supply in the market reform era. It negatively affected the normal operation of market-driven rural water conservancy supply institutions and led to institutional change. The analysis of the market-driven rural water conservancy supply institutions will be helpful to clearly understand the market and governments' roles in rural China's public goods supply.

5.4.1 The weakened of government involvement in conservancy supply

According to Demsetz, the establishment of property rights is the contractual relationship of long-term exchange among people based on private considerations (1988, pp.13-15). New forms of property rights configuration are adjustments based on cost-benefit analysis among interacted people (Demsetz, 1974).

The government's involvement in rural issues had made great contributions to help rural China recover from the wartime (Yan, 2003, pp.38-40). The organizational and mobilized methods of the centralized government also helped the establishment and maintenance of modern rural water conservancy supply system (Wu, 2007). Meanwhile, the low effectiveness and rigid management approaches caused many problems. The government's involvement in conservancy supply should be reviewed critically since the weakened of the government in conservancy supply issues brought both positive and negative impacts for rural China's sustainable development especially for rural water conservancy supply system's development.

The collapse of the government-driven rural water conservancy supply system broke the unfair relationship between the government and farmers in rural China. Farmers were no longer working tools for the state (Kelliher, 1992, pp.7-10). They sought for their private interests in the market-driven institutions. The history has shown that market-driven institutions and household contact responsibility system released farmers' enthusiasm, increased agricultural productivity and made more space for the free development of rural economy (Zweig, 1997, pp.10-14). A scholar argued that rural China achieved an

economic miracle in the early 1980s thanks to the collapse of the government-driven institutions (Ling, 1999, pp.257-259). Since the reform era, the government's functions in conservancy supply especially the organizational and management functions were criticized officially[44].

The success of the market-driven institutions in releasing agricultural productivity could be seen as cooperation between the government and social groups, especially farmers. The government transferred part of its power to farmers and other social groups and allowed them to get benefit from the new institutional arrangements (Lin, 1988). It shaped an incentive for farmers to work hard. Although top leaders and the central government in the market reform era still had their political preference and interests, the official interests and farmers' interests in establishing household contract responsibility system and increasing agricultural productivity were the same (Naughton, 1996, pp.151-162).

According to North and Thomas, if the society guaranteed acceptable paybacks or interests for actors in new institutional arrangements, the society could achieve economic growth (North & Thoms, 1973, pp.1-3). In order to reduce transaction cost and promote economic growth, rulers and their ruling groups have to reform the property rights configuration method to reduce the rent (North, 1990, pp.161-165). From this perspective, the weakened of government involvement in conservancy supply brought positive effects to the development of conservancy supply system. New market-driven property rights configuration methods and division of works and responsibilities of different stakeholder should increase the effectiveness of conservancy supply in the market-reform era.

Meanwhile, the reality showed that the weakened of government involvement in the reform era led problems for rural China's long-term development and caused low effectiveness of rural water conservancy supply. Without the support from the government, the market-driven rural water conservancy supply institutions were hardly to make clear and effective property rights configuration regulations to conservancy facilities and infrastructures. The institutional arrangements just generally mentioned that the central government offered the freedom for local governments to separate ownerships and use rights of conservancy facilities and infrastructures to different stakeholders appropriately (Ge, 2010).

According to Coase, clearing property rights is the premise of reducing

[44] See No.1 central documents from 1982, 1983, and 1986.

transaction costs to enhance the economic efficiency (1960). Although market-driven rural water conservancy supply institutions took market approaches to deal with conservancy supply issues, social groups were too weak to replace the government to offer effective incentive mechanism and solve problems by clearing property rights configuration of conservancy supply infrastructures and facilities (Tam, 2013, pp.181-186).

The weakened of government involvement in conservancy supply meant the collapse of a pyramid administrative control system from the central government down to village leaders (Lin et al, 1996). It caused a power vacuum in rural water conservancy supply. Since the nature of market economy is free competition and survival of the fittest, the market mechanism mainly aimed to release the power of the market and protect the rights of market entities rather than support the vulnerable groups (Sun, 2003, pp.41-45). Since investing conservancy supply programs could not make much economic interests within a short time period, the market and the government naturally did not pay much attention on those programs. Without administrative commands' control, the market mechanism eliminated conservancy supply programs (Kanbur & Zhang, 2005). The power vacuum of rural water conservancy supply caused by the weakened of government involvement was neither filled by the government nor social groups in the 1980s and 1990s. Once the government reduced its involvement in rural public goods supply, there was no effective organized power to offer effective rural water conservancy supply (Tang & Li, 2005).

In general, the weakened of government involvement in conservancy supply in the market reform era made conservancy supply programs lost the protection from the collective to resist natural and social problems. Vivienne Shue argued that for individual farmers, the weakened of the government in the market reform era meant they lost the protection from a local organization, though they might not feel the change themselves (1990, pp.4-7). Farmers had to face the market and the state directly since then (Sun, 2003, pp.86-89). Worse, in the market economy, family-based production methods and household contract responsibility system could not help farmers to collect enough capital and labours to establish and maintain the large-scale modern conservancy supply system since farmers lacked effective organizational support[45]. Without necessary financial and administrative support from the government, the market-driven rural water conservancy supply institutions did not have strong

[45] The household contract responsibility neither allowed farmers to trade their contracted land nor established their formal non-government organizations rather than the village autonomous organizations in the 1980s and the 1990s.

dominate power to keep the normal operation of conservancy supply system. Therefore, although the post-1980 institutional environment was open and free, the weakened of government involvement in conservancy supply caused institutional failure of market-driven rural water conservancy supply institutions.

5.4.2 Social integration mode in the reform era[46]

Since the PRC was founded, the central government took the strong political mobilization and integration in rural China to establish modern rural water conservancy supply system in many areas. Since the then CCP regime was weak and lacked resources, the strong political integration in rural China was the most suitable way to achieve the government and top leaders' political interests, preference and the communist ideology (Sun, 2003, pp.82-84). Meanwhile, the political integration mode forced social groups to participate in collective works and violate the laws of the economy (Lin, 1989). Once the government-driven institutions collapsed, the political integration mode lost its foundations and also collapsed in the late 1970s.

In order to maintain state's ruling and rural development, the central government changed its strategy to reform and established market-driven institutions to fix problems (Lin, 1989). Social power had replaced political power in the integration of capital and resources (Sun, 2003, pp.30-34).

The social integration mode was used to integrate capital and resources and regulate responsibilities and behaviours of the government and social groups to keep the effectiveness of the market mechanism (Sun, 2003, pp.24-34). The social integration mode focused on economic development. Economic growth has been one of the sources of the new leadership's legitimacy. Top leaders' political preference was in economic development rather than political issues (Zhou, 2006). If farmers paid taxes, fees and crops on time, the government would not involve much in other issues since it reduced its political involution in rural areas (Zhou, 1995).

Besides that, the social integration mode increased social groups especially farmers' bargaining abilities with the government (Ling, 1996, pp.201-215). The new top leadership tried to limit local governments' forces and offered more freedom and tolerance to social groups in the market reform era to keep the stability of its ruling (Zhou, 2006). The direct negative influence of this

[46] Sun Liping used the idea of integration mode to study how the government and social powers integrated capital and resources to compare different functions of political power and social power in the Chinese society.

arrangement was that if farmers did not participate in rural water conservancy supply programs organized or managed by local governments or village autonomous organizations, local governments or village autonomous organizations could not give them strict punishment (Wang, 2012).

In the market-driven institutions, social groups could make voice and seek their interests (Hirschman, 1970, pp.14-25). Farmers got rights and abilities to say no to the government-sanctioned water conservancy supply institutional arrangements which they thought could not satisfy with their interests (Wong, 2009).

The social integration mode followed the basic rule of market economy and allowed resources to flow to areas that could make high profits (Lin, 1991). Social integration mode's influence on rural water conservancy supply was weak. It was hard to manage resources for conservancy supply and adjust relationships among different stakeholders effectively (Yang et al, 2003). Worse, local governments and new village leadership in many areas could no longer use political integration to coerce farmers to finish tasks of conservancy supply (Luo, 2006). Besides that, village leaderships also had their interests. Many of them led their villages to seek for economic profits rather than taking their public service duties to organize conservancy supply issues (Kelliher, 1992, pp.86-88). The social integration mode caused the disorganization of rural water conservancy supply system. The social integration mode deprived rural water conservancy supply programs to get support from political powers and social powers.

Therefore, dominated by the social integration mode, neither governments nor social groups could integrate resources and labours effectively to deal with conservancy supply problems in the market reform era. Social integration mode was originally applied to keep political and social stability, supply enough food and reduce financial investment in rural areas for the sustainable development of urban areas and industries (Sun, 2003, pp.86-89). As most rural water conservancy supply programs could not meet requirements of the institutional design of social integration mode, the social integration mode did not bring obvious positive influence on rural water conservancy supply as it had in other aspect (Kanbur & Zhang, 2005).

5.4.3 Problems of institutional arrangements in the market-driven rural water conservancy supply institutions

Problems of institutional arrangements were roots of low effectiveness and changes of the market-driven rural water conservancy supply institutions. Sun

(2004, pp.25-29) and Naughton (1996, pp.209-211) thought that some scholars blamed the failure of the government-driven institutions to the Cultural Revolution mainly aimed to find the legitimacy of the reform rather than making objective analysis. Sun thought the real problem was that institutional arrangements of government-driven institutions were not stable and sustainable (Sun, 2004, pp.30-34). Although the newly established market-driven institutions solved some problems of the government-driven institutions and increased agricultural productivity to some extent, there were still problems of institutional arrangements in rural water conservancy supply.

The era of China's market-driven institutions could be separated into three different stages. The first stage was from the late 1970s to the early 1980s. During this period, the attempts of market-driven institutions were mainly among farmers (Lin, 1989). It could be seen as the induced change from the bottom of the society. Farmers, village leaders and some local officials were major powers to attempt market-driven institutions. The state tried to find an appropriate way to transfer property rights to social groups (Hirschman, 1970, pp.95-101). The integration mode also changed from the political integration mode to the social integration mode. Farmers, village leaders and some local officials' attempts were proved success and pushed the government to establish formal market-driven institutions all over China (Oi, 1999, pp.11-16).

The second stage was from the early 1980s to the early 1990, during which formal market-driven institutions had been established by the central government (Yu, 2001). The market-driven institutions had been applied in different aspects (Lin, 1989). Governments and social groups cooperated in land use property rights configurations and other aspects. The government reduced its political involution in rural areas to get stable taxes and fees income, establish low cost management system and win farmers' support of its ruling (Zweig, 1997, pp.78-84). The economic growth in the 1980s proved the market-driven institutions were successful in some aspects. However, some problems also appeared.

The last stage was from the early 1990s especially after the tax reform to the late 1990s. Since the dividends of market-driven institutions were exhausted in the late 1980s, problems of market-driven institutions became serious and obvious in the 1990s especially in the aspect of rural water conservancy supply (Cao, 2000, pp.42-44). Since the social integration mode did not work effectively to solve public goods supply problems, the market reform was in the bottleneck which was hard to continue without hurting vested interests groups'

interests (Sun, 2004, pp.12-15). Therefore, the market-driven institutions could not continue without reform since problems and conflicts burst out in the 1990s.

From above analysis of market-driven institutions' different stages, it is not difficult to find out that problems of institutional arrangements mainly appeared in the 1990s. However, the root of problems of institutional arrangements existed through the 1980s to the 1990s (Sun, 2003, pp.145-150). Institutional arrangement problems of the market-driven rural water conservancy institutions were shown in the following aspects:

First, property rights of rural water conservancy supply facilities and infrastructures were not clear. Based on market-driven rural water conservancy supply institutions, conservancy supply facilities and infrastructures could belong to individual farmers, village autonomous organizations, local governments or water stations (Wang, 2012). However, most stakeholders just wanted to get benefits from those facilities/infrastructures but did not want to take responsibilities to maintain those infrastructures (Song et al, 2014). Farmers became free-riders of those facilities and caused irreversible damages. Therefore, from the 1980s to the 1990s, in the market-driven institutions, property rights configurations of rural water conservancy supply infrastructures were chaotic. According to Fischel, without clear property rights configuration, there would not be any institutional arrangements with high economic performance (2003, pp.14-21). Unclear property rights of rural water conservancy supply infrastructures decided the market-driven institutions could not have sustainable development.

Second, the market-driven rural water conservancy supply institutions had problems of the truncation of ownership. Demsetz used the concept of ownership truncation to explain that the state's intervention of property rights could lead to economic declines (1970). The problems of the truncation of ownership in rural China were obvious since farmers could only get the land use rights rather than land ownership in the market reform era (Ho, 2005, pp.56-58). Therefore, farmers cultivated the state's land essentially. Although there was formal institutions regulated farmers' land use rights should be protected, farmers still had to face the reality that the government could get back their contracted land for other uses in any time (Ho & Spoor, 2006). It meant that farmers' personal investments of rural water conservancy supply facilities/infrastructures on the contracted land might not get paybacks. The truncation of ownership caused high risks to invest in rural water conservancy supply system. The institutional arrangements combated the enthusiasm of investors.

Third, the market-driven rural water conservancy supply institutional

arrangements lacked stability. On the one hand, this was associated with the problem of the truncation of ownership (Krusekopf, 2002). It was not possible for farmers to use the contracted land as the guaranty to get loan from banks or rural credit cooperatives to establish or maintain necessary water conservancy supply infrastructures in the market reform era (Wang, 2012). Without, necessary financial support, market-driven rural water conservancy supply institutional arrangements could not be implemented effectively. On the other hand, crop price was kept low in the 1990s, which made high-cost investment in rural water conservancy supply not reasonable. Farmers had to calculate what they could get from investing in rural water conservancy supply and what they might lose (Huang et al, 2006). Besides that, in the market reform era, farmers were possible to move to coastal areas to be peasant workers (Gaetano & Jacka, 2004, pp.43-47). Cooperative autonomous organizations established by farmers to deal with rural water conservancy supply problems therefore were also not stable due to the lost of human labours and capitals (Jia & Huang, 2011).

Market-driven rural water conservancy supply institutions with problematic institutional arrangements could not have long-term sustainable development in the market economy (Kanbur & Zhang, 2005). The government consciously ignored the aspect of rural public goods supply in the reform era since they did not belong to the government's core concerns (Khan et al., 1993). Social groups broke market-driven institutions and tried to find ways to maximize their own interests in the 1990s (Liang, 2010, pp.117-121). Those situations also increased problems of institutional arrangements of market-driven rural water conservancy supply institutions.

5.4.4 Ineffective interactions of conservancy supply stakeholders in the reform era

In the market reform era, the government and social groups interacted in establishing household contract responsibility system and improving agricultural productivity. However, there were no effective constraints to regulate governments and social groups' behaviours and interactions in conservancy supply institutions (Wang, 2007). Interactions among different stakeholders brought negative influence on market-driven conservancy supply institutions in the reform era. Neither formal nor informal institutional arrangements offered effective conservancy supply services. Since there was no effective communication and interactions between different stakeholders, participants of rural water conservancy supply focused on their interests without keeping the normal operation of market-driven rural water conservancy supply

institutions (Luo, 2006).

Lacking effective interactions could be shown in shirking responsibility of rural water conservancy supply. According to No.1 Central documents from 1982 to 1986, local governments and village autonomous organizations should take responsibility to organize and manage rural water conservancy supply while farmers should participate in the construction and maintenance works of those programs (The CCP Central Committee and State Council, 2014). Unfortunately, both social groups and governments tried to maximize their economic returns, reduce cost and avoid risks in conservancy supply. Neither the government nor social groups took the duty of supplying conservancy services. Therefore, rural water conservancy supply in the market reform era became a neglected issue (Luo, 2006). Lacking detailed institutional arrangements to regulate actors' behaviours aggravated stakeholders' actions to shirk their responsibilities

Lacking effective interactions could also be shown in the repeated construction/investment and disorder of rural water conservancy supply programs. In the market reform, farmers have been actual and major suppliers of rural water conservancy services (Wang, 1996, pp.124-127). Since there was no effective official organizational support, individual farmers/families were hard to be organized to participate in conservancy supply programs or share conservancy facilities in the reform era (Wang, 2003). Once farmers had to use rural water conservancy supply facilities for agricultural producing but could not get help from official departments or others, they chose to invest conservancy facilities which could just meet conservancy demands of their own contracted land (Wang, 2012). Infrastructures such as irrigating drains which might be used by others were abandoned (Wang, 2012). This caused fragmentation, repeated works and huge waste of rural water conservancy supply constructions and maintenance. Farmers did not trust each other and afraid that others might be free-riders of their conservancy investment (Luo & He, 2008). Lacking effective interactions made it hard for farmers to apply real market approaches to cooperate with each other for conservancy supply services to reduce transaction cost and improve economic performance (Yang, 2011). From this perspective, the market-driven rural water conservancy supply institutions were ineffective.

One case in Henan Province could be used to state the ineffective interactions between the government and social groups.[47] Lankao County in

[47] This case was used as the typical case to explain the weakness of village autonomous organizations and disorder in rural China in the 1990s. The case was from the *internal officials learning materials of New Socialist Countryside's construction in Henan Province* (河南省社会主义新农村建设领导干部学习资料). The material is not open to the public.

Henan Province was famous for terrible natural conditions and low agricultural productivity. Since the 1960s, the Communist party cadre Jiao Yulu organized farmers to construct water conservancy supply system and other public programs to improve poor natural conditions. Jiao and his successor established public conservancy supply system in the 1960s and 1970s which significantly increased agricultural productivity [48] . Meanwhile, since the 1980s, market-driven institutions had changed the situation. Like most areas in Henan Province and the Midwest China, in Lankao County agricultural development could not be sustained without rural water conservancy supply system. In the market-driven rural water conservancy supply institutions, farmers in Lankao had to be responsible for conservancy supply constructions and maintenance in their contracted land without effective collective support. Since farmers did not have effective interaction and cooperation mechanism, many farmers borrowed money to dig water wells in their contracted land and bought necessary facilities for their own conservancy supply. Each family did repeated works for rural water conservancy supply on their contracted land. Some families therefore carried a heavy debt and could not even have normal lives (Learning materials of New Socialist Countryside's Construction in Henan Province, 2010, pp.60-65).

In Lankao, there was one village called Huzi Village which hoped to solve the problem of repeated construction and chaotic rural water conservancy supply. According to statistical data, in 1995, there were 216 families in Huzi village. There had been 195 motor vehicles (offer power to get water) in total. Almost each family had one. There were 150 electric water pumps in the village. However, each pump just worked a few hours a year. The village leader thought if farmers could be organized, the investment in machines and pumps for conservancy could reduce for 60% and got higher effectiveness. Their plan was to uniformly dig water wells and establish relevant facilities for each 50 Mu (Chinese Acres) of land (Learning materials of New Socialist Countryside's Construction in Henan Province, 2010, pp.65-67). Under the premise of maintaining the household land contract system, they tried to relocate each family's land to one place and coordinate several different families to share the same well and conservancy facilities. This idea seemed to offer effective water conservancy service. But the village leader mentioned that the implementation of the idea was bad. Even until 1997-two years after the idea was brought up, the

[48] Jiao Yulu worked as the county clerk in Lankao County from 1962 to 1964. Jiao died of liver cancer in the position in 1964. Jiao was seen as a good example of Communist cadres in the collective era and won high respect in local areas and all over China. Jiao was seen as the spirit of severing for the people and establishing public programs to resist terrible nature conditions. Jiao's story has been published as films and books.

idea had not been carried out (Learning materials of New Socialist Countryside's Construction in Henan Province, 2010, pp.67-72).

The reason was that farmers never believed village autonomous organizations could do that work fairly and refused to cooperative with them (Luo, 2006). Although the amount of land could be kept the same in the plan while differences of soil fertility, the distance from the land to farmers' homes and other detailed information could hardly be judged and calculated by market approach easily (Ge, 2010). Without effective interactions among different stakeholders, strong administrative force and the support of the government, it was impossible for village autonomous organizations to organize farmers to solve the problems of repeated construction/investment and chaotic rural water conservancy supply effectively (Luo & Liu, 2005). Ineffective interactions between the government and social groups stopped the possibility for reducing farmers' burdens and solving problems of repeated construction/investment of rural water conservancy supply system.

Besides that, ineffective interactions also existed within social groups. There were strong groups (businessman, the relatives of officials or bank staff) and vulnerable groups (normal farmers and those who cannot work) in the market-driven rural water conservancy supply institutions. Each of them had different interests which made them could not interact and cooperative with each other in rural water conservancy supply issues (Jia & Huang, 2011). The strong groups such as businessmen had more bargaining chips and better skills to negotiate with the government. They controlled the rights to make voice and nominally represented different social groups. They had huge influence on government's policy making (Khan et al, 1993). The vulnerable groups were made up of farmers and those with poor political and social status. They did not have any channel to access the government (Khan et al, 1993). Their opinions and demands were not easy to be get and accepted by policy makers (Song et al, 2014). Therefore, although people in vulnerable groups needed effective rural water conservancy supply services, their voices were hard to be heard. Interest differences between strong groups and vulnerable groups caused ineffective interactions within social groups, which reduced the effectiveness of market-driven rural water conservancy supply institutions.

The ineffective interactions of stakeholders seriously affected the normal operation of market-driven rural water conservancy supply institutions and caused institutional change (Zhang, 1996, 35-37). Therefore, when problems of the market-driven rural water conservancy supply institutions burst out in the

1990s, the market-driven institutional operation could not last long. Since there were no radical and direct conflicts between the government and social groups, the government and social groups' ineffective interactions affected the operation of the market-driven rural water conservancy supply institutions gradually.

Lacking effective incentive mechanism in establishing and maintaining rural water conservancy supply facilities/infrastructures was a significant reason to lead to weak relationships and ineffective interactions between the government and social groups. Social groups tried to search for suitable innovative approaches to break limits of the market-driven institutional arrangements and increase the effectiveness of rural water conservancy supply (Wang, 2012). However, without necessary organizational, financial and policy support and cooperation from governments, social groups could not solve rural water conservancy supply problems by their own strength.

Ineffective property rights distribution of rural water conservancy supply facilities/infrastructures, problems of division of works and responsibility, problems of conservancy maintenance institutional arrangements were roots of weak relationships and ineffective interactions of different stakeholders. The ineffective interactions of different stakeholders directly affect the normal operation of the market-driven rural water conservancy supply institutions. Here is a model which can be used to explain how ineffective interactions between the government and social groups affected the institutional operation of the market-driven rural water conservancy supply institutions (See Figure 5.1).

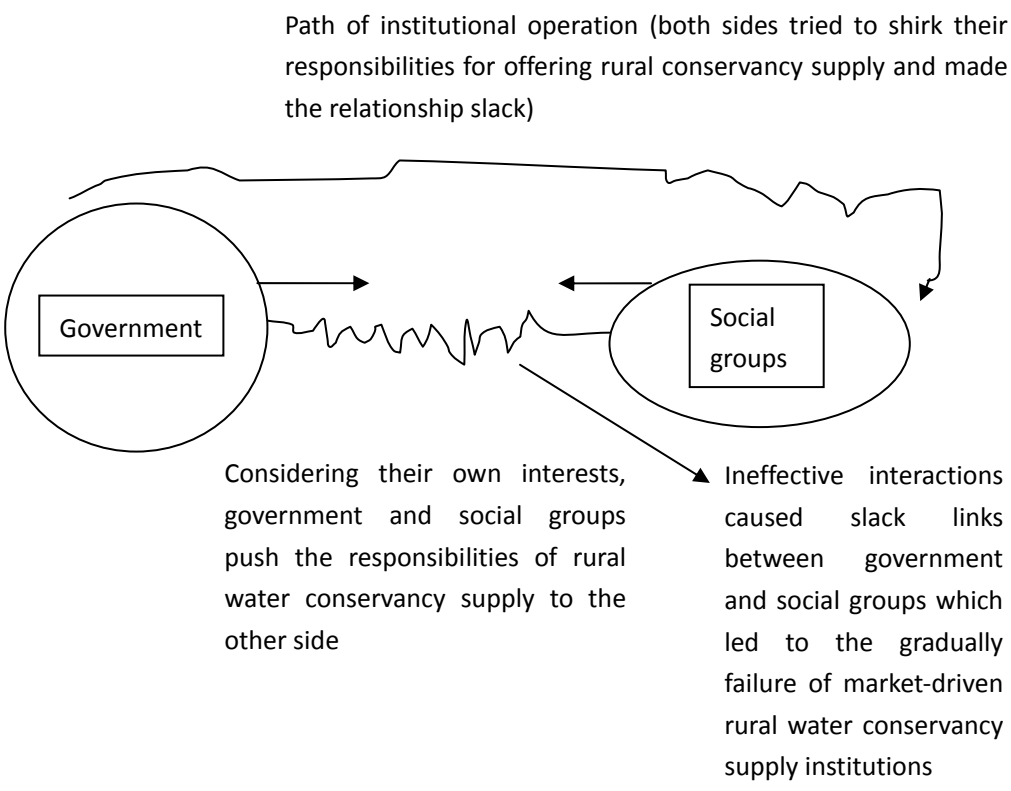


Figure 5.2 The operational model of market-driven rural water conservancy supply institutions

Since the early 1980s, the Chinese government loosed its administrative control in rural China and reduced organizational and financial support for rural water conservancy supply. Market-driven institutions generally protected the development of market economy while lacking effective institutional arrangements and clear property rights configuration about rural water conservancy supply since it was hard to bring high economic profits (Luo, 2006).

Compared with those in the collective era, social groups became more influential in the market-driven rural water conservancy supply institutions in general while the government decreased it influences on the institutional operation. From Figure 5.2, the government shirked its responsibility to manage and supply conservancy services. Lacking governments' involvement and support made social groups not possible to rely on their own strengths to implement market-driven conservancy supply institutional arrangements well. Since social groups could get neither effective conservancy supply services nor economic profits from those programs, they also had no motivation or interests to implement the market-driven conservancy supply institutional arrangements (Ge, 2010). Social groups therefore rejected to interact and cooperate with the

government about conservancy supply and reduced their input in conservancy supply programs.

The ineffective interactions between the government and social groups caused slack links between the government and social groups. Figure 5.2 showed that the slack links were not strong enough to connect the government and social groups to keep the normal operation of the market-driven rural water conservancy supply institutions. It led to various problems to reduce the effectiveness of rural water conservancy supply and caused institutional change and the gradual failure of market-driven rural water conservancy supply institutions (Luo & He, 2008).

Therefore, when the dividends and benefits of market-driven institutions were exhausted in the 1980s, people met more problems of rural water conservancy supply in the 1990s. Besides, many farmers chose to break public conservancy facilities to get water or even gave up growing crops and left rural areas (Zhang & Liu, 2009). It further reduced the possibility to adjust conservancy supply institutional arrangements within the market-driven institutional framework (Gaetano & Jacka, 2004, pp.43-47).

Since existed problems of rural water conservancy supply could not be solved within the framework of market-driven institutions, market-driven rural water conservancy supply institutions could not work effectively in the 1990s and led to the gradually institutional change. The institutional change in the late 1990s to the early 2000s was the inevitable result of the gradual accumulation of problems of ineffective interaction and institutional arrangements.

5.5 THE SUMMARY OF THE FAILURE OF THE MARKET-DRIVEN RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

As the market-driven rural water conservancy supply institutions met various institutional arrangement problems, the institutions could not avoid the paradox of property rights and could not always keep high supply effectiveness. The market-driven rural water conservancy supply institutions failed in the late 1990s.

Although the government is the key element of economic development, if the government involves too much in economic operation, it would cause economic declines (North, 1981, pp.20-22). However, on the contrary, in the market-driven rural water conservancy supply institutions, the government did not take the responsibility to offer effective management of rural water

conservancy supply system. It became the major problem to lead to the failure of market-driven rural water conservancy supply institutions.

According to the China Statistical Year Book (2001), from 1997 to 2000, the per capita income in rural China increased from 2090.13 Yuan RMB to 2253.4 Yuan RMB. However, the annual increase rate was 4.6%, 4.3%, 3.8% and 2% from 1997 to 2000 (China Statistical Year Book, 2001). The increase rate of farmers' income decreased in the late 1990s. The statistical data was the average rate. Since there were some individuals with high incomes, most farmers' income increase rate was much lower than the average (Khan et al, 1993). For most farmers in the 1980s to the 1990s, growing crops was still their major income source. However, in the free market, the prices of major crops were keeping decreasing due to competition. In the late 1990s, the prices of major crops decreased of 30% to 40% than the highest point of the 1990s while the productivity of major crops did not increase much at the same time (Cao, 2000, pp.118-121). Farmers' general income actually decreased. Many farmers were unwilling to grow crops (Gaetano & Jacka, 2004, pp.34-36). Therefore, most farmers considered it carefully that whether to spend much money and labours to invest conservancy supply facilities/infrastructures which were necessary for agricultural producing but hard to bring direct economic interests (Ge, 2010). The conservancy investment would increase much costs while they were hard to bring better income.

The macro economic situation in rural China in the 1990s led to a reduction of farmers' investment in rural water conservancy system. Such reduction in turn reduced agricultural productivity. The crop producing therefore was in a vicious circle. At that time, the government's inaction has led to further deterioration of the situation. In the 1990s, governments still followed basic rules of market economy to seek for their interests and never increased administrative support, financial support or took any effective measures to solve problems in rural water conservancy supply (Cao, 2000, pp.152-155)

The weakened of government involvement negatively affected the implementation of market-driven rural water conservancy supply institutions. According to Atkinson and Stern (1974) and Murphy et al. (1993), the withdrawal of the government in rural area, and reducing governments' responsibilities in public goods supply could reduce transaction costs and solve the problems of low supply effectiveness and reduce the possibilities of seeking rents. If property rights could be clearly separated and free riders could be avoided, market could become effective and efficient (Tullock, 1967). Although

the market-driven rural water conservancy supply institutions hoped to establish institutional arrangements to clear division of work and responsibilities and property rights, policy makers neither made property rights configurations clear nor considered the reality of low economic paybacks of investing rural water conservancy supply infrastructures (Zhang, 2008).

Chaotic property rights of rural water conservancy infrastructures caused various problems and the failure of market-driven conservancy supply institutions. From Banerjee and Duflo's research, property ownerships of the rural water conservancy system are always clearly shared by the government and non-government organizations in Southeast Asia (2011, pp.35-42). However, in China's market reform era, the market-driven rural water conservancy supply institutions did not have clear statements and specific regulations about property rights configurations of rural water conservancy supply facilities and duties of different actors (Ge, 2010). In most areas, there were only basic principles that governments at all levels should separate conservancy property rights to different stakeholders and take the responsibility to manage and organize rural water conservancy supply but did not have detailed regulations (Ye, 2015). Loopholes of the market-driven institutional arrangements allowed governments and social groups get benefit from conservancy property rights but shirk their conservancy supply responsibilities.

Besides, the inappropriate distribution of conservancy property rights and marketization/privatization of conservancy supply infrastructures/facilities also caused the failure of market-driven rural water conservancy supply institutions. The nature of rural water conservancy supply decided the establishment and maintenance of conservancy infrastructures needs cooperation among different stakeholders (Pan, 2002). Most conservancy supply facilities could not be separated into different parts and be privatized (Wang, 2012). It is neither possible nor necessary for an individual family to manage a whole rural water conservancy system (Wang, 2012). However, property rights of most conservancy supply facilities within a whole conservancy program were divided into different pieces and distributed to each family inappropriately in the market reform era. It was impossible to make the whole conservancy supply system operate normally without governments' support in the 1980s and 1990s. Farmers and other social groups were hard to cooperate with each other by market approach (Ye, 2005). It also caused the failure of market-driven rural water conservancy supply institutions.

Conservancy supply institutional arrangements connected with household

contract responsibility system and contracted land were also significant factors to affect the effectiveness of market-driven rural water conservancy supply institutions. Small pieces of contracted lands in household contract responsibility system limited the proper use of modern rural water conservancy system (Pan, 2002). Based on the household contract responsibility system, farmers' land use rights also could not expand to others' and or the collective land by market approach in the reform era (Long, 2014). Therefore, it was not possible to establish effective large-scale rural water conservancy supply system on one farmers' contracted land within the market-driven rural water conservancy supply institutions (Song et al, 2014).

The household contract responsibility system also limited the application of new technology in rural water conservancy supply. According to North's argument, new technology and knowledge could increase the effectiveness of existing institutions (1990, pp.100-101). New technology also brings many positive institutional change since it might bring in potential profits for actors to change existing institutions (North, 1990, p.pp.99-102). However, the application of most new technology and facilities need large-scale of land and unified property rights. Bringing new technology or machines in conservancy supply also need farmers to invest more money and time. The household contract responsibility system set institutional border that limited the scale of land and the amount of capital to apply new conservancy technology and facilities. Family-based units made farmers neither had enough capital nor enough land to develop mechanized agriculture (Pan, 2002). Chinese farmers' nature of avoiding risks and the family-based household contract responsibility system determined that in the market-driven institutional framework, farmers were not able to bring in new technologies and enough capital to break institutional limits of market-driven rural water conservancy supply institutions (Luo, 2007). Since local governments still owned farmlands and some conservancy supply infrastructures in rural areas in the 1990s, it reduced the possibilities of using complete market approaches to solve conservancy supply problems within the household contract responsibility system. The failure of the market-driven rural water conservancy supply institutions became an inevitable result.

In general, the failure of the market-driven rural water conservancy supply institutions was decided by unsuitable institutional arrangements and unclear property rights configurations. In the market-driven institutions, both the government and social groups would seek for high economic paybacks but did

not want to invest in rural water conservancy supply programs. Besides, the market-driven institutional arrangements separated rural water conservancy facilities/infrastructures within a conservancy system to different stakeholders. Those facilities/infrastructures could not work together and the conservancy supply effectiveness was much lower than expected. More, small pieces of contracted land and social integration mode also limited institutional innovation and the application of new technology and facilities within the framework of market-driven rural water conservancy supply institutions. Those problems together caused the failure of the market-driven rural water conservancy supply institutions.

CHAPTER 6 THE BENIGN DEVELOPMENT OF MODERN RURAL WATER CONSERVANCY SUPPLY SYSTEM: THE ERA OF THE POLYCENTRIC RURAL WATER CONSERVANCY SUPPLY

The focus of this chapter is the polycentric rural water conservancy supply institutions in the new socialist countryside construction period since the 21st century[49]. The polycentric rural water conservancy supply institutions are a series of institutions formed by both the government and different social groups aiming to offer diversified rural water conservancy supply methods to increase the effectiveness of conservancy supply system. In the polycentric conservancy supply institutions, institutional arrangements of the allocations of conservancy supply programs, division of works and responsibilities of different stakeholders, conservancy construction and maintenance institutional arrangements and conservancy supply property rights distributions all have significant changes. Therefore, the polycentric institutions get some new features to encourage the government and different social groups to participate in rural water conservancy supply programs and keep the stability of the intuitions. The rural water conservancy supply issues in the new socialist countryside era get into a new stage of benign development.

This chapter will introduce China's rural water conservancy supply in the 21st century. The establishment of polycentric conservancy supply institutions in rural China will be introduced first. Then, the next part will present institutional framework and institutional arrangements of the polycentric conservancy supply institutions. This chapter will also give statements about actual operation of the polycentric conservancy supply institutions. It will also offer the institutional analysis of the polycentric rural water conservancy supply institutions. A model

[49] The polycentric rural water conservancy supply institutions in rural China mean both the government and different social groups participate in rural water conservancy supply issues. The institutional framework is relatively open and there are few institutional limits of rural conservancy supply. Diversified rural water conservancy supply methods (*Duoyuanhua Nongtian Shuili Gongji*, 多元化农田水利供给) dominated by governments made formal institutions or dominated by social groups made informal institutions are acceptable and encouraged. Institutional innovations which could increase the effectiveness of rural conservancy supply such as collective shareholding system, private contracting conservancy system with user payment principle and market-oriented conservancy supply operation by the third party are all supported. The polycentric conservancy supply institutions can be seen as the application of Elinor Ostrom's polycentric theory in rural China.

of the institutional operation of the polycentric rural water conservancy supply institutions will be shown to support the analysis. The last part is about problems of polycentric rural water conservancy supply institutions.

6.1 THE ESTABLISHMENT OF THE POLYCENTRIC CONSERVANCY SUPPLY INSTITUTIONS

The establishment of polycentric conservancy supply institutions is the inevitable result of historical choice. The failure of market-driven rural water conservancy supply institutions forced government officials, village leaders, farmers and conservancy professionals to think about and attempt new institutions to deal with conservancy supply problems and increase conservancy supply effectiveness. The establishment of polycentric conservancy supply institutions affected by social and economic factors under specific historical conditions of the late 1990s. The application of polycentric conservancy supply institutions are results of multiple attempts and compromises among different stakeholders.

6.1.1 Social and economic background in rural China from the late 1990s to the early 2000s

The increasing FDI flows, expansionary fiscal policy and tax reform in the early 1990s led to the rapid development of China's economy. But good time did not last long since the economic growth rate kept decreasing in the later years of 1990s (Yu, 2001). In the late 1990s, China's economy had a soft landing, thus significantly influencing the social and economic development (Yu, 2001). Low economic growth rate brought problems for rural China's development especially for rural public goods supply. The continuing reform became the necessity for the sustainable development of rural China.

Compared with the late 1980s, farmers' living conditions did not have significant improvement in the late 1990s. Although the productivity of major crops was at a stable level and most farmers had enough food for the living, the price of major crops, as commodity, was at a low level (Mushtaq et al, 2006). According to relevant statistical data from Xiangyang Grain Bureau in the late 1990s, the average gross production of rice was 400-500kg per Mu (Chinese Acre)/season in most plain areas in Hubei province[50] (Archives of Xiangyang Grain Bureau, 1999, vol131). The average amount of land for a four-person family was about 4-6 Mu in

[50] All the regions in this research which joined the interviews have two harvest seasons. It can be divided into two types: 1.Two seasons of rice; 2.One season of rice and one season of wheat or other crops. Xiangzhou district belongs to the first type. If farmers work hard, they even have time to grow another season of cole or vegetable in Xiangzhou district.

the plain areas. A four-person family needed to consume at least 1000kg food per year (Archives of Xiangyang Grain Bureau, 1999, vol131).

Between 1982 when the complete household responsibility system was established and 2006 when agricultural tax was abolished all over China, farmers in Xiangzhou district normally paid 160 Yuan RMB per Mu for agricultural taxes as their duties in normal years[51] (Archives of Xiangyang Agricultural Bureau, 2008, vol287). If there were serious droughts, the fees were increased to over 200 Yuan RMB per Mu to use the public or collective conservancy facilities and water though the supply effectiveness was low (Archives of Xiangyang Agricultural Bureau, 2008, vol287). The market price of rice in the 1999 was 47 Yuan per 50kg in Xiangzhou district and the price was relatively stable from the middle to the late 1990s (Summary of Agricultural, Industrial and Social Development in the 1990s in Xiangyang County, 2002). Since the local government still needed to submit certain amount of grain to the national reserve granary, farmers also had to sell crops directly to the official departments (Farmers called them public grain, *gongliang,* 公粮). The price of the public grain was about 20% lower than the market price in the 1990s (Sato, 2008).

Doing a simple calculation of above data will find that a four-person family (two adults and two children) should have a gross cash income of 3740 Yuan RMB per year if we do not consider the public grain[52]. Pesticides, fertilizers and other necessary expenditure cost about half of the cash income in Central and Western rural China (Summary of Agricultural, Industrial and Social Development in the 1990s in Xiangyang County, 2002). It meant that the net cash income of a four-person family was about 1870 Yuan RMB per year. The average annual cash income per person in Xiangzhou district was about 467.5 Yuan RMB in 1999 according to above calculation. At the same time, the average monthly salary of a state-owned company worker was about 500 Yuan RMB (Xiangfan Statistical Yearbook, 2000). The income gap between rural and urban areas became a serious problem.

In the late 1990s, growing crops were no longer enough for farmers to support their daily lives and keep normal living standards. On the one hand, farmers had to pay heavy taxes and fees to local governments and village autonomous organizations while they could not get the necessary support and services from official departments (Sun, 2003, pp.58-62). Although taxes had

[51] According to interviews and official data, the amount of payment has not had obvious increase since the early 1980s.

[52] In order to do the calculation, I regard it is a normal year without serious natural disasters, the amount of land as 6 Mu per family (4 people, 2 adults and 2 children) and the production as 500kg per Mu/Season (two season rice). The rice price used the 1999 data.

not been increased since the early 1980s, local governments added various fees instead and did not provide necessary public goods/services for the normal operation of agricultural producing and rural lives (Liang, 2010, pp.123-127). Heavy agricultural taxes and administrative fees limited the enthusiasm for agricultural production; on the other hand, the price of major crops was kept at a low level in the late 1990s, which also seriously hurt farmers' enthusiasm (Shui & Veeck, 2012). The increased investment in conservancy facilities, pesticides and fertilizers made the situation worse (Shui & Veeck, 2012). Moreover, the fast industrial development and urbanization of coastal regions offered an new option for farmers in Central and Western China who abandoned their farmland and became peasant workers in the coastal regions (Gaetano & Jacka, 2004, pp.8-11). Low effective conservancy supply system, abandoned farmland and left-behind children became the new image of rural China in the late 1990s. *San nong* problems were obvious and needed to be solved urgently[53].

The market-driven institutions that generated above problems could not solve rural China's problems and even increased the difficulties to some extents. However, neither farmers nor officials wanted to be return to the collective era and apply government-driven institutions to solve problems. Therefore, a new set of institutions and the reorganization of rural areas were needed and considered by both the government and different social groups.

6.1.2 Inevitability of applying new rural water conservancy supply institutions

Considering the social and economic situations in rural China in the late 1990s, new rural water conservancy supply institutions are inevitable to increase conservancy supply effectiveness. The market-driven rural water conservancy supply institutions led to the low effectiveness of conservancy supply and the collapse of modern rural water conservancy supply system in the market reform era. It is necessary to bring new rural water conservancy supply institutions to replace the old ones.

According to China Statistical Yearbook 2000, the development of rural water conservancy supply system was almost stagnant from the 1980s to the 1990s. The irrigation areas only increased from 5281 in 1985 to 5683 in 2000 (Unit: ten thousand hectares) all over China. The effective irrigation areas increased from 2077.7 in 1985 to 2449.3 in 2000 (Unit: ten thousand hectares)

[53] Left-behind children are children whose parents go to make money in urban or coastal areas while the children live with the grandparents, relatives or live alone in the rural areas. Those children lack necessary guardianship, supervision and education. The phenomena have caused various problems in the Chinese society.

and the number of small reservoirs was 83219 in 1985 and increased to 85120 in 2000 (China Statistical Yearbook, 2000). In 15 years, there were totally 1901 small reservoirs constructed all over China[54]. The total capacity of small reservoirs was 56.4 billion m³ in 1985. This number only increased by 3 billion m³ in 15 years' time (China Statistical Yearbook, 2000). In order to show the efficiency and achievement of official and professionals' works, staff reported higher statistics than the reality (Wang, 2003). In hence, considering the development and expanding of agriculture scale since the late 1970s, rural water conservancy supply almost had no development in the market reform era.

The low effectiveness and various problems of the market-driven rural water conservancy supply institutions required continuous institutional reform and new institutions to solve those problems. Although the modern rural water conservancy supply system had been established from the late 1950s to the 1970s, there were only 40% of the farmland all over China could get general irrigation and drain services in the early 2000s (China Water Resources Yearbook, 2003). In provinces with better natural conditions such as Jiangsu and Zhejiang, conservancy service could cover about 65% of the farmland. However, this number in the northwestern provinces was just 25% (China Statistical Yearbook, 2004). The basic conservancy supply services in Hubei, Shaanxi, Henan could only covered less than 40% of the farmland in the late 1990s (China Statistical Yearbook, 2004).

Since most existed conservancy supply programs were established from the 1950s to the 1970s, the design, construction and functions of facilities/ infrastructures no longer met conservancy demands of the 21st century. According to official statistics, in 2001, the general irrigation index all over China was just 0.4[55] (China Water Resources Yearbook, 2002). There were 21% of the major drains and 30% of other facilities unfinished and 60% to 80% of the farmland did not have effective micro conservancy supply system[56] (China Water Resources Yearbook, 2002). Over 40% of major rural water conservancy supply infrastructures did not get any maintenance or management and 20% of them needed to be rebuilt. The general effectiveness rate of rural water conservancy system in 2001 was just about 70% of that in 1975 (China Water Resources Yearbook, 2002). Therefore, over half farmers in rural China could

[54] The capacity of small reservoirs is from 100 thousands m³ to 10 million m³.

[55] The general irrigation index is used to measure the effectiveness of conservancy facilities especially drains and pipelines. The index is from 0 to 1. The more the index closes to 1, the more effective the conservancy system is. In the western countries, the index is generally over 0.8. In Israel, the index is even over 0.9 is some places. If the index is lower than 0.6, it will be regarded as low effective.

[56] Micro conservancy supply system is the system for a small piece of land. It is built up with different narrow drains or pipelines on the farmland.

only rely on natural conditions rather than modern conservancy facilities for conservancy services in the late 1990s (China Water Resources Yearbook, 2002). The low effectiveness and poor management of rural water conservancy supply system led to the low productivity of crops and had seriously affected the long-term development of agriculture and rural economy.

Besides, neither the government nor social groups could change the poor conservancy supply situation. The central government gave up to allocate conservancy supply programs in different areas; the division of works and responsibilities of different stakeholders were not clear; there was not suitable conservancy maintenance institutional arrangements; property rights configurations of conservancy supply infrastructures/facilities also had obvious problems. Problems of four major aspects of conservancy supply institutional arrangements in the market-driven institutional framework decided that the market-driven rural water conservancy supply institutions met serious situations and could not last long.

In the market reform era, although local governments took administrative fees from farmers, local governments and water stations could not provide effective conservancy services for farmers (Wang, 2012). Local governments did not have enough budgets to establish and maintain conservancy supply programs effectively since they could just rely on local financial expenditures and collect fees from farmers. They could not get necessary support from the central government (Tang & Li, 2005). Without government support, unclear property rights configuration and administrative limits in market-driven rural water conservancy supply institutions also disincentivized social groups to invest in conservancy construction and maintenance programs to make economic profits (Tang & Li, 2005).

In the late 1990s, the Chinese government also tried to reform rural water conservancy supply institutions within the market-driven institutional framework. Due to the limits of institutional arrangements and limits of social and economic situations, the attempts failed (Song et al, 2014). Since the Chinese government had found problems of rural water conservancy supply in the late 1990s, some government officials tried to use a new rural management system which was the so-called "*Case-by-case Approval System (Yishi Yiyi)*" to replace the market-driven institutions in rural public goods supply[57] (Alm & Liu, 2013). The new institutions aimed to further reducing governments' power and

[57] The Chinese meaning of the Case-by-case Approval System is *Yishi Yiyi*(一事一议). Farmers could vote for the specific issues and make decisions of significant rural issues in their own villages. Refer to Note 8.

allowed farmers to decide on significant rural issues themselves by market approaches. The system appeared to be more democratic than the bureaucratic management system in rural China offering farms more autonomy (Pereira et al, 2007). Meanwhile, since the government could not provide necessary financial support, farmers still had to pay huge bills of rural water conservancy supply programs themselves. The new institutions lacked basis for implementation and did not bring significant change for conservancy supply (Sato, 2008).

Therefore, within the market-driven framework, institutional arrangements in four major aspects of conservancy supply institutions especially for property rights distributions had serious problems. Those institutional problems made stakeholders have neither motivations nor abilities to invest or participate in conservancy supply programs. The reform of the *Case-by-case Approval System* within the institutional framework of market-driven institutions also hardly led to any significant change. Hence, a set of new rural water conservancy supply institutions rather than the government-driven institutions and the market-driven institutions were inevitable and necessary to change the situation and promote the effectiveness of rural water conservancy supply in the late 1990s and the early 2000s.

6.1.3 The establishment of polycentric rural water conservancy supply institutions

Since the market-driven rural water conservancy supply institutions brought negative influence on the sustainable development of conservancy supply system and the development of agriculture, institutional change and the establishment new conservancy supply institutions became inevitable. The gradual declines of market-driven rural water conservancy supply institutions guided the appearance of new institutions to increase the effectiveness of rural water conservancy supply (Wu, 2007). The polycentric conservancy supply institutions tried to avoid previous institutions and critically inherit the advantages of the government-driven institutions and the market-driven institutions (Wang, 2012).

The polycentric rural water conservancy supply institutions were new institutions to replace the market-driven institutions. Although problems of market-driven rural water conservancy supply institutions had existed since the 1980s and become more and more serious, the institutional change happened gradually. Not until the early 2000s, the central government started to make new institutional arrangements to promote conservancy supply effectiveness. The central government, local government officials and different social groups all participate in the establishment of new institutional arrangements and attempt

diversified ways to solve rural China's conservancy supply problems. The details of the establishment of polycentric conservancy supply institutions can be found in Figure 6.1 (the number is following the time series).

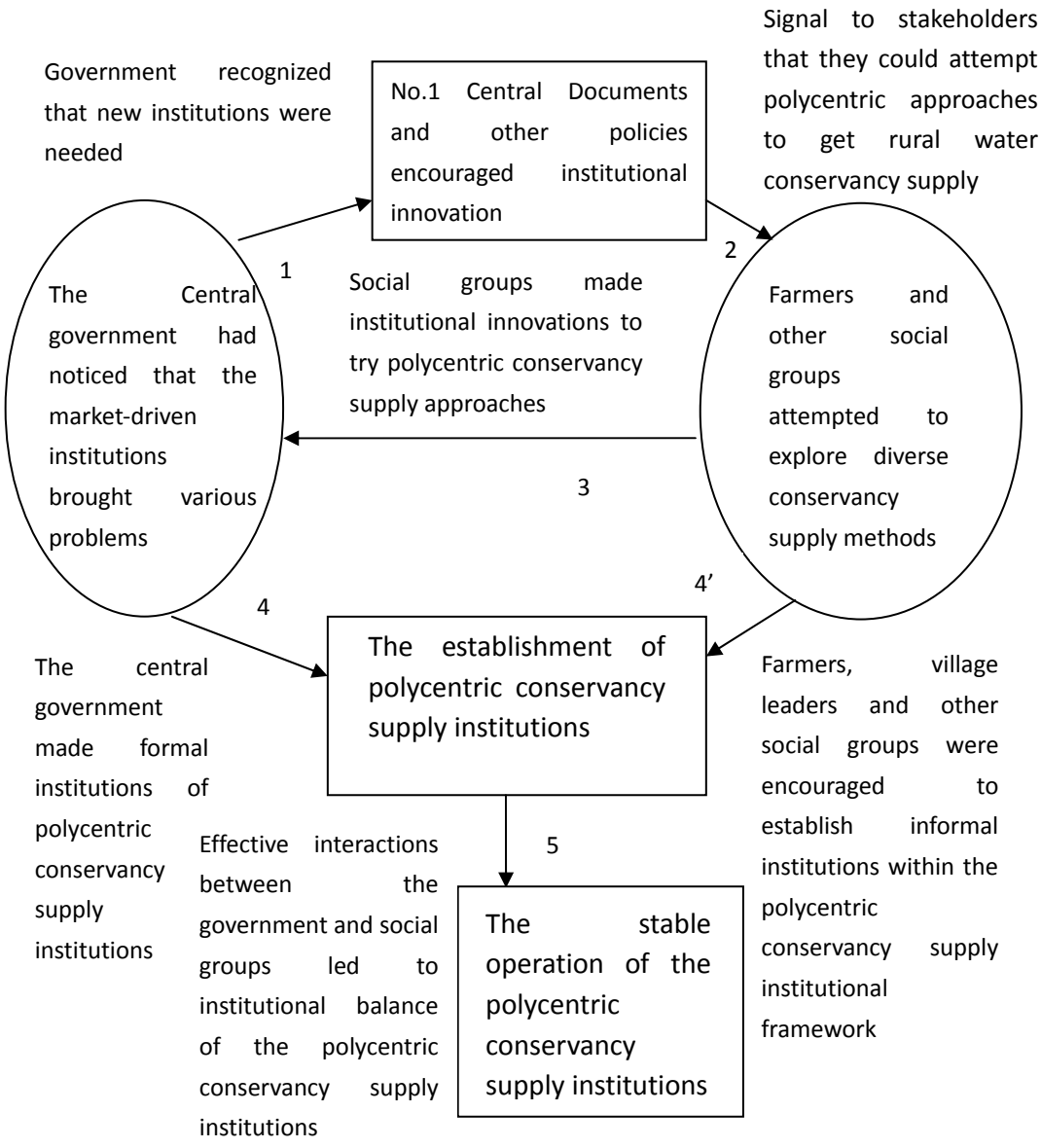


Figure 6.1 The establishment of polycentric rural water conservancy supply institutions

From Figure 6.1, serious problems and declines of rural water conservancy supply system were noticed by top leaders and the central government in the the 1990s. They used No.1 central documents and other policies to encourage institutional innovations in rural water conservancy supply and other aspects[58]. Once social groups got clear signal and institutional support from the central government, they started to attempt diversified rural water conservancy supply methods (Fischbacher & Gachter, 2010). Both governments and social groups

[58] No.1 Central documents in 2007, 2009, 2011 and 2015.

tried to apply new institutions to increase conservancy supply effectiveness. Although the attempts of new conservancy supply institutions spent several years, both the government and social groups had better understanding about others' interests, the aim of new institutional arrangements, accepted diversified supply methods, interacted and compromised with each other. The polycentric conservancy supply institutions were established on the basis of various formal institutions and informal institutions.

As the market economy with government macro-control has been the mainstream since the reform era, the polycentric rural water conservancy supply institutions keep the major framework of the market-driven rural water conservancy supply institutions (Sun, 2004, pp.6-11). The new institutions also critically inherit and apply many reasonable and effective institutional arrangements of government-driven rural water conservancy supply institutions (Luo & He, 2008). Compared with the market-driven rural water conservancy supply institutions, the polycentric institutions aim to increase governments' roles in conservancy supply issues. New institutions also try to encourage both the government and social groups to participate in diversified conservancy supply methods and make institutional innovations to cooperate with each other to increase the effectiveness of rural water conservancy supply (Ministry of Finance & Ministry of Water Resource, 2009).

In the polycentric conservancy supply institutions, the central government showed its ambition to re-establish effective rural water conservancy supply system in rural China. Some of the most important policies were included in No.1 Central Documents and other official documents.

In the market reform era, No.1 Central Documents focused on the legitimacy and the implementation of household contract responsibility system[59]. However, in the new socialist countryside era, contents of No.1 Central Documents were more diversified and emphasized rural institutional innovations and public goods supply[60] (CCP's Central Committee and State Council, 2014, pp.4-12). No.1 Central Documents in the 2000s mentioned several times about the importance of rural water conservancy supply system. Since 2007, the No.1 Central Documents have started to pay attention to the solution of problems of rural water conservancy supply[61]. In 2011, the major theme of the No.1 Central Document was the reform and development of rural

[59] No.1 Central Documents from 1982 to 1986.
[60] No.1 Central Document in 2011.
[61] No.1 Central Document in 2007.

water conservancy supply system[62].

No.1 Central Documents in the new century have encouraged both the government and social groups especially banks and private corporations to participate in rural public goods supply[63] (Lai, 2016, pp.106-130). Both the government and different social groups could invest in rural water conservancy supply programs to secure relevant property rights and get appropriate interests[64]. The government and different social groups were possible to have effective interactions and cooperate with each other. There were few institutional limits, formats or regulations for conservancy supply[65]. Pragmatic approaches to increase the effectiveness of rural water conservancy supply are encouraged[66]. No.1 Central Documents in the new century offered diversified supply subjects, supply approaches and property rights configuration methods, and inclusive institutional arrangements to shape the basic framework of the polycentric rural water conservancy supply institutions.

Besides, since 2004, there have been obvious changes of macro policies of agriculture and rural development. Those changes offered suitable institutional environment and policy support for the implementation of polycentric conservancy supply institutions. The most significant change was the abolishment of agricultural taxes, the provision of subsidy for growing crops and application of land transfer policies[67] (Chen, 2009).

One case about the function of the abolishment of agricultural taxes was in Xiangyang City. Xiangyang City started to offer subsidy and reduce agricultural taxes for growing crops in 2003 and totally canceled agricultural taxes in 2005 (Xiangyang government website, 2005). In 2004, only one year after reducing agricultural tax and offering subsidy, there was a great harvest and the average net income per person increased to 2897 Yuan RMB[68]. The annual increase rate was 13%, the highest since 1997[69].

The subsidy policy also became more comprehensive and covered more farmers. General subsidies were about 30 Yuan RMB per Chinese Mu in 2003 and increased to about 80 Yuan RMB per Chinese Mu in 2012 and about 110

[62] No.1 Central Document in 2011.
[63] No.1 Central Documents in 2011.
[64] No.1 Central Document in 2007.
[65] No.1 Central Documents in 2007, 2009 and 2011.
[66] No.1 Central Documents in 2009, 2011 and 2015.
[67] The cancel of agricultural taxes was started in 2004 and had nationwide implementation in 2006.
[68] The official data did not reduce the cost of fertilizer, pesticide, labour and conservancy cost et al. when they calculate the net income. Using the method in 6.1.1, actual net income per person in Xiangzhou district in 2004 should be increasing from 1000 Yuan RMB to 1300 Yuan RMB.
[69] Source: Xiangyang City government website. Original information was from Xinhua News, Jan.24, 2005, http://www.xf.gov.cn/news/xyxw/xyyw/200501/t20050125_38965.shtml, recruited in the 10th, June, 2016.

Yuan RMB in 2015[70]. In addition, there is subsidy for using certain good seeds (Rice: 20 Yuan per Chinese Mu; Cotton: 15 Yuan per Chinese Mu; Wheat, Corn, Cole: 10 Yuan per Chinese Mu)[71]. Using agricultural machines, using conservancy supply services and other production-related new technology were fully supported by the central and local governments[72].

Besides, introduced in 2005[73], land transfer policies were also helpful for the implementation of polycentric rural water conservancy institutions. Allowing farmers to get or transfer land use rights legally, new policies solved property rights configuration problems of rural water conservancy supply system (Song et al, 2017). Some farmers transferred use rights of their contracted land to individuals or big companies (Ho, 2017). It offers the opportunity to re-establish the property rights configuration of rural water conservancy supply infrastructures/facilities since the land scale was big enough to hold an independent conservancy supply system (Deininger & Jin, 2005).

New institutions ease the contradiction between the government and social groups to enhance the government's prestige among farmers (Kennedy, 2007). The government's support of developing rural water conservancy system also have increased agricultural productivity and reduced farmers' powerlessness (Wang, 2012). The implementation of the polycentric rural water conservancy supply institutions have offered a new mind for the government to establish an interacted-based long-term sustainable mechanism to deal with rural public goods supply problems and reduce the government's input (Wong, 2009).

Therefore, the application of various institutional arrangements in the new socialist countryside era offer chances to establish polycentric institutions to solve rural water conservancy supply problems. The establishment of polycentric rural water conservancy supply institutions tries to combine interests of different stakeholders to invest and participate in rural water conservancy supply (Wang & Yao, 2007). The polycentric rural water conservancy supply institutions aims to set new institutional arrangements to change the situation of low supply effectiveness and open a new era for rural water conservancy supply in rural China.

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[70] The general subsidy is the major subsidy for growing crops. It has a basic standard while it is also changed based on the real situations. Therefore, the data in the thesis take the average number from interviews and statistical data.

[71] Source: Xiangzhou District Agriculture Bureau Website: http://www.xzqnyj.gov.cn/, recruited in the 13th, June, 2016.

[72] Ibid.

[73] In 2005, the Ministry of Agriculture published *Rural Land Contracting Right Transfer Management Approach*. It offered basic principles and regulations of land use right transfer.

6.1.4 Features of polycentric rural water conservancy supply institutions in the market economy

The establishment of polycentric rural water conservancy supply institutions was still in the context of the market economy. Macro political and social institutions were generally stable from the late 1990s to the early 2000s. Compared with the establishment of market-driven rural water conservancy supply institutions in the late 1970s and early 1980s, the establishment of the polycentric rural water conservancy supply institutions in the 2000s was more like an institutional evolution as it did not lead to rapid and significant social and economic changes (Ke, 2010).

The establishment and application of polycentric conservancy supply institutions was to solve previous institutional problems in conservancy supply and increase conservancy supply effectiveness. Since the 1990s, China's market economy has changed its focus from recovering productivity to increasing the power of the rich and high-ranking officials (Wu, 2014)[74]. The government reduced its support and investment on conservancy supply. The 1994 tax-sharing reform and other similar policies further reduced the effectiveness of the market-driven conservancy supply institutions since the central government cut financial incomes of local governments (Wang, 1997; Wong, 2000).

Therefore, in order to change the low effectiveness of rural water conservancy supply, the government applied the polycentric rural water conservancy institutions to deal with problems occurred in the market economic environment. Since the macro institutional environment of market economy did not change significantly, the government kept the general institutional framework of the market-driven institutions when applying the polycentric institutions (Wang, 2012). The government just adjusted accurate institutional arrangements and increased the government's functions in rural conservancy supply (The CCP Central Committee and State Council, 2014). Hence, the new institutions did not lead to significant negative social and economic change in rural China.

Compared with the market-driven institutions, one key point of polycentric conservancy supply institution is that the central government aims to play a significant role in the polycentric rural water conservancy supply institutions. The central government promises to offer enough financial and policy support for the establishment and maintenance of rural water conservancy supply

[74] Tencent News 29 May 2014. *Wu Xiaobo's opinions about Zhu Rongji's reform*. Available at http://finance.qq.com/a/20140529/029642.htm, recruited in the 21st, June, 2016.

programs (Wong, 2009). Another significant point of polycentric conservancy supply institutions is that social groups are also encouraged to participate in rural water conservancy supply without strict institutional limits (Song et al, 2014). They can get reasonable economic profits and subsidies through investing in rural water conservancy supply programs (Song et al, 2014).

It seems that the return of the government in polycentric rural water conservancy supply institutions is in contradiction to the basic rule of the market economy. However, the nature of rural water conservancy supply system proves that market operation cannot bring high effectiveness (Pan, 2002). In fact, finding government's proper role in the market economy was one of the major tasks in the 1990s' reform (Yu, 2001). The return of the government is a pragmatic strategy to solve problems of market failures in rural water conservancy supply and reshape the leading position of the government in rural issues (Wang, 2012).

Meanwhile, governments' positions in the polycentric institutions are different from what they used to be in the collective era and the early stage of the market reform era. The central government just makes macro development plans and offers policies and financial subsidies for rural conservancy supply while local governments take positions of guiding and supervising conservancy supply programs (The CCP Central Committee and State Council, 2014). Pragmatic and resilient policies in the new socialist countryside era are welcomed (Ye, 2015). The relatively liberal social and economic atmosphere of the market economy offers the space for the government to take effective actions to involve in conservancy supply but limit political involution at the same time.

In general, the establishment and conduct of the polycentric rural water conservancy supply institutions does not challenge the market economy (Song et al, 2014). The polycentric institutions are new strategies and products of the development of the market (Duan et al, 2016). The new institutions evolve to increase the effectiveness of rural water conservancy supply in the market economy. The polycentric rural water conservancy supply institutions try to enrich methods and meanings of the market economy with establishing effective interactions and cooperative relationships among different stakeholders.

6.2 THE INSTITUTIONAL FRAMEWORK AND ARRANGEMENTS OF POLYCENTRIC RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

The polycentric conservancy supply institutions are established on the basis of

the market economy. They inherited the general institutional framework of market-driven rural water conservancy supply institutions but also increase the government's involvement in conservancy supply. The institutional framework of polycentric conservancy supply institutions can be seen as the combination of government-driven institutions and market-driven institutions (Zhang, 2009). The polycentric conservancy supply institutions try to compatible with different conservancy infrastructures/facilities, different conservancy supply methods, different stakeholders and different property rights distribution methods within the same institutional framework. Openness, compatibility and diversity are general guidelines of polycentric conservancy supply institutions. Diversified supply approaches and polycentric governance structure are major features of polycentric conservancy supply institutions (Zhang, 2009). The institutions aims to overcome previous institutional problems in conservancy supply, increase the effectiveness of conservancy supply and keep the sustainable development of modern conservancy supply system.

The polycentric conservancy supply institutions mainly make adjustments and set new institutional arrangements in the four major aspects of formal conservancy supply institutions. In the polycentric conservancy supply institutions, both the government and social groups are encouraged to participate in conservancy supply (The State Council, 2010). Any institutional innovation that can increase conservancy supply effectiveness are encouraged (The State Council, 2010). Statements of accurate institutional arrangements of polycentric conservancy supply institutions will be presented based on four major aspects of conservancy supply institutions.

The polycentric conservancy supply institutions have made significant changes about the allocations of conservancy supply programs in different areas. In the new socialist countryside era, since the central government, local governments and social groups pay more attention to conservancy supply, there are many large-scale conservancy supply programs are newly established or recovered (Jia & Huang, 2011). The central government makes macro policies to support those programs and allows local government officials and other stakeholders to choose the accurate locations of those programs based on their interests (No.1 Central Documents, 2011; 2015). No.1 Central Documents regulated that the government should guide the allocation of conservancy supply programs. Other stakeholders should be responsible for the accurate allocations of conservancy supply programs[75]. Therefore, different stakeholders make the

[75] No.1 Central Documents in 2011 and 2015

allocations of conservancy supply programs in the new socialist countryside era. On the one hand, the institutional arrangement hopes to increase the government's responsibilities in conservancy supply. On the other hand, the institutional arrangement hopes to respect other stakeholders' interests and opinions (Song et al, 2014). More, this institutional arrangement tries to make the best use of local knowledge and official resources to select most suitable allocations for conservancy supply programs to maximize the supply effectiveness (He et al, 2016).

The division of works and responsibilities of stakeholders in conservancy supply in the new socialist countryside era followed the polycentric governance mechanism. New institutional arrangements allowed different stakeholders to be suppliers and funders of conservancy supply programs (Song et al, 2014). The central government mainly offers policy support, subsidy and financial support to all the suppliers but does not involve in accurate management works (No.1 Central Document, 2009;2011;2015). Local governments play the leading and guiding positions in rural water conservancy supply. Local officials who manage rural water conservancy supply well also can get political promotions (The State Council, 2010). The institutional arrangement tries to offer effective incentive mechanism for local governments and officials to pay more attention to rural water conservancy supply issues (Talhelm et al, 2014). Although they still need to pay money and/or labours to join the construction and maintenance of rural water conservancy supply programs, farmers who join agricultural producing directly get more support from the central government, local governments, financial organizations and autonomous cooperative organizations (Archives of Wuhan City Water Bureau, 2015, vol513). This arrangement not only help farmers to get effective and sufficient rural water conservancy supply services but also guarantee participants' property rights of conservancy facilities and relevant subsidies (such as digging well funding) (Ye, 2015). Farmers again actively participate in constructing and maintaining rural water conservancy supply system (Archives of Wuhan City Water Bureau, 2015, vol513). Farmers' participations have offered enough labours and local knowledge for the establishment and maintenance of rural water conservancy supply programs. The institutional arrangement aims to promote the effectiveness of rural water conservancy system (Wang, 2012). In the new institutional framework, official banks, financial cooperatives and private investors can invest conservancy supply programs freely without strict institutional limits (No.1 Central Document, 2007; 2011). Besides their investment interests, the government will

also offer investors subsidy to encourage their investment enthusiasm (The State Council, 2010). This institutional arrangement aims to mobilize private capital and civil power to participate in conservancy supply. It can not only support diversified conservancy supply methods but also reduce government's financial and administrative burdens in conservancy supply issues (Ye, 2015). Most conservancy professionals in the new era get official financial support again from the government (The State Council, 2010). Their duties mainly focus on supervising the construction and maintenance situations of conservancy supply programs. They also offer fair professional advices to other stakeholders for conservancy development (He et al, 2016). Since conservancy professionals do not have to make money from conservancy supply, they can be objective and fair in offering professional advices. This institutional arrangement aims to establish a fair and objective group to supervise and guide the development of conservancy supply within the polycentric institutional framework.

The new division of works and responsibilities of stakeholders aims to use polycentric governance framework to coordinate and compromise interest differences of various stakeholders and solve interest conflict problems (Ye, 2015). Since there is no fixed method of division of conservancy supply works and responsibilities in the polycentric institutions, both the government and social groups could choose the most suitable and effective positions to supply rural water conservancy services according to local situation (The CCP Central Committee and State Council, 2014). The new institutional arrangements also hope to use the division method to encourage institutional innovations to increase conservancy supply effectiveness.

In the polycentric conservancy supply institutions, the construction and maintenance institutional arrangements both follow the polycentric governance mechanism (Huang et al, 2006). All the stakeholders of conservancy supply could participate in different aspects of construction and maintenance works and take relevant responsibilities (No.1 Central Documents, 2011;2015). The central government and local governments have to take responsibilities to manage conservancy construction and maintenance (The CCP Central Committee and State Council, 2014). However, they cannot join in the construction and maintenance works directly. The construction and maintenance works of conservancy supply normally organized and supervised by local governments and implemented by private construction corporations or farmers' autonomous conservancy supply organizations (The State Council, 2010). If individual farmers or private agricultural corporations have large-scale farmland, they can

also do the conservancy construction and maintenance works themselves with the support from the government or financial organizations (No.1 Central Document, 2011). Local government also can organize farmers and villages to construct and maintain conservancy supply programs (No.1 Central Document, 2011). Construction and maintenance institutional arrangements in the polycentric conservancy supply institutions aims to transfer the government and social groups' functions in conservancy supply (He et al, 2016). The institutional arrangements mainly hope to increase the government's roles in conservancy supply while also control the government's political involution and intervention. The new intuitional arrangements also hope to establish a service-oriented administrative system in the new socialist countryside era (Li, 2007). Within such institutional environment, social groups are also possible to release their potentials to seek for economic interests in conservancy supply and increase the effectiveness of conservancy supply.

Property rights and benefits of investing in rural water conservancy supply programs are decided by shareholders' choices and positions in the new socialist countryside era (No.1 Central Documents, 2015). All stakeholders in the polycentric conservancy supply institutions could be owners and users of conservancy supply infrastructures/facilities if they own property rights (The CCP Central Committee and State Council, 2014). New institutional arrangements such as collective shareholding system, private contracting conservancy system with user payment principle and market-oriented conservancy supply operation by the third party are all applied in the new socialist countryside era (Tam, 2013, pp.78-82). Diversified forms of conservancy property rights and different property rights owners coexist in the polycentric conservancy supply institutions (The State Council, 2010). However, the basic principle of market economy does not change. Property owners have legal rights to use and get benefit from conservancy supply infrastructures/facilities. They also have more advantages to access and use irrigation water (No.1 Central Documents, 2011; 2015). If others want to use conservancy supply facilities/infrastructures, they must get the permission of the owners and pay relevant fees with market price (Wang, 2012). The new institutional arrangements aim to reestablish property rights distribution methods and find a suitable mechanism to integrate fragmented property rights together (No.1 Central Documents, 2011; 2015). A diversified conservancy property rights system hopes to be established to apply modern property rights theory in conservancy supply. The new conservancy property rights institutional

arrangements also try to make all the stakeholders get equal rights and treatments in conservancy supply (He et al, 2016). The major aim of the polycentric property rights institutional arrangements is to increase the effectiveness of conservancy supply from the institutional level.

In general, the institutional framework and arrangements of polycentric conservancy supply institutions try to fix previous institutional problems led by market-driven institutions and government-driven institutions. The polycentric conservancy supply institutions hope to increase the effectiveness of conservancy supply by diversified conservancy supply approaches and property rights distribution methods (He et al, 2016). Improving the quality of conservancy services and adjusting government and social groups' functions in conservancy supply are significant in polycentric conservancy supply institutions (Ye, 2015). The polycentric rural water conservancy supply institutions hope to bring positive changes of conservancy supply in the new socialist countryside era.

6.3 THE DEVELOPMENT AND INNOVATIONS OF RURAL WATER CONSERVANCY SUPPLY SYSTEM

The polycentric rural water conservancy supply institutions are established by a set of formal and informal institutions. The polycentric institutions offer a relatively free and supportive institutional framework for various conservancy supply methods. Various methods coexist with each other. The government and social groups can find suitable positions in rural water conservancy supply. Different stakeholders have chances to have effective interactions and establish stable cooperative relationships. In short, institutional arrangements and institutional innovations of polycentric conservancy supply institutions bring positive changes of conservancy supply in the 21st century. The following part will state the actual operation of the polycentric conservancy supply institutions.

6.3.1 No.1 Central Documents and official support from the central government

Regulations and plans in No.1 Central Documents and other official policies are significant parts of formal polycentric conservancy supply institutions. Since 2007, the central government recognized the importance of rural water conservancy supply system in agricultural development, thus setting reestablishing rural water conservancy supply system as a key subject in No.1 Central Documents to support the sustainable development of conservancy

supply system[76]. The central government has provided financial and policy supports in No.1 Central Documents and other official documents to encourage the recovery and development of rural water conservancy supply system.

In the No.1 Central Document of 2007, the central government proposed improving the effectiveness of rural public goods and services supply (CCP's Central Committee and State Council, 2014). Rural water conservancy supply system has been put in the primary status and emphasized by the central government[77].

In 2011, the main subject of the No.1 Central Document was to accelerate water conservancy reform[78]. In the document, the Chinese central government hoped to use 5 to 10 years to obviously change the backward situation of rural water conservancy supply system[79]. The central government hoped to raise the general irrigation index to 0.55 and increase effective irrigated farmlands of 40 million Mu (Chinese Acre) in 2015 (CCP's Central Committee and State Council, 2014). The ambitious plan of the central government also showed that the adjustment, promotion and modernization of rural water conservancy system would generally be finished in 2020[80] (CCP's Central Committee and State Council, 2014). In order to achieve above aims, the central government has decided to use 10% of the land revenue interests collected by local governments to develop rural water conservancy supply system[81].

In the No.1 Central Document of 2015, the central government mentioned the importance of rural water conservancy system again and decided to increase financial support for the construction and maintenance of rural water conservancy supply system[82] (Xinhua News Agency, 2015). The 2011 and 2015 No.1 Central Documents also mentioned that local governments should dominate the implementation of new policies. The two documents also encourage making institutional innovation by having social groups to participate in rural water conservancy construction and maintenance[83]. The documents clearly regulate local governments and social groups' roles in rural water conservancy supply in the polycentric institutions. It offers institutional

[76] No.1 Central Documents in 2007, 2009, 2011 and 2015.
[77] No.1 Central Document in 2007.
[78] No.1 Central Document in 2011.
[79] Ibid.
[80] The modernization means to bring in modern technology and methods such as sprinkler and drip irrigation technology to increase the effectiveness of rural water conservancy supply system.
[81] According to Wu Xiaobo, it was a deal between the then prime ministry Zhu Rongji and local governments. The land revenue interests have been collected by local governments since the 1990s tax reform as the compensation.
[82] Financial support policies included increasing the investment of relevant basic conservancy supply infrastructure constructions, subsidy and so on.
[83] No.1 Central Documents in 2011 and 2015.

protections to prevent local governments from shirking their responsibilities in rural water conservancy supply issues.

To ensure conservancy supply aims and regulations in No.1 Central Documents can be implemented well, the central government has also offered specific funding for the adjustment and improvement of rural water conservancy supply system since 2005 (CCP's Central Committee and State Council, 2014). The specific funding includes the fees for digging water wells, buying electric pumps, recovering drains on the farmland, repairing local pump station and using irrigating water. Official staff supervise that all the money is used in the conservancy supply area. Detailed policies have been made to ensure the money not be used for other purposes (CCP's Central Committee and State Council, 2014).

One case in Wuhan City can prove that the government tightly controls the specific funding for the construction and maintenance of conservancy supply programs. The Hubei provincial government and Wuhan City government have made policies to regulate the use of rural conservancy subsidies from the central government (Archives of Wuhan City Water Bureau, 2015, vol513). No officials could use the subsidy for other purposes. The City Water Bureau sent inspectors to check the use of the subsidy in different districts each season (Archives of Wuhan City Water Bureau, 2015, vol513). Government officials also encouraged farmers to report the abuse of conservancy subsidies. If district/township officials violate relevant regulations, there might be negative consequences for their political promotions (Archives of Wuhan City Water Bureau, 2015, vol513).

The case in Lingbao also proved the argument. Based on the city government archives, compared with the 1990s, the central government offered more subsidies for growing crops and conservancy supply in the 2000s especially in recent 10 years (Archives of Lingbao City Government, 2012, vol642). The subsidy was distributed to farmers directly rather than via local governments or village autonomous organizations (Archives of Lingbao City Government, 2012, vol642). Since farmers could get the conservancy subsidy from the central government directly, they just needed to spend a little money for rural conservancy supply. The local government also organized and helped farmers to deal with large-scale conservancy programs such as maintaining drains and reservoirs (Archives of Lingbao City Government, 2012, vol642).

No.1 Central Documents and other policies from the central government show that government has noticed rural water conservancy supply problems and

take effective actions and support to solve those problems within the polycentric institutional framework (Ye, 2015). Compared with the 1980s and 1990s, the central government has provided direct and strong financial and policy support to local governments and farmers. The central government also makes accurate regulations and aims for local governments to improve the rural water conservancy supply system[84]. No.1 Central Documents and other policies have played positive roles for the actual operation of polycentric rural water conservancy supply institutions.

6.3.2 Rural water conservancy key county program

Apart from direct and indirect financial support for the development of rural water conservancy supply system, the central government also has established specific official programs to promote the development of rural water conservancy supply. Those specific programs are also significant parts of formal polycentric conservancy supply institutions.

The Rural Water Conservancy Key County Program (*Nongtian Shuili Zhongdianxian*, 农田水利重点县) is the most obvious program to encourage and manage local officials' efforts in this regard. The Rural Water Conservancy Key County Program is led by the central government. The program takes a competitive approach to ask counties/districts to apply for the title of the *Rural Water Conservancy Key County*. The competition is based on the previous conservancy construction/maintenance situations and proposals of rural conservancy development plan of the county/district (Ministry of Finance & Ministry of Water Resource, 2009). With such a title, the county/district gets much more funding from the central government to support rural water conservancy supply programs than other counties/districts. If the county/district could reach its proposed conservancy supply targets within 3 years, it automatically gets the next round of conservancy supply funding until the county/district finishes all the necessary construction and upgrading of rural water conservancy supply infrastructures and becomes capable of offering effective conservancy supply services[85] (The state Council, 2010). The program offers an effective incentive for local governments to focus on rural water conservancy supply issues and reduces local governments' financial burdens of rural conservancy supply.

Compared with other interests, local officials pay more attention to political

[84] No.1 Central Documents in 2007, 2009 and 2011.

[85] More details could be seen in the *Rural Water Conservancy Key County Performance Evaluation Methods*. Source from the official website of the State council, available at: http://www.gov.cn/gongbao/content/2010/content_1645552.htm, recruited in the 28th, June, 2016.

achievements and their promotion (Cao, 2000, pp.165-167; pp.500-507). The Rural Water Conservancy Key County Program attracts local officials' enthusiasm in conservancy supply issues since the program sets constructing and developing rural water conservancy supply system as a political task and connects with officials' political promotion (The state Council, 2010).

Interviews in Xiangyang City Government and Hubei Provincial Department of Water Resource showed that all the officials clearly understand the importance to participate in the Conservancy Key County program. There is no clear documents or regulations state that there is specified rewarding for officials' good performance in the construction of Rural Water Conservancy Key County program. However, local officials understand that if their counties could be selected as key counties of rural water conservancy supply development and if they could finish all the construction and maintenance works on time, they would be easier to get political promotion[86] (Summary of Interview Materials). Local officials welcome and actively participate in the Rural Water Conservancy Key County program (Ye, 2015). Winning the Key County title is regarded a significant political achievement of cadres of relevant towns and county/district. The conservancy key county program is highly valued by the central government and the county/district can get huge financial and policy support from the central government and provincial government[87] (Summary of Interview Materials).

The Rural Water Conservancy Key County Program can be seen as the implementation of the central government's polycentric rural water conservancy supply institutions in the new socialist countryside era. The central government no longer uses administrative commands to force local governments but uses policies to encourage local governments to reach certain targets and involve in conservancy supply directly (Wong, 2009). As one of the basic administrative units in China, county/district governments are encouraged to take the leading and guiding responsibility to organize and manage rural water conservancy supply issues in the polycentric conservancy supply institutions. Besides, since most rural water conservancy supply infrastructures are established within the confine of a county/district, the county/district government is easier to coordinate interests of different actors (Wang, 2012). Setting county/district as the unit to establish and maintain conservancy supply programs is helpful to coordinate different stakeholders' interests and establish cooperative

[86] Normally, the construction programs will last 3 years and the inspection unit of the central government and the provincial government will be back to check the maintaining situation regularly.
[87] Refer to Note 88.

relationships in the polycentric rural water conservancy supply institutions (Luo, 2006).

The Rural water Conservancy Key County program is implemented in two different parts. The general guidance and supervision are dominated by the county/district government while the actual construction/maintenance is operated by professional construction corporations (Ministry of Finance & Ministry of Water Resource, 2009).

The main task for the county government is to apply for the conservancy key county program funding, organize the relevant bidding, supervise social groups and deal with other administrative activities (The state Council, 2010). The county/district government is the agent of the central government in local areas on the one hand and is the coordinator and organizer of a series of conservancy supply programs within the county's region on the other hand (Mushtaq et al, 2006). The county/district government needs to select at least one conservancy program in a town as the key program and organizes and supervises relevant stakeholders (corporations, village leaders, farmers and financial organizations et al.) to finish all the work within the year. The county/district government itself does not construct and maintain those programs directly (The State Council, 2010). Unlike the situation under the government-driven institutions and market-driven institutions, local government could neither shirk its rural conservancy supply responsibility nor involve too much in the direct and detailed conservancy management in the polycentric rural water conservancy supply institutions.

Social groups also play significant roles in the Rural Water Conservancy Key County Program. According to the Opinions on the Implementation of the Central Financial Support to the Rural Water Conservancy Construction Key County Programs (中央财政农田水利重点县建设管理办法)[88], a document issued by the Ministries of Finance and Ministry of Water Resources, county governments and local water stations could apply for rural water conservancy supply construction and maintenance programs; farmers and village leaders can decide where and how to construct and maintain conservancy infrastructures/facilities (The Case-by-case Approval System); professional construction corporations can implement detailed program constructions (Ministry of Finance & Ministry of Water Resource, 2009).

Both the central government and local governments encourage professional

[88] Source from the official website of the Ministry of Finance. Available at: http://www.mof.gov.cn/zhengwuxinxi/caizhengwengao/2009niancaizhengbuwengao/wengao200912qi/201002/t20100203_267964.html, recruited in the 15th, July, 2016.

construction corporations to join in the bidding and construction (Ministry of Finance & Ministry of Water Resource, 2009). Since construction corporations can get direct economic profits from conservancy supply programs and financial subsidies from the government, they are motivated to join rural water conservancy supply programs and cooperate with government (Song et al, 2014). Construction corporations have professional knowledge about construction, operating with higher effectiveness and spending less money than ordinary farmers in the construction and maintenance of conservancy supply programs (He et al, 2016).

Construction corporations have actively participated in the Rural Water Conservancy Key County Program. In order to join the conservancy key county program, many professional construction corporations spend their own money or borrow money from the bank/rural credit cooperatives first to gain their competitiveness [89] (Summary of Interview Materials). However, most construction corporations have no professional knowledge of rural conservancy supply and lack local knowledge. They might also play tricks in conservancy supply programs. Therefore, local governments also ask farmers, village leaders and conservancy professionals to participate in and supervise program bidding and constructions (Ministry of Finance & Ministry of Water Resource, 2009).

Based on the Rural Water Conservancy Key County Program, the Ministry of Water Resources also establishes the Rural Conservancy Information System (RCIS)[90]. The system shows the financial support and funding use in each county. It also offers statistical data about the conservancy supply effectiveness of each county through the Internet (The State Council, 2010). Specific officials in county/district government and local water departments are responsible for data input and upgrade. The information system helps both the central government and local governments to understand regional differences of rural water conservancy supply in each town clearly (The State Council, 2010). The establishment of the RCIS also means that the scientific management system of rural water conservancy supply has systemized and formalized.

In general, the Rural Water Conservancy Key County Program is an institutional arrangement to encourage local governments and social groups to recover the effectiveness of rural water conservancy supply. It also means the formal and scientific operation of the polycentric rural water conservancy supply institutions. The conservancy key county program helps the central government,

[89] It could be regarded as an investment method. Private corporations pay their own money first and get all the money and economic profits back from the government once the program is finished.

[90] The website of the system: http://www.ntsl.org.cn

local governments, farmers, village leaders, conservancy professionals and private construction corporations to find their positions in rural water conservancy supply in the new era and establish effective interactions. The conservancy key county program also shows that the government attempts polycentric supply approach of rural water conservancy services that never appeared before. The conservancy key county program has solved some problems in the market-driven rural water conservancy supply institutions to some extent.

6.3.3 Land use right transfer and consolidation

Compared with direct financial support from the central government and the Rural Water Conservancy Key County Program, policies of land use rights transfer have indirect but significant impacts on the actual operation of polycentric rural water conservancy supply institutions.

The nature of rural water conservancy supply system decides that the chaotic conservancy supply property rights can lead to various problems (Pan, 2002). The household contract responsibility system in the 1980s and the 1990s limited the establishment of large-scale modern agriculture and led to the low effectiveness of market-driven institutions (Yep, 2004). The biggest problem of the market-driven rural water conservancy supply institutions was unclear property rights of conservancy supply infrastructures/facilities (Luo, 2006). Local governments and village autonomous organizations held the property rights of some public rural water conservancy infrastructures/facilities but could not supply effective conservancy services. Individuals/families also had neither necessity nor abilities to afford a whole conservancy supply system since they just held fragmented and small pieces of contracted land (Luo & He, 2008). However, if individual farmers or private corporations were allowed to have a large piece of farmland, they would be motivated to invest and establish effective rural water conservancy supply system (Simmons, 2016).

In 2005, the Ministry of Agriculture published the *Farmland Use Rights Transfer Management Approaches* (农村土地流转管理办法)[91] permitting and regulating land use rights transfer in rural areas. The approaches are based on voluntary consultations. Various actions such as land exchange, land rental, land shares have been legally protected by the policy (Ministry of Agriculture, 2005). Implementations of the land use rights transfer policies solve property rights problems of rural water conservancy supply infrastructures/facilities in the

[91] The original document in Chinese is available at: http://www.agri.gov.cn/blgg/t20050126_311817.htm, recruited in the 15th, July, 2016.

1980s and the 1990s. Both individual farmers and private corporations are interested in investing in rural water conservancy supply programs in the new socialist countryside era (Long, 2014). Because they can transfer and consolidate land use rights to get large scale of farmland and establish a relatively comprehensive rural water conservancy supply system with complete property rights (Ye, 2015).

Interview materials in Xinzhou showed that most farmers understood the power of new technology and modern agriculture. However, interviewees mentioned that the household contract responsibility system limited farmland's expansion, the implementation of agricultural machine and the newest rural water conservancy supply technology (Summary of Interview Materials). Land use rights transfer policies offered farmers the chance to establish their own big farms through collecting and transferring land use rights from the peasant workers in the village (Summary of Interview Materials). Farmers can apply sprinkler irrigation and drip irrigation technology in the land with government's financial support and subsidy. They can also get the property rights and ownership of all the conservancy supply facilities in their farms without sharing with others (Summary of Interview Materials). The implementation of land use rights transfer policies encourage farmers to invest more in conservancy supply programs.

Although the household contract responsibility system is still the main configuration method of farming land in the new socialist countryside era, the central government and local governments allows free land transfer among individuals, the collective and corporations to solve peasant worker problems and meet the demands of agricultural development (Ye, 2015). Land transfer policies make the totally privatization and marketization of a whole rural water conservancy supply system possible.

In addition, farmers' autonomous organizations and private corporations use the form of shareholding to invest in rural water conservancy supply programs. Land use rights transfer policies allow different stakeholders to bargain with each other in the market to distribute land use rights (Farmland Use Rights Transfer Management Approaches, 2005). It solves problems of the truncation of ownership, reduces the transaction cost of conservancy supply and increases supply effectiveness (Zhang, 2009). Land use rights transfer policies establish effective interactions and cooperative relationships among different actors, which are based on contractual relationship between government and different social groups (Ye, 2015). It is helpful to release the power of the market to make rural water conservancy supply more effective.

Farmers those who left rural areas and became peasant workers also could transfer their contracted land to others and benefit economically from it. On the one hand, peasant workers could earn extra money from the land transfer. On the other hand, farmlands would not be abandoned if the use right could be transferred to others (Long, 2014).

In general, the implementation of land use rights transfer policies make farmland can be transferred for farming and allow rural water conservancy supply infrastructures/facilities on it to keep working. Facilities such as drains and motor-pumped wells on the transferred land can be integrated into the regional rural water conservancy supply system effectively (He et al, 2006). Effective land transfer prevents the abandonment of rural water conservancy supply infrastructures/facilities. People who get others' contracted land for farming could also establish their independent water conservancy system on the farmland by private investment or cooperate with other stakeholders (Simmons, 2016). The land use rights transfer policies are institutional innovations to integrate and reshape the rural water conservancy supply system in the polycentric institutional framework. Conservancy supply effectiveness is no longer limited by conservancy supply infrastructures' fragmented property rights in the new socialist countryside era (Wong, 2009).

6.3.4 Financial organizations in rural water conservancy supply

Besides the official financial support, the polycentric rural water conservancy supply institutions also encourage the participation of financial organizations. Financial mechanism in China has become more comprehensive since the 2000s compared with the 1980s and the 1990s (Tam, 2013, pp.23-26).

After the 1994 reform, spun off from the Agricultural Bank of China in 1996, rural credit cooperatives have tried to pay more attention to have cooperation with farmers and local governments (The State Council, 1996). In the same year, the Agricultural Development Bank of China established its nationwide system at county level (Tam, 2013, pp. 83-85). It meant that an independent financial system in rural China has been established.

Besides banks, the non-bank financial organizations and private financial organizations also got development. Like in the 1980s, the private financial organizations and autonomous financial organizations still operated in the gray area in the early 1990s. However, some provincial governments acquiesced and supported the development of private organizations to some extent in the mid-1990s (Yu, 2001). In some provinces, the village collective and autonomous organizations among farmers were allowed to establish their own financial

cooperative organizations or shareholding foundations (Jilin Provincial Government, 1992)[92]. However, the development and innovation of private financial organizations were limited and forbidden by the central government in 1998 and 1999 (The State Council, 1998; 1999)[93].

Not until 2007, the central government released the control for autonomous groups and individuals to establish financial cooperatives and foundations within the polycentric institutional framework. The new institutional arrangements allow diversified financial organizations to participate in the development of rural China (The CCP Central Committee and State Council, 2014). Capital from various sources has been introduced in the polycentric rural water conservancy supply system since then.

Investment in rural water conservancy supply programs has been seen as normal economic activity since 2007 (No.1 Central Document, 2007). Financial investors could get appropriate economic benefits and financial subsidy from participating and investing in conservancy supply programs (No.1 Central Document, 2007). Therefore, many of them become enthusiastic to involve in rural conservancy supply issues.

However, although the amount of official and private financial organizations increase a lot, demands of financial services in rural water conservancy development have also increased greatly (Song et al, 2014). Small financial organizations do not have enough capital to support the development of many rural water conservancy supply programs while state-owned banks also have to select significant conservancy supply programs to support (He et al, 2016).

In general, financial organizations have played more significant roles in rural water conservancy supply than that in the 1980s and the 1990s. However, there are still some problems in attracting enough and stable investment for the comprehensive upgrading and development of the conservancy supply system in Central and Western rural China.

6.3.5 The development of social groups in the polycentric institutions

Social groups' positions and functions also significantly affect the operation of polycentric rural water conservancy supply institutions. Social groups' positions and functions have changed in the polycentric rural water conservancy supply

[92] The source was the No.28 political document of the Jilin provincial government in 1992.

[93] The document of *Banned measures of illegal financial organizations and illegal financial business activities* （非法金融机构和非法金融业务活动取缔办法）which published in July 1998; Relevant information also could be found in the No.3 document of the state council in 1999.

institutions. Their statuses have been further improved. Farmers, financial organizations, private investors and professionals have generally achieved their interests in the new institutions (Mattingly, 2016). Social groups have interacted with each other and cooperate to increase the effectiveness of rural water conservancy supply.

As the largest group directly connected with rural conservancy supply system, farmers have played significant roles to affect the effectiveness of rural water conservancy supply. However, farmers belonged to the vulnerable group in the market economy since their individual abilities were too weak and hard to cooperate with each other (Huang, 1989, pp.15-18). In order to change the situation, the central government offers direct conservancy subsidies for farmers and asks local governments to reorganize farmers for conservancy supply issues in the new socialist countryside era (Song et al., 2014). Local governments and village autonomous organizations offer practical conservancy plans for farmers and accept their opinions of conservancy supply as well (He et al, 2016). Farmers' feedback and demands of conservancy services also offer significant local knowledge to increase the effectiveness of conservancy supply (Luo & He, 2008). The polycentric rural water conservancy supply institutions on the one hand re-attracted farmers' enthusiasm to participate in rural water conservancy supply and on the other hand reduced farmers' burdens and risks of conservancy supply.

Farmers who relied on conservancy system to develop agriculture welcomed the central government's policies in the new socialist countryside era (Wang, 2012). The direct conservancy subsidy could almost cover farmers' expenditure on conservancy supply. For conservancy supply issues, the government has also considered and supported farmers' interest to some extent (Luo, 2007). In order to increase individual farmer's ability to deal with conservancy supply issues, many areas establish farmers' conservancy autonomous organizations to represent themselves (Song et al., 2014). Although the development of autonomous conservancy supply organizations still meet many problems, this idea increases farmers' voices in conservancy supply.

However, although the central government and local governments make a series of policies to support agricultural development and improve farmers' living standards, more and more farmers have given up growing crops and left rural areas (Jia & Huang, 2011). Whether farmers would like to transfer their land use rights and attached conservancy supply facilities/infrastructures to other individuals or corporations is decided by the attitudes of local governments

and village autonomous organizations, and how much transfer fees they can get (Song et al, 2014). Although most farmers knew they would get economic profits and the transfer would be good for the sustainable development of conservancy supply and agricultural development, transferring part or all the rights of conservancy facilities/infrastructures or land use rights to an unknown person or a corporation still worried them (Tam, 2013, pp.117-121). Using relatives or the collective to be the guarantors reduced farmers' resistance and make farmers more cooperative to transfer their land and conservancy facilities/infrastructures (Tam, 2013, pp.117-121). However, there were still cases in which individuals/ corporations got farmers' land use right but did not keep their promise to pay transfer fees or change farmlands to construction lands or industrial lands (Deininger & Jin, 2005).

In short, farmers' interests of rural water conservancy supply have been protected in the polycentric institutional framework. Farmers can generally cooperate with other stakeholders and cooperate with each other in conservancy supply. Meanwhile, the cooperation is weak. If farmers' interests could not be guaranteed, they might still break institutional arrangements to seek their interests.

Financial organizations and private investors are significant participants of social groups to join in polycentric conservancy supply system. In the polycentric rural water conservancy supply institutions, regulations and policies have been made to encourage and support financial organizations and private investors to participate in rural public goods supply (CCP's Central Committee and State Council, 2014). Since financial organizations and private investors get official subsidies and economic profits from investing in conservancy programs, more and more investors join in rural water conservancy supply programs (No.1 Central Document, 2007). They can choose the most suitable way to cooperate with other stakeholders and participate in rural water conservancy supply without strict institutional limits (No.1 Central Document, 2007). The polycentric institutions integrate fragmented capital and use it in conservancy supply programs effectively.

Since the government offers preferential policies for financial organizations and private investors and encourage their development, the relationship between the government and conservancy investors is friendly, cooperative and stable in general in the new socialist countryside era (Wong, 2009). Meanwhile, because of historical reasons and unequal status, financial organizations and private investors sometimes still worry about the sudden

change of government's policies (Tam, 2013, pp.134-136). Farmers and some village leaders also worry financial organizations and private investors put their own economic interests ahead of farmers' real needs in their participation of rural water conservancy supply programs (Long, 2014). Farmers believes that financial organizations and private investors have much more capital, resources and closer relationship with governments than other stakeholders. It is easy for them to play tricks in offering conservancy supply services (Luo, 2007). The trust between financial organizations/private investors and other conservancy supply stakeholders still needs strengthening in the polycentric institutions.

Conservancy professionals' statuses and functions also have changed in the polycentric rural water conservancy supply institutions. The polycentric rural water conservancy supply institutions improve professionals' statuses by changing their positions and functions in rural water conservancy supply (Wang, 2012). Professionals do not join the construction, maintenance and management of conservancy supply directly in the polycentric institutions while they just offer professional advices and become supervisors for the government and other stakeholders (Ministry of Finance & Ministry of Water Resource, 2009). The new institutional arrangement cut the direct economic interest links between conservancy professionals and conservancy supply system. This change makes professionals more fair and professional in dealing with conservancy issues. Professionals have changed from players to supervisors and advisors (Simmons, 2016).

In short, social groups have had long-term development to participate in rural water conservancy supply in the polycentric institutions. New institutional arrangements allow social groups to interact with each other and establish relatively cooperative relationship for conservancy supply. Meanwhile, there are still some problems in the actual operation of polycentric conservancy supply institutions. For example, farmers are still hard to establish effective autonomous organizations. Rights and obligations of financial organizations and private investors still need further improvement in the polycentric institutional framework (Deng et al, 2010).

6.4 INSTITUTIONAL ANALYSIS OF THE POLYCENTRIC RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

The polycentric rural water conservancy supply institutions brought new situations in conservancy supply. Institutional arrangement of the allocations of

conservancy supply programs in different areas, divisions of works and responsibilities of conservancy stakeholders, institutional arrangements of conservancy construction and maintenance and property rights related institutional arrangements all have significant changes in the new socialist countryside era. The adjustment of conservancy supply institutions actually is the result of the government's adjustment of policy objectives. Experienced over two decades' fast economic development, the Chinese government has noticed that it should pay more attention to public goods supply to balance social problems (Ang, 2016, pp.3-5). The implementation of polycentric conservancy supply institutions is a contingent, interactive process. Institutional innovations in the polycentric conservancy supply institutions both increase the effectiveness of conservancy supply and promote economic development. The analysis of the polycentric rural water conservancy supply institutions will be helpful to summarize the characteristics of China's institutional innovation and institutional reform in the aspects of rural public goods supply.

6.4.1 The third way of rural water conservancy supply

The institutional change of the market-driven rural water conservancy supply institutions was inevitable. The establishment of polycentric rural water conservancy supply institutions is a contingent, interactive process. The polycentric institutions take a way to supply conservancy services different from market-driven institutions and government-driven institutions (He et al, 2016). The polycentric rural water conservancy supply institutions combine advantages of both the government-driven institutions and market-driven institutions and make institutional innovations to offer effective rural water conservancy supply services.

The polycentric rural water conservancy supply institutions are adjustments of previous conservancy supply institutions. The new institutions could be regarded as the institutional evolution of market-driven rural water conservancy supply institutions. As North argued, institutional change has the feature of path-dependence that actors would make choices based on their previous experience (1981, pp.45-52). Since the establishment of the polycentric rural water conservancy supply institutions is still in the context of the market economy, the basic institutional framework of the market-driven rural water supply has been kept. The polycentric conservancy supply institutions have critically inherited and applied good ideas and approaches of the market-driven institutions (Wang, 2012). The establishment of the polycentric rural water conservancy supply institutions was the result of the induced institutional

change of the market-driven institutions.

Compared with the market-driven rural water conservancy supply institutions, the polycentric institutions have also made institutional innovations to bring the government into conservancy supply as well (Wang, 2012). The combination of governments and social groups within the same institutional framework is helpful to shape effective interactions of the state and the society (Ling, 1999, pp.85-92). In the polycentric institutional arrangements, both governments and social groups can seek for their interests in rural water conservancy supply. Since there is no significant interests conflicts, the government and different social groups have effective interactions with each other (He et al, 2016). Cooperative relationships among different conservancy supply stakeholders reduce transaction cost of property rights configuration and increase effectiveness of rural water conservancy supply (David, 1994).

Limits of the household contract responsibility system also have been overcome in the new institutions. Free land use rights transfer policies make the establishment of large-scale farm and rural water conservancy supply system with single property right become possible (Long, 2014). Official capital and non-official capital are both welcomed to join in rural water conservancy supply programs in the new socialist countryside era (Sato, 2008).

In general, the polycentric rural water conservancy supply institutions use relatively inclusive institutions to break problematic institutional operation and negative path-dependence of the government-driven institutions and market-driven institutions. Instead, the polycentric rural water conservancy supply institutions allow diversified conservancy supply methods and innovations coexist to increase the supply effectiveness (Ostrom, 2006). Since the interests among different actors could be coordinated within the polycentric institutional framework, effective interactions between the government and social groups and among different social groups bring positive influence on the operation and effectiveness of conservancy supply system (Aoki, 1996). Therefore, compared with the government-driven institutions and market-driven institutions, the polycentric rural water conservancy supply institutions can bring positive influence for the sustainable development of rural water conservancy supply system.

6.4.2 The analysis based on Ostrom’s polycentric governance theory

The establishment and implementation of China’s polycentric rural water conservancy supply institutions generally match with Ostrom’s polycentric

governance theory. Meanwhile, China's polycentric conservancy supply institutions do not completely copy Ostrom's theory. The Chinese government and top leaders also make adjustments on the basis of Ostrom's theory to establish China's polycentric conservancy supply institutions especially emphasizing the role of the government in conservancy supply.

According to Ostrom, rural water conservancy supply system is public good that all the actors could access without limits (2010). However, once some actors possessed or occupied a part of the public goods, this part could only be consumed by the occupiers (Ostrom, 1994, pp. 5-12). The key factor in Ostrom's theory is human being's self-organized behaviours (Gardner et al, 1990). Through autonomous organizations, the framework of the polycentric institutions can be established effectively to replace the traditional government-driven or market-driven approaches to solve problems such as the tragedy of the commons and prisoner's dilemma (Hardin, 1977; Olson, 1962; Ostrom et al, 1961). Ostrom's polycentric governance theory also solved problems of collective irrational actions by allowing the third party to participate in rural public goods supply (Ophuls, 1973; Smith, 1981; Ostrom, 1994, pp.13-17). Ostrom believed self-governance and polycentric institutions could break the dilemma of the self-interest market mechanism, information asymmetry and low effectiveness caused by the government's involvement (Zhang, 2009).

Ostrom's experience mainly came from the third world countries. She found that in Nepal, the effectiveness of the conservancy system established by local farmers was better than that established by social donors or the government (Ostrom, 2010). Although the planning and engineering techniques of the official support programs were much better than farmer-made ones, Ostrom argued that officials and professionals who managed official programs lacked local knowledge (1994, pp.132-136). Those elites paid more attention to technical rather than organizational problems. Once institutional designs and program constructions excluded the participation of local farmers and other relevant social groups, they were hard to escape the fate of low effectiveness and failure (Ostrom et al., 1994, pp.3-15). In short, Ostrom's theory emphasizes the importance of local knowledge and autonomous organizations in conservancy supply. She encouraged using diversified supply methods to provide water conservancy services and fully mobilize social resources and social groups to join in the construction and maintenance works (Ostrom et al, 1992).

China's situation is more complex than third world countries that Ostrom

researched. The polycentric rural water conservancy supply institutions in China are a bit different from what Ostrom found in Nepal and other third world countries. It seemed that top leaders in China have searched many possible options to replace the government-driven institutions and market-driven institutions (Wendner & Goulder, 2008). Scholars like Hu An'gang, Wang Yahua and Cao Jinqing's researches about conservancy supply offered the chance for Chinese to have understanding about Ostrom's polycentric governance theory. Top leaders and government officials might feel interests about Ostrom's arguments and hoped to apply those theories in rural China (Wong, 2009). However, they could not like Ostrom's argument about kicking out the government in conservancy supply and fully supporting the development of autonomous organizations. In hence, they have to modify Ostrom's theory and make it more suitable for China's conditions and the CCP's ruling.

Therefore, the polycentric institutions in rural China both allow the establishment of various autonomous organizations and diversified conservancy supply methods and put all the autonomous organizations under the supervision and control of the government, and increase government's roles in conservancy supply.

One the one hand, the polycentric conservancy supply institutions can be seen as the application of Ostrom's polycentric governance theory in practice. The major thoughts, diversified supply methods, the participation of different stakeholders and polycentric property rights distribution methods of polycentric conservancy supply institutions all learn from Ostrom's theory (Zhang, 2009). The polycentric rural water conservancy supply institutions in China are also possible to solve problems that Ostrom's theory can do (He et al, 2016).

On the other hand, compared with Ostrom's theory, the organizational structure and institutional framework of the polycentric water conservancy supply institutions in rural China focus on increasing the government's role in rural water conservancy supply (Luo & He, 2008). Ostrom concluded that in Nepal, avoiding the official involvements and developing autonomous organizations could increase the conservancy supply effectiveness (1994, pp.164-167). However, in China, the polycentric rural water conservancy supply institutions try to establish cooperation of government and social groups to increase the supply effectiveness (Wang, 2012). Although the polycentric institutions have made various conservancy supply approaches, the government and social groups generally have clear division of works and responsibilities in rural water conservancy supply (Luo, 2007). The government's appropriate

involvement in conservancy supply in the polycentric institutional framework obviously improve the conservancy supply effectiveness in the new socialist countryside era (He et al, 2016).

Based on Ostrom's polycentric governance theory, polycentric conservancy supply institutions in China mainly hope to solve three major institutional problems. The institutional arrangements hope to increase conservancy supply effectiveness by solving problems of institutional suppliers, credible commitment and mutual supervision.

The first one is about institutional suppliers (who have motivation to participate in rural water conservancy supply and maintain the operation of institutions). Ostrom argued that, only interactions and communications can make different actors understand who they could trust, how their actions could affect others and how to avoid possible risks (1990, pp.76-82). The polycentric rural water conservancy supply institutions allow actors to choose their preferred conservancy supply methods and freely cooperate with other stakeholders (Luo, 2007). Since cooperation can maximize interests, most stakeholders in the polycentric institutional framework choose to abandon self-interest conservancy supply institutions to cooperate with each other (Luo, 2007). Therefore, different stakeholders including governments and social groups have shaped common principles and community of interests to offer effective institutions that most stakeholders can get benefit[94]. Since the establishment and application of new institutions is a gradual process, stakeholders who participate in conservancy supply have strong desires to coordinate different actors' interests and keep the stable institutional supply within the polycentric institutional framework.

The second one is the credible commitment. Free riding, shirking of responsibility and opportunism significantly reduce the effectiveness of rural water conservancy supply in the government-driven institutions and the market-driven institutions (Pan, 2002). Social groups broke institutional arrangements to seek their interests in previous rural water conservancy supply institutions. The government-driven institutions used administrative forces to control social groups to fulfill the commitment of conservancy supply while the market-driven institutions did not have effective methods to force government and social groups to fulfill their commitments of conservancy supply (Wang, 2007). However, Ostrom argued that external forces should be abandoned to

[94] The community of interests here means different individuals or groups who participate in rural water conservancy supply have the same interest. If someone's' interests are hurt, others' interests are also hurt. Members of the community of interests can cooperate with each other to maximize their common interests.

fulfill the commitment and it is better to ask conservancy supply participants to achieve self-incentive to implement their credible commitment of rural water conservancy supply (1990, pp.135-143). Since most stakeholders choose to cooperate with each other to maximize their interests in the polycentric rural water conservancy supply institutions, if any stakeholder who resist to implement their commitments of conservancy supply, they also hurt others' interests and would be kicked out of the institutions (Wang, 2007). One case to prove the statement is that there were still a few farmers resisting to participate in rural water conservancy supply programs in the new socialist countryside era, hoping instead to be free-riders of others' conservancy supply infrastructures such as stealing water from breaking the drain near their farmland. However, the rest participants used the plastic pipeline to replace the traditional soil drain which made the free-riders unable to get any water from it (Luo, 2006, pp.145-147). Self-incentive arrangements and self-supervision arrangements of the polycentric rural water conservancy supply institutions keep conservancy supply participants' interests and avoid free-rider problems. The polycentric rural water conservancy supply institutions use interests to inspire participants' enthusiasm to fulfill their commitments of rural water conservancy supply.

The third one is the mutual supervision. Without effective supervision, there would not be any credible commitment. Without credible commitment, there would not be effective institutional suppliers. Ostrom argued that effective interactions between different stakeholders and the community of interests offer motivations for stakeholders to supervise others since it connects with their interests (2010). The polycentric rural water conservancy supply institutions in China have made institutional arrangements to allow the central government to supervise local governments, allow local governments to supervise corporations, farmers, village leaders, financial organizations and professionals and allow financial organizations, farmers, village leaders and professionals to supervise conservancy supply construction corporations (The State Council, 2010). Institutional arrangements have shaped mutual supervision mechanism among different stakeholders and can reduce the cost of supervision (Wang, 2007). The supervision has been the extra product of conservancy supply participants to apply diversified rural water conservancy supply approaches to achieve their interests.

In general, in China, the application of polycentric rural water conservancy supply institutions is the systematically institutional evolution of the market-driven institutions rather than chaotic autonomous attempts. It applies

Ostrom's polycentric governance theory in rural China's conservancy supply practice and increases the government's roles in conservancy supply. The polycentric rural water conservancy supply institutions combine and take advantages of the government-driven institutions and the market-driven institutions. In China's polycentric institutional practice, governments play the most significant/dominated roles in rural water conservancy supply rather than leaving the responsibility to autonomous organizations as Ostrom argued.

6.4.3 Incentive mechanism in sustainable conservancy development

Compared with the government-driven institutions and the market-driven institutions, the polycentric conservancy supply institutions have comprehensive and effective incentive mechanism to support the sustainable development of conservancy supply system. The effective incentive mechanism mainly comes from the effective property rights distribution methods, suitable institutional arrangements and positive interactions among different stakeholders.

Ostrom recognized the importance of incentive mechanism in conservancy supply (1995, pp.14-16). She believed that incentive mechanism could increase the effectiveness of conservancy supply. Ostrom argued that the incentive mechanism of polycentric governance should consider the performance of institutional arrangements and property rights configurations. It includes aspects of whether institutional arrangements could match with economic efficiency of Pareto optimality, whether property rights configuration considered equality and fairness, and whether institutional arrangements could be adjusted easily and could have strong adaptability (Ostrom, 1995, pp.152-163).

Ostrom argued that the polycentric governance could establish effective incentive mechanism to allow different stakeholders to seek their interests and cooperate with each other (1995, pp.204-212). Through polycentric institutions, the central government gets high grain production and people's support in rural areas. Local government officials are inspired to have political promotion if they could management rural water conservancy supply well. Farmers could get effective conservancy supply services and financial organizations and private investors could make economic interests from conservancy supply issues (Wang, 2012). All the stakeholders can get benefits and incentives from the polycentric conservancy supply institutions. Such institutional arrangements can inspire stakeholders to improve the effectiveness of conservancy supply.

Through the land use rights transfer policies and reallocation of

conservancy property rights, the investment of conservancy system no longer meets unclear property rights problems. As Coase mentioned, only in the situation with clear property rights configuration, the transitional cost could reduce to the lowest level (Coase, 1960). Clear property rights and regulations protect stakeholders' proper interests and encourage social groups' enthusiasm to participate in rural water conservancy supply. This thesis has stated that in the plain and hill areas of Central and Western China[95], individual farmers, village autonomous organizations, township and county government all could be the property rights owners of conservancy supply infrastructures/facilities in the polycentric conservancy supply era (No.1 Central Document, 2007). Although the Chinese government and the collective still have the land ownership, the free land use rights transfer policies offer institutional protection of social groups' labour and capital investment of participating in rural water conservancy supply (Ye, 2015). Only the open and inclusive environment of the polycentric institutions allows the government and social groups to emphasize collective rationality, equality, effectiveness and fairness (Aoki, 1996).

Effective interactions between the government and social groups establish coordinate relationships among different stakeholders. Based on the community of interests, close links between the government and social groups keep the normal operation of the polycentric rural water conservancy supply institutions (Zhang, 2009). Although interest differences between the government and social groups still limit the cooperation, there are formal/informal constraints to regulate the government and social groups' behaviours in the polycentric institutions (Fehr & Gächter, 1999). Human beings are not all selfish since they are rational and understanding cooperation and helping others could bring them higher profits while breaking roles might bring them punishment (Mattingly, 2016). Since the community of interests offers the incentive mechanism for actors to fulfill their commitment and motivation to supervise others' actions, it stops any actions to break the normal operation of the polycentric rural water conservancy supply institutions.

Besides that, the effective interactions and the community of interests reduce information asymmetry in rural water conservancy supply in the new socialist countryside era. The polycentric rural water conservancy supply institutions have asked people such as farmers, village leaders and conservancy professionals with local knowledge and professional knowledge to participate in and supervise rural water conservancy supply programs to reduce unnecessary

[95] These areas include the southern and western part of Henan Province, middle and western part of Hubei Province and Southern part of Shaanxi Province where grow both rice and wheat.

problems (Ministry of Finance & Ministry of Water Resource, 2009). Local governments and construction corporations therefore have better understanding of farmers' real needs and professional knowledge of conservancy supply infrastructures. The involvement of local people and professionals significantly reduce the cost and increase supply effectiveness (Luo, 2007).

The incentive mechanism of the polycentric rural water conservancy supply institutions is also shown that institutional arrangements limit strong social groups and support vulnerable groups in rural water conservancy supply issues. Although the polycentric rural water conservancy supply institutions generally coordinate different actors' interests and establish the community of interests, different social groups still have accurate interest differences in rural water conservancy supply (Simmons, 2016). Therefore, the bilateral and multilateral relations among different social groups might bring in either positive or negative effects. In the polycentric rural water conservancy supply institutions, diversified property rights configuration and institutional arrangements have coordinated interests and relationships among different social groups especially standardize financial organizations and private investors' behaviours to some extent in rural water conservancy supply programs (Long, 2014). Fair institutional arrangements have kept the equality and fairness of rural water conservancy supply and encouraged social groups especially vulnerable groups to participate and invest in rural water conservancy supply programs.

In general, the polycentric rural water supply institutions offer effective incentive mechanism to increase the effectiveness of rural water conservancy supply in the new socialist countryside era. Advantages of polycentric conservancy supply institutions can be found in aspects of effective property rights distribution methods, suitable institutional arrangements and positive interactions among different stakeholders .On the one hand, new conservancy supply institutions match with the reality of rural areas and have a wider tolerance and adaptability. The polycentric institutions encourage and support weak autonomous organizations and social groups to offer effective conservancy supply services (Luo, 2007). On the other hand, the new institutions establish the community of interests to increase conservancy supply effectiveness and allow different stakeholders to make appropriate interests from conservancy supply (Wang, 2012). Therefore, the polycentric rural water conservancy supply institutions are effective to keep the normal operation and sustainable development of rural water conservancy system with unique advantages of

incentive mechanism.

6.4.4 Effective interactions of conservancy supply stakeholders in the new socialist countryside era

The polycentric rural water conservancy supply institutions establish effective interactions between the government and social groups and make the institutional operation stable. The government and social groups have established cooperative relationships to offer effective conservancy services since all the stakeholders can get appropriate interests from conservancy supply.

In the polycentric institutional environment, relationship between the government and social groups is neither too tense nor slack. As the government and social groups have established the community of interests, self-interest and collective irrational actions are no longer accepted by stakeholders of rural water conservancy supply (Simmons, 2016). Instead, stakeholders of rural water conservancy supply cooperate and help with each other to maximize the collective interests in the polycentric institutions (Ye, 2015). Therefore, compared with the government-driven institutions and market-driven institutions, the polycentric rural water conservancy supply institutions can better keep the stability of the institutions. Interactions and communications could not only increase private interests but also inspire actors' altruistic behaviours and reciprocity behaviours.

In order to explain the conservancy institutional operation in the new socialist countryside era, this part wants to use a model to explain how interactions between the government and social groups affect the normal operation of polycentric conservancy supply institutions (See Figure 6.2).

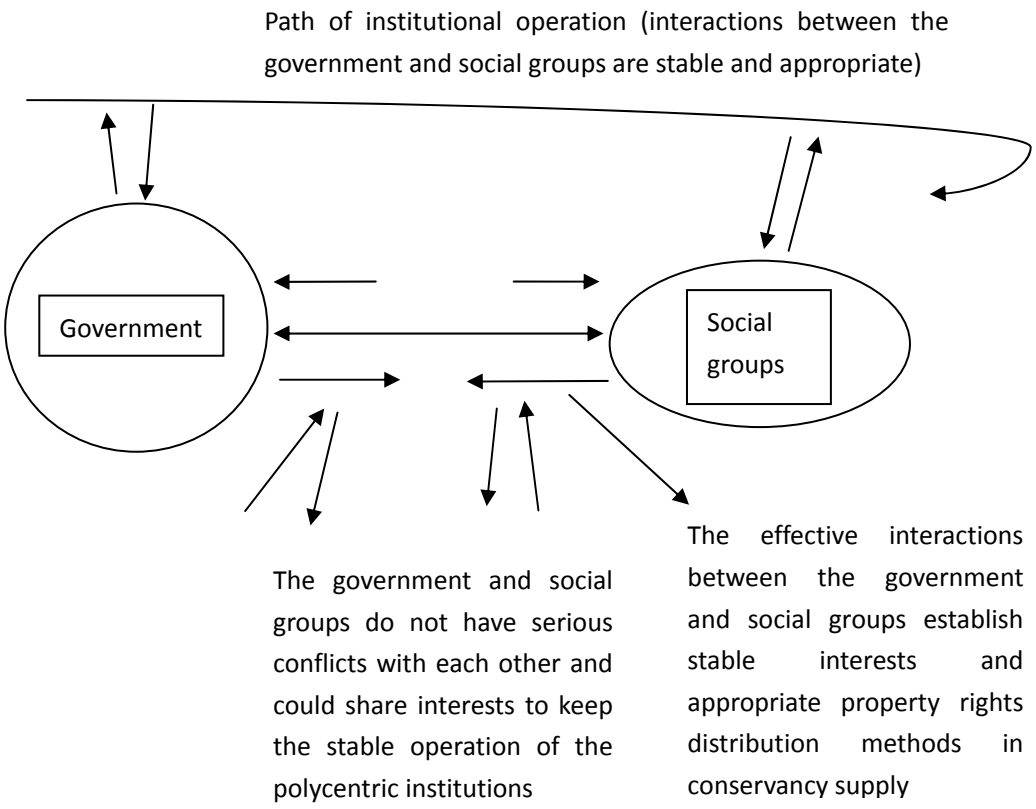

Figure 6.2 The operational model of polycentric rural water conservancy supply institutions

In the polycentric rural water conservancy supply institutions, government officials reestablish formal institutions to regulate property rights configuration methods, protect stakeholders' appropriate interests and apply various institutional arrangements to encourage farmers, private investors, financial organizations and conservancy professionals to participate in rural water conservancy supply programs (The State Council, 2010). The government changes its strategy by interacting and cooperating with social groups via policy support and financial subsidies to get social groups' support (He et al, 2016).

Social groups such as farmers' autonomous conservancy supply organizations, private conservancy construction corporations and professional conservancy supply management corporations also have had development in the polycentric rural water conservancy supply institutions though there are still some problems. They have been major participants to offer diversified conservancy supply approaches (Luo, 2007). Informal institutions such as conservancy supply deals between farmers and the village autonomous organization and folk agreements between farmers and private corporations have significantly affected the operation of polycentric institutions and have been the supplement of formal institutions made by the government (Wang, 2012). Diversified conservancy supply methods and flexible institutional framework of

polycentric conservancy supply institutions allow social groups to make institutional innovations and cooperate with the government to increase the effectiveness of conservancy supply.

The government has made formal institutional arrangements to set constraints to regulate stakeholders' behaviours in polycentric conservancy supply institutions. Social groups also established informal constraints to punish those who broke formal institutional arrangements and hurt others' interests (Mattingly, 2016). Therefore, the government and social groups have a common basis for cooperation in the polycentric institutional framework.

Since the government just makes the macro development plan and offers necessary support for the development of rural water conservancy supply, it does not involve much into accurate conservancy supply. The government tries and applies diversified supply approaches and property rights configuration methods to encourage social groups to participate in conservancy supply without taking much political involution, thus allowing institutional changes happen within the polycentric institutional framework (Luo, 2007). Hence, the institutional operation of the polycentric rural water conservancy supply institutions is neither tense nor slack. The operational path of polycentric institutions is generally stable and appropriate.

Without many institutional limitations, social groups can try various conservancy supply methods to maximize their private interests with the help and support from the government (Wang, 2007). If the new approach is effective to increase the effectiveness of rural water conservancy supply, the government will add it to the formal institutional arrangements (No.1 Central Document, 2015). Therefore, farmers, village leaders, financial organizations, private investors and professionals are all interested in participating in rural water conservancy supply.

Social groups' institutional innovations offer more options to increase conservancy supply effectiveness. The innovations also become bridges to connect formal institutions and informal institutions since they offer chances for informal institutions to become formal institutions (Mattingly, 2016). The innovations keep the balance of the operation of the polycentric institutions. The mechanism of bringing in new institutions is also helpful to increase conservancy supply effectiveness since institutional arrangements of the whole set of polycentric rural water conservancy supply institutions are dynamic (Simmons, 2016). Any inappropriate conservancy supply approach is eliminated.

The polycentric rural water conservancy supply institutions establish interaction and communication mechanism among different conservancy supply stakeholders to weaken information asymmetry and coordinate interest differences (Luo, 2007). The interaction and communication mechanism encourages both the government and social groups' enthusiasm to keep collective interests and keep the stability of the polycentric rural water conservancy supply institutions (Luo, 2006, pp.152-155). As both government and social groups could achieve their interests through the polycentric conservancy supply system, they are not motivated to challenge or break existed institutions. It reduces the possibility of an institutional change beyond the confine of existed institutional framework.

In general, diversified institutional arrangements, diversified conservancy supply approaches and diversified property rights distribution methods shape effective interactions of different stakeholders in the polycentric conservancy supply institutions. Effective interactions are helpful for different stakeholders to establish cooperative relationships and increase the effectiveness of conservancy supply. Effective interactions of different stakeholders in polycentric conservancy supply institutions keep the stability of institutional operation and sustainable development of rural water conservancy supply system in the new socialist countryside era.

6.5 PROBLEMS OF POLYCENTRIC RURAL WATER CONSERVANCY SUPPLY INSTITUTIONS

Compared with government-driven institutions and market-driven institutions, polycentric rural water conservancy supply institutions do have many advantages to increase the effectiveness of rural water conservancy supply. Meanwhile, there are still three major problems in the institutional implementation.

The first problem is that information asymmetry still exists in rural water conservancy supply. Although some local officials have asked conservancy professionals to supervise private corporations' construction work for conservancy supply, current rural water conservancy supply institutions are still made by central government officials who do not have necessary professional conservancy knowledge and local knowledge (Luo & He, 2008). Sometime, although officials have the good desire to help farmers with rural conservancy supply, they fail to establish effective institutions due to information asymmetry.

One case was in Xiangzhou district. In order to avoid local government and

other social groups use conservancy subsidies for other purpose, the central government offers financial subsidy directly to farmers for their small-scale conservancy system[96]. It should be a policy to increase farmers' enthusiasm for rural conservancy supply and improve maintaining conditions of conservancy facilities in rural areas. However, farmers mentioned that in order to get irrigation water, they dug water well in their land since it is easy to get water (Summary of Interview Materials). Digging a water well in Xiangzhou normally costs about 5000 Yuan RMB in the 2010s and the government offers direct subsidy for 5000 Yuan RMB for one water well (Archives of Xiangzhou District Water Station, 2010, vol88). There is no limit for how many wells a farmer can dig (Archives of Xiangzhou District Water Station, 2010, vol88). Therefore, farmers welcomed the policy and tried their best to dig well in their farmland.

Meanwhile, although most farmers welcomed such institutions, the individual water well could not last long since the groundwater resources is limited in this region (Archives of Xiangzhou District Water Station, 2010, vol88). Once the water well could not offer enough water, farmers have to dig a new, deeper well. This approach not only wastes official financial subsidy but also breaks the local environment and causes salinization (Archives of Xiangzhou District Water Station, 2010, vol88). Besides that, farmers believe water wells are almost free and therefore nobody would like to participate in regional public conservancy supply programs (Summary of Interview Materials). It has negatively affected the effectiveness of rural water conservancy supply in the whole district.

Therefore, although governments make institutions with good expectation in the polycentric institutional framework, it might also lead to negative results due to information asymmetry. If detailed problems could not be solved, the polycentric institutional framework would not last long.

The second problem is that the autonomous conservancy supply organizations made by farmers are still needed to be promoted. According to Ostrom's theory, autonomous organizations should be established by farmers and other social groups without government involvement (Ostrom, 1994, pp.234-237). Meanwhile, China's reality has shown that farmers were hard to establish an independent autonomous organization without government support (Song et al, 2014). Individual farmers have different accurate interests in conservancy supply issues though they belong to the same social group. Some of them would like to pay more money to get better conservancy services while

[96] No.1 Central Document in 2011.

others do not want to pay (Summary of Interview Materials). Although the polycentric conservancy supply institutions have made regulations to support the development of autonomous organizations, some autonomous organizations still do not have enough capital or resources to coordinate different farmers' interests (Deng et al, 2010). They also cannot meet the challenge from other strong social groups. Therefore, functions of farmers' autonomous conservancy supply organizations are still limited in the polycentric institutions.

Successful farmers' autonomous conservancy supply organizations are all supported by county/township government or village autonomous organizations. None of them could live independently (Luo & He, 2008). Without official support, autonomous conservancy organizations could not develop since farmers could not coordinate conservancy supply interest differences by themselves (Wang, 2012). However, if the government involves too much, farmers are unhappy and think they are controlled by the government again just like in the the collective era (Mattingly, 2016).

Theoretically, the government-driven conservancy supply methods and farmer-driven methods are both accepted in the polycentric institutions. County and township leaders all mentioned that they would like to organize farmers to establish autonomous organizations for conservancy supply (Summary of Interview Materials). This is one of officials' working tasks and it also can be seen as a part of their political achievements in the new socialist countryside era. However, farmers still feel worried about the official involvement. Most Chinese farmers still hold the minds that the government's involvement might infringe on their interests (Summary of Interview Materials). This causes the situation that on the one hand, farmers are afraid that the government might snatch the initiative of their autonomous organizations while on the other hand, farmers cannot establish independent autonomous conservancy supply organizations without official help (He et al, 2016). How to deal with the relationship between the government and autonomous organizations is a problem that policy makers have to work out.

The third problem is about rights and obligations of financial organizations and private investors. Financial organizations and private investors have controlled much non-government capital and resources in conservancy supply (Luo, 2006, pp.72-75). However, the interest-seeking nature of those groups might lead to problems. Although conservancy supply participants establish cooperative relationships to share interests of conservancy supply programs (Ostrom et al, 1992), financial organizations and private investors have much

stronger influences and powers than other social groups. They also care much more about economic profits of conservancy supply programs than other social groups (Wang, 2012). Although the government has made institutional arrangements to keep social groups' appropriate economic interests and have made institutions to regulate their behaviours, it also has the risk that financial organizations and private investors might put their own interest ahead of common interests (Jia & Huang, 2011).

One case in Xunyang proved the existence of such risks. Since the polycentric rural water conservancy supply institutions allow local governments to have project outsourcing to private investors, one town outsourced its irrigating drains maintaining program to a private investor with the market price (Archives of Xunyang County Water Station, 2013, vol80). The private investor also finished the work on time. However, when the irrigation season came, farmers found that although the drains seemed no problem on the surface, many places of the drains had seepage seriously. The irrigating effectiveness did not improve much (Archives of Xunyang County Water Station, 2013, vol80). In order to reduce investment, the private investor neither reinforced the bottom of the drain nor added any waterproof materials (Archives of Xunyang County Water Station, 2013, vol80). Officials who were responsible for the supervision and acceptance could not distinguish without professional knowledge and equipment (Archives of Xunyang County Water Station, 2013, vol80).

The idea of project outsourcing is common and effective in western countries (Mushtaq et al, 2006). Meanwhile, it does not receive good results in China's polycentric rural water conservancy supply institutions since there has not been effective professional supervisory authority (Wang, 2012). Officials, farmers, village leaders and some professionals might offer effective knowledge and normal supervisions to financial organizations, private investors and corporations, it is still not enough (Mushtaq et al, 2006). Specific supervisory authority which combines different actors should be introduced in rural water conservancy supply supervision (Simmons, 2016). Accountability should also be established to regulate all the stakeholders' behaviours in rural water conservancy supply.

In general, the polycentric rural water conservancy supply institutions have solved many problems of previous conservancy supply institutions and have increased conservancy supply effectiveness obviously. Applying autonomous organizations and self-governance to solve rural water conservancy supply problems have been attempted in China. Social groups and non-government powers have played significant roles in conservancy supply and have increased

conservancy supply effectiveness. Establishing effective interaction, communication and supervision mechanism to coordinate different conservancy supply participants' interests is also generally achieved.

Meanwhile, there are still some problems in the polycentric conservancy supply institutions. Information asymmetry still exists in rural water conservancy supply; conservancy supply autonomous organizations in China are still very weak and cannot take the responsibility to offer conservancy services independently and effectively without the government's support and supervision; the government and social groups should further strengthen supervision and management of rights and obligations of financial organizations and private investors.

It has been less than ten years since China establishes the polycentric rural water conservancy supply institutions. Institutional design, institutional arrangements and institutional operation of the polycentric rural water conservancy supply institutions still have room for further improvement. There is still time and chance for the polycentric rural water conservancy supply institutions to better match with rural China' reality and meet people's real needs.

CHAPTER 7 CONCLUSION

The last chapter will summarize findings and general arguments of this research. It will also discuss contributions and limitations of this research, and plans for future research.

7.1 SUMMARY AND FINDINGS OF THE RESEARCH

This part will give a general explanation of the research and will state major findings of the thesis. It will mainly explain interactions between the government and social groups, interactions between different social groups and property rights related issues in conservancy supply institutions

7.1.1 The dilemma of rural water conservancy supply system and reasons

The development path and ups and downs of rural water conservancy supply system in the reform era and the new socialist countryside era shows conservancy supply problems are mainly caused by institutional reasons. The allocation methods of conservancy supply programs, division of works and responsibilities of conservancy stakeholders, institutional arrangements of conservancy construction and maintenance works and property rights related institutional arrangements of conservancy supply intuitions could significantly affect the effectiveness and sustainable development of conservancy supply.

Economic reform brought the market mechanism to the rural water conservancy supply system. Although the market economy helped China to achieve economic success, it did not solve problems of rural water conservancy supply effectively (He & Luo, 2006). The market-driven rural water conservancy supply institutions caused free-riders and the tragedy of the commons in conservancy supply and further broke rural water conservancy supply infrastructures/facilities that had existed since the collective era.

In order to solve problems of rural water conservancy supply, the Chinese government together with different social groups has established polycentric rural water conservancy supply institutions since the 2000s especially after 2010. The institutions have made clear roles of the government in rural water conservancy supply and used various approaches to offer subsides and financial support to develop rural water conservancy supply system[97]. Social groups are

[97] No.1 Central Documents in 2007, 2009, 2011 and 2015.

also encouraged and supported to participate in rural water conservancy supply.

Compared with other rural public goods, the rural water conservancy supply system is a whole system. Most infrastructures cannot be separated into pieces with different property rights ownership holders. It is also hard to increase the conservancy supply effectiveness by privatization (Pan, 2002).

An effective rural water conservancy system should contain middle and small scale pump stations, water reservoirs, water wells and various drains and so on. Besides, there must be a whole set of formal and informal institutions to match with physical facilities to make the whole conservancy supply system operation normally (Luo & He, 2008). Once physical infrastructures and the institutional arrangements are combined, all the conservancy facilities/infrastructures within one system can be linked and work effectively. However, if institutional arrangements have shortages and limits, they will be hard to deal with physical problems of conservancy supply infrastructures effectively (Luo, 2007).

Lacking effective institutions to arrange construction and maintenance has been the major reason to reduce the effectiveness of rural water conservancy supply (Ostrom et al, 1992). The government did not provide necessary protection and support to the rural water conservancy supply system until in the polycentric conservancy supply era. As social groups calculate their respective interests in the rural water conservancy supply, conservancy supply could not be effective without official institutional arrangements to coordinate different actors' investment and paybacks. In the reform, local governments did not have much interests and motivations to organize and support the development of rural water conservancy supply system (Kanbur & Zhang, 2005). They paid much attention to economic performance and effectiveness rather than the duty of public service. There were not clear and detailed institutions about the government's responsibilities in rural water conservancy supply, which caused the failure of rural water conservancy supply institutions (Luo, 2006). Since the central government clearly regulated local governments' functions and offer financial support to rural water conservancy supply in the new socialist countryside era, governments at all levels take their responsibilities to offer effective rural water conservancy supply services.

Social groups also play significant roles in rural water conservancy supply. Although social groups have made significant achievements in rural development since the 1980s, they had not taken effective measures to change the low effectiveness of rural water conservancy supply (Tang & Li, 2005).

Farmers, professionals, financial organizations and private investors cared about their cost and return, none of them were interested in participating rural water conservancy supply. Farmers could only rely on their limited resources and labours to deal with conservancy supply issues of their contracted land. Farmers' self-interest natures and short-sightedness further reduced the effectiveness of rural water conservancy supply. Rural water conservancy supply became chaotic in the market reform era (Luo, 2007). Besides that, in order to reduce the agricultural investment, many farmers chose to break the public conservancy facilities and to be free-riders. This further reduced financial organizations and private investors' confidence to invest rural water conservancy supply programs (Luo & He, 2008). Conservancy professionals also had to use conservancy supply services to make money to feed themselves from the 1980s to the 1990s. Social groups were unorganized in conservancy supply in the market reform era. Until they get organizational, financial and policy support from the government in the new socialist countryside era, social groups become more active and effective to cooperative with each other to participate in conservancy supply (Luo, 2006, pp.172-175). Farmers are interested in participate in conservancy supply programs since they can get official financial subsides and support. Financial organizations and private investors can get preferential policies and economic interests in conservancy supply programs while professionals become supervisors in conservancy supply (Wang, 2012). Each of social groups finds their appropriate positions in rural water conservancy supply issues.

Singularized government-driven rural water conservancy supply institutions caused low effectiveness while singularized market-driven rural water conservancy supply institutions caused market failures. Under the household contract responsibility system, which is still the mainstream, China has encountered difficulties in establishing a large-scale market-oriented agriculture within a short time period (Huang et al, 2006). Only polycentric institutions, which combine advantages of the government-driven institutions and the market-driven institutions, can make diversified institutional arrangements to satisfy and coordinate interests of different stakeholders and support the sustainable development of rural water conservancy supply system (Luo & He, 2008).

The development of rural water conservancy supply has shown that solving conservancy supply problems need the cooperation of government and different social groups. Institutional arrangements and institutional operation are key factors to understand and explain the dilemma of rural water conservancy supply

system. Effective interactions and cooperation among different stakeholders are helpful to solve problems of rural water conservancy supply. Neither the government nor social groups can successfully increase the effectiveness of rural water conservancy supply without others' support. Only the government and social groups interact and cooperate with each other effectively, can conservancy supply effectiveness be increased and good to the sustainable development of rural water conservancy supply system.

7.1.2 The institutional analysis of rural water conservancy supply

According to the development of rural water conservancy supply in the past decades, rural water conservancy supply can be divided into three stages. The first stage was from the mid-1950s to the late 1970s when the government dominated rural water conservancy supply and offered unified conservancy services in rural areas. The second stage was from the 1980s to the late 1990s, characterized by the market dominated rural water conservancy supply. The market mechanism have been the basis of rural water conservancy supply. The third stage is from the 2000s to now. The polycentric institutions have been made to offer diversified rural water conservancy supply approaches.

The historical experience has shown that both government-driven rural water conservancy supply institutions and market-driven institutions have shortages. Those institutional arrangements of rural water conservancy supply did not have clear division of works and responsibilities and could not protect individuals' interests and encourage social actors' enthusiasm (Wu, 2007). Neither singularized government-driven institutions nor market-driven institutions made effective property rights configuration and reduced transaction cost in conservancy supply (Wang, 2012). Only polycentric rural water conservancy supply institutions offer diversified conservancy supply approaches and property rights distribution methods for the government and social actors to release their potentials to increase the effectiveness of rural water conservancy supply (He et al, 2016). Effective interactions and cooperative relationships between the government and social groups and among different social groups are helpful to reduce negative externalities, transaction cost and conflicts of interest in conservancy supply.

In order to have a clear understanding of the development and changes of China's rural water conservancy supply institutions in the past decades, I will use a table to summarize rural water conservancy supply approaches, government/social groups' involvements, relationships of the government and social groups and infrastructures' property rights configurations (See Table 7.1).

Table 7.1 Summary of rural water conservancy supply in different eras

Time period	The Mid-1950s to the late 1970s	The 1980s to the late 1990s	The 2000s to now
Conservancy supply approach	The government-driven rural water conservancy supply	The market-driven rural water conservancy supply	The polycentric rural water conservancy supply
Government's involvement	Strong political intervention and involution (from macro planning to detailed program management; hurt farmers' enthusiasm and interests; caused low effectiveness and waste)	Slackness and shirk responsibility (offered limited support for conservancy supply; could not stop free-riders and the collapse of the conservancy supply system)	Appropriate involvement (The central government offered financial support, subsidies and policy support while local governments guide and supervise the macro development)
Social groups' involvement	Farmers were coerced to participate in conservancy supply; they were slack to join in conservancy constructions and maintenance but paid more attention to their small pieces of plots	Social groups were not interested in participate in conservancy supply since it had high risk but low paybacks; social groups were also limited to participate in conservancy supply	Social groups are active in conservancy supply since they can get official support from the government and appropriate economic interests
Key Social groups in rural water conservancy supply	Farmers, village leaders	Farmers, some conservancy professionals, a few financial organizations and private investors	Farmers, financial organizations, various private investors (financial investors, construction/management corporations), conservancy professionals
The relationship between the government and social groups	Tension; both government and farmers wanted conservancy supply institutions met their preference	Slackness; neither government nor social groups took the responsibility to offer effective conservancy supply services	Both the government and social groups find their positions in conservancy supply and coordinate different actors' interests
Relationship among different social groups	None	Social groups cared about their direct economic benefits	Social groups play different roles in conservancy supply; they cooperate to increase supply effectiveness
Conservancy supply infrastructures' property rights configuration	Governments and the collective controlled all the conservancy infrastructures, programs' ownership and use rights; government offered conservancy supply uniformly	Property rights configuration of conservancy supply was unclear and chaotic; free-riders caused the tragedy of the commons	Diversified property rights configuration methods; clear configuration that both the government and social groups can hold property rights of conservancy infrastructures

Institutional arrangements and changes have affected conservancy supply participants' behaviours and actions and property rights configuration of conservancy supply infrastructures/facilities in different eras. Different

institutional arrangements cause differences of property rights configurations. It makes the government and social groups take different strategies to deal with conservancy supply to maximize their interests. Conservancy supply participants' strategy choices lead to different interactions and different effectiveness of rural water conservancy supply. The interactions between the government and social groups, interactions between different social groups and property rights related issues are three major research aspects in conservancy supply institutions. The following institutional analysis will be presented in the three aspects:

Findings of interactions between the government and social groups

The historical experience has shown that interactions between the government and social groups can affect the implementation of rural water conservancy supply (Ostrom, 2010). Both the government and social groups used various methods to make institutional arrangements of rural water conservancy supply beneficial to their own requirements, interests and preference. According to North's argument, effective institutional arrangements were just a few parts of the interactions between the government and social groups in history (1981, pp.20-23). If there were huge interest differences between the government and social groups, their interactions would also lead to conflicts.

Interactions between the government and different social groups cause of the change of formal and informal institutions. When the government and social groups have common interests, they could cooperate with each other based on binding agreements (Zhang, 1996, pp.35-37). Collective rationality, efficiency, fairness and quality will be noticed in the cooperation between the government and social groups. The cooperation can bring high economic performance and stability of the institutions (Nash, 1953). Otherwise, the government and different social groups will conflict with each other for their own interests. Individual rationality and individual optimal decision emphasized in those interactions may reduce economic performance (Nash, 1951; Friedman, 1971).

In China's rural water conservancy supply institutions, formal institutions which made by the central government and official powers importantly affect institutional arrangements and institutional operations of rural water conservancy supply. The government controls resources and have much stronger forces in conservancy supply (Wu, 2007). While informal institutions in most times could be seen as social groups' responses to or reflections of formal institutions.

The Chinese government has absolute authority to make formal

conservancy supply institutions. The government and top leaders in China also have their own political preference and interests (Lin, 1989). Social groups' interests (especially those of the farmers) might be ignored and hurt by unsuitable conservancy supply institutions made by government. However, social groups are more flexible to change their strategies by breaking and changing institutions (Tsai, 2007). Social groups choose their strategies depending upon whether the government would like to consider and bargain about their interests.

Informal institutions closely connect with formal institutions and are affected by formal institutions. Meanwhile, informal institutions also can affect formal institutions through stakeholders' interactions. Interactions between the government and social groups shape the institutional operation path within the institutional framework. Due to the government and social groups take different strategies in different eras, interactions of the government and social groups of rural water conservancy supply are various.

North argued that the government and top leaders used the name of the state to establish formal institutions for different social groups to gain their interests (North, 1981, pp.22-26). Formal institutions have official power as backing and can have significant influences on informal institutions. The compromise and concession of the government was just the strategy to maximize the government's interests (developing productivity and keeping stability of the regime). However, when social actors dissatisfied with the existed formal institutions, they would also use informal institutions to interact with the government. In China's rural water conservancy supply institutions, whether social groups cooperate with the government is decided by both social groups' strategic choice and the government's strategic choice about conservancy supply (Zhang, 1996, pp.2-8).

In general, interactions between the government and social groups in rural water conservancy supply are different in different eras. Government and different social groups seek for their maximum interests in conservancy supply through interactions. Different interactions between the government and social groups can lead to different effectiveness of rural water conservancy supply.

Findings of interactions between different social groups

Interactions also happen between different social groups. Individuals, interest groups and different organizations also have conflicts and compromise with each other in conservancy supply issues in different eras (Zhou, 2000; Zhang et al, 2004). The relationship and structures among different social groups are also

various in different time periods due to different interest orientation.

When different actors within social groups have similar interests in conservancy supply, they could shape an interest union to cooperate with each other to change or keep existing institutions (Whiting, 2006, pp.34-37). Otherwise, they might establish competitive relationships which might break informal institutions and hurt others' interests. Ineffective interactions between different social groups would also reduce social groups' bargaining abilities with the government and reduce the effectiveness of rural water conservancy supply in practice.

In this study of rural water conservancy supply, social groups are non-government stakeholders of rural water conservancy supply institutions. Informal (not official) norms, behaviours, traditions, consensus and regulations of different social groups make up informal institutions (North, 1990, pp.65-68). Each of different social groups in informal institutions has unique interests. In order to seek their interests, some short-sighted social groups and individuals may have ineffective interactions with others, thus hurting others' interests and leading to the change of conservancy supply institutions (Nash, 1951; Zhang, 1996, pp.2-8).

In rural water conservancy supply, if unreasonable property rights configuration methods and institutional arrangements cannot use incentive mechanism to encourage social groups' enthusiasm to participate and make agreements in rural water conservancy supply, actors in different social groups might find ways for their own lives and interests beyond the boundary of the existed institutional framework. Compared with the government, social groups neither have formal organizations nor enough power to protect their interests and bargain with the government (Xie, 1997, pp.210-215). Therefore, actors in different social groups are hard to cooperate with each other to form a unified group if there are not suitable institutional arrangements (Zhang, 1996, pp.2-8).

Actors of social groups in this study of rural water conservancy supply institutions are generally farmers, village leaders, private investors, financial organizations and conservancy professionals. Each group has played it unique role in rural water conservancy supply. Together, those groups' interactions established informal institutions of rural water conservancy supply. The interactions affected institutional arrangements and conservancy supply effectiveness. Here is analysis of different social groups and their interactions:

Farmers

Chinese farmers are the most significant stakeholders in rural water

conservancy supply since they have direct interest links with formal conservancy supply institutions and other social groups. Although this group lacks effective organizing and legal, equal bargain status with the government, farmers' attitudes, behaviours, traditions and norms are among the most significant parts of informal institutions of rural conservancy supply issues. Since most farmers have similar traditions, thoughts and they meet similar natural, social and economic situations, they have similar interests in rural water conservancy supply (Tang & Li, 2005).

Individual farmers interact with each other to maximize private interests rather than collective interests. Therefore, it is common that farmers conflict with each other in conservancy supply but hard to see their effective cooperation if there is not authoritative intervention (Murrell, 1991). Even though some of them might get more benefits or be easier to take free riding than others, the whole group in general was vulnerable compared with other social groups in terms of capital and networks.

Farmers have frequent interactions with other social groups in conservancy supply in different eras. In the collective era, farmers mainly had interactions with village leaders. They tried to escape from village leaders' control in heavy labour works of conservancy construction and maintenance. They were slack in collective conservancy work to resist village leaders' commands and put more strength in their small piece of plots; in the market reform era, after implementing the household contract responsibility system especially after tax reform in the 1990s, farmers got more freedom in agricultural production and there was not strong authority to supervise them in conservancy supply. Farmers tried to establish cooperative relationships with other social groups. However, farmers could not get necessary support from the government or other social groups for conservancy supply due to market reasons and institutional limits. Many of them chose to be free riders of collective conservancy infrastructures; in the new socialist countryside era, farmers establish diversified interactions with village leaders, professionals, financial organizations and private investors in rural water conservancy supply. The polycentric institutional arrangements allow farmers to choose strategies to maximize their interests through cooperate with other social groups (See Table 7.2).

Table 7.2 Interactions between farmers and other social groups in rural water conservancy supply in different eras

Farmers	Village leaders	Financial organizations	Private Investors	Professionals
Government-driven rural water conservancy supply institutions	Escape their control and be slack under their supervision	None	None	None
Market-driven rural water conservancy supply institutions	No longer under their control and supervision, and refused their organize	Tried to get loan from them but seldom success	Tried to get loan from them but seldom success	None
Polycentric rural water conservancy supply institutions	Get services from them and accept supervision	Cooperate with them and get financial support from them	Cooperate with them and get financial support from them	Get macro and professional supervision from them

Source: Author's research.

Although farmers interact with other social groups in different eras, they are hard to form a unified group. Since their interests in conservancy supply were easy to be hurt by others, farmers have stronger motivations to change existed conservancy supply institutions to protect and improve their interests. Although individual farmer or a family could not bring significant influence to affect rural water conservancy supply institutions, farmers' collective irrational actions especially their interactions with other social groups could significantly affect informal institutions and the effectiveness of rural water conservancy supply (Ye, 2005).

Village leaders

Village leaders are bridges between farmers and local governments. On the one hand, they are representatives of farmers nominally. On the other hand, they are agents of the government in rural areas. In most time, they were between the interactions of the government and farmers and had to be the coordinators to keep the normal operation of rural water conservancy supply institutions. Many village leaders would like to follow the government's policies since doing so could keep and maximize their interests (Sun, 2003, pp.187-189).

In the collective era, village leaders organized farmers and coordinated financial organizations and professionals to establish and maintain conservancy supply programs by following official political commands. Although the interactions between village leaders and farmers were tense, village leaders basically kept the normal operation of rural water conservancy supply system with their political power; since the 1980s, village leaders' political authority

was weakened. They lost political and financial power to organize and coordinate farmers and professionals to participate in conservancy supply. They also could not get financial support from financial organizations and private investors to establish and maintain conservancy supply programs. Village leaders' interactions with other social groups in that era were weak and ineffective; in the new socialist countryside era, village leaders change their positions and mainly coordinate different social groups' interests and offer relevant services. The interactions between village leaders and other social groups become more harmonious and orderly. Village leaders' actions are also inspected by other social groups in this era (See Table 7.3).

Table 7.3 Interactions between village leaders and other social groups in rural water conservancy supply in different eras

Village leaders	Farmers	Financial organizations	Private Investors	Professionals
Government-driven rural water conservancy supply institutions	Control and push them to participate in conservancy supply	Ask for financial aid with official commands	None	Get professional supervision
Market-driven rural water conservancy supply institutions	Lost control to manage and organize them to join in conservancy supply	Cannot get money from official financial organizations	Tried to get financial from them but seldom success	Help farmers to get water from conservancy infrastructures and coordinate relations between farmers and professionals
Polycentric rural water conservancy supply institutions	Offer services, supervise and coordinate interest differences	Cooperate with them and supervise them	Cooperate with them and supervise them	Cooperate with them and supervise financial organizations with them

Source: Author's research.

Since village leaders are not real local officials, they also have to take farmers' responsibilities to grow crops besides daily management work. Village leaders are not only agents of the government in rural areas but also beneficiaries of rural water conservancy supply institutional arrangements (Siu, 1992, pp.200-203). They also have to consider their own interests in conservancy supply. Their dual identity provided convenience for them to interact with the government and other social groups. Meanwhile, the dual identity also make village leaders hard to manage conservancy supply well. Even until recent years, the status of village leaders does not have fundamental change though village leaders and other social groups have tried to find diversified ways to

interact and cooperate with each other. This is because the governance structure and governance mode in rural China has not been significantly changed.

Private investors and financial organizations

Besides farmers and village leaders, private investors (include individuals and corporations) and financial organizations also have played significant roles and interacted with other social groups in conservancy supply institutions especially since in the 21st century.

In the collective era, there was no private investor in rural water conservancy supply. Public financial organizations followed local governments' orders to provide financial services to village leaders to establish and maintain conservancy programs. Financial organizations did not have direct interactions with other social groups in the collective era; in the market reform era, both public financial organizations and most private investors focused on programs that could make large and direct economic profits. They had seldom interactions with village leaders and farmers about conservancy supply though village leaders and farmers hoped to interact with financial organization and private investors to get financial support. Public financial organizations also controlled and limited private investors and farmers' self-organized organizations to invest conservancy supply programs; in the new socialist countryside era, both public financial organizations and private investors have equal rights to invest conservancy supply programs and cooperate with village leaders and farmers. Financial organizations and private investors are allowed to get appropriate interests through investing conservancy supply programs. Therefore, they have more motivations to interact with farmers and village leaders in this era (See Table 7.4 and Table 7.5).

Table 7.4 Interactions between private investors and other social groups in rural water conservancy supply in different eras

Private Investors	Village leaders	Farmers	Financial organizations	Professionals
Government-driven rural water conservancy supply institutions	None	None	None	None
Market-driven rural water conservancy supply institutions	Avoid offering money for them about conservancy supply	Avoid offering money for them about conservancy supply	Be Controlled and limited in the aspect of conservancy supply	None
Polycentric rural water conservancy supply institutions	Cooperate with them and accept their supervision	Select programs and offer financial support	Cooperate with each other	None

Source: Author's research.

Table 7.5 Interactions between financial organizations and other social groups in rural water conservancy supply in different eras

Financial organizations	Village leaders	Farmers	Private Investors	Professionals
Government-driven rural water conservancy supply institutions	Offer financial aid and loans	None	None	None
Market-driven rural water conservancy supply institutions	Avoid offering financial support for conservancy supply programs	Avoid offering financial support for conservancy supply programs	Controlled and limited their involvement in conservancy supply	Avoid support and offer financial aid for them
Polycentric rural water conservancy supply institutions	Cooperate with them and accept their supervision	Select programs and offer financial support	Cooperate with each other	None

Source: Author's research.

Private investors and financial organizations followed the logic of the market economy to look for their interests. They used contracts and capital as their tools to establish various links with the government and other social groups. Although some private investors and financial organizations helped the reestablishment and development of the rural water conservancy supply system in the 21st century, some others still put their interests ahead of public interests to bring negative influence on the development of rural conservancy supply.

On one hand, the government and farmers would like to use the capital of private investors and financial organizations to improve the effectiveness of rural conservancy supply; on the other hand, the government, farmers and village leaders were afraid that the involvement of private investors and financial organizations might make the dilemma of rural conservancy supply worse. Therefore, private investors and financial organizations could bring either positive or negative impacts on rural water conservancy supply system, depending on their interests and interaction strategies with the government and other social groups.

Professionals

Since rural water conservancy supply needs professional knowledge, conservancy professionals' positions in conservancy supply are significant. They worked in official water departments, institutes or water stations with specific conservancy knowledge and relevant techniques. Professionals' interests and social statuses in conservancy supply are varied in different eras. Their interactions with other social groups are also varied.

In the collective era, conservancy professionals followed officials' political commands to plan conservancy development and supervise local cadres and village leaders for conservancy supply. They just had weak interactions with village leaders; since the reform era, professionals were no longer highly valued since top leaders and the central government's political preference and interests have changed to industrial and urban development rather than rural and agricultural development (Kanbur & Zhang, 2005). Government conservancy departments have been reform to public affair departments which could hardly get enough official financial support. Many professionals transferred from government staff to non-government staff. In the market economic environment, although professionals had better understanding of conservancy supply than normal people, they also had to consider their lives and tried to make money through rural water conservancy supply. It has affected professionals' motivations and behaviours when they used their specific knowledge and techniques to provide conservancy related services. The professionals had tense relationships with farmers and village leaders due to water fee and conservancy maintenance issues; in the new socialist countryside era, professionals have changed their roles as supervisors and actively joined interactions with other social groups. They do not join in the supply or construction of conservancy infrastructures/services directly but offer professional knowledge, suggestions and supervise conservancy supply from the macro level. Conservancy professionals' new positions make them fairer, more objective and more independent in conservancy supply when they interact with other social groups (See Table 7.6).

Table 7.6 Interactions between professionals and other social groups in rural water conservancy supply in different eras

Professionals	Village leaders	Farmers	Private Investors	Financial organizations
Government-driven rural water conservancy supply institutions	Supervised conservancy construction with official commands	None	None	None
Market-driven rural water conservancy supply institutions	Provided conservancy services and asked for water fees	None	None	Tried to get financial support but seldom success
Polycentric rural water conservancy supply institutions	Cooperate with them and supervise financial organizations with them	Offering macro and professional supervision for them	None	None

Source: Author's research.

In general, although conservancy professionals do not have many interactions with other social groups, their professional knowledge and comments to other social groups significantly affect the effectiveness of rural water conservancy supply.

Social groups in China have played significant roles in rural water conservancy supply (see Table 7.7). Unlike in the Western countries, there has not been any clear formal institutions to support social groups' development in China before the 2000s due to the Chinese government was vigilant to any organized activities. In order to keep the stability of the regime, China controlled the development of any non-government organizations (Sun, 2003, pp.79-87). Therefore, social groups were always in delicate and sensitive positions of rural water conservancy supply. Even farmers' self-organized conservancy cooperative groups were forbidden with the excuse of illegal fund-raising groups in the 1990s (The State Council, 1998). Meanwhile, when the government has felt that the proper development of social groups could also be helpful for the government's interests and the long-term development of rural water conservancy supply, it offered more space and policy support for the development of social groups in rural water conservancy supply under official control.

Table 7.7 Social groups' roles of rural water conservancy supply in different eras

Social groups	The government-driven conservancy supply era	The market-driven conservancy supply era	The polycentric conservancy supply era
Farmers	Coerced labours for conservancy supply	Self-financing actors in conservancy supply who cannot afford huge investment; free-riders of conservancy infrastructures	Direct participants and investors of conservancy infrastructures with the support of the government and other investors
Village leaders	Rural agents to carry out the government's policies and coordinators of the government farmers	Conservancy supply organizers in the village nominally; who lost official support and forces	Coordinators of conservancy supply programs and organizers of offering rural public goods/services
Private investors and financial organizations	None	Speculators who hope to get private interests in investing public goods supply while still limited by the government	Investors of rural conservancy supply under supervisions from the government and other social groups
Professionals	Participants, organizers and supervisors of various conservancy supply programs	Lost their official statuses and ignored by the government; tried to make money from conservancy supply services	Supervisors who do not join conservancy supply directly

Source: Author's research.

Social groups sought their interests in rural water conservancy supply institutions. If they cannot establish cooperative relationship with each other, social groups might be motivated to take ineffective interactions to hurt others' interests and bring negative influence on the effectiveness of conservancy supply.

In China's rural water conservancy supply institutions, as social groups lacked self-restraint and self-adjustment mechanism, they still could not be a strong power to make formal conservancy supply institutions and offer effective conservancy supply services. Therefore, cohesion of social groups appropriately is significant. Establishing effective interactions and cooperative relationships between different actors within social groups will be helpful to keep the effectiveness and the long-term development of rural water conservancy supply institutions.

Property rights configuration in rural water conservancy supply institutions

Property rights configuration method is the key element to affect relationships among different conservancy supply participants and effectiveness of rural water conservancy supply. It also affects the stability of rural water conservancy supply institutions. Different property rights configuration methods are major reasons of different effectiveness of rural water conservancy supply institutions.

In the collective era, the government and the collective controlled property rights of rural water conservancy supply infrastructures/facilities and offered conservancy supply uniformly. The collective property rights configuration method focused on the government and top leaders' interests and ignored farmers' interests. Therefore, it caused the tension between the government and farmers. The property rights configuration broke the effective interactions between the government and farmers. The property rights arrangement problems caused the low effectiveness of rural water conservancy supply and the collapse of the government-driven rural water conservancy supply institutions.

In the market reform era, there was not clear property rights configuration of rural water conservancy supply. The chaotic property rights configuration method caused institutional loopholes, free-riders and problems of the tragedy of the commons in rural water conservancy supply issues. Therefore, it caused the slack interactions between the government and social groups. The chaotic property rights configuration was one of the most significant reasons to cause the failure of the market-driven rural water conservancy supply institutions.

In the new socialist countryside era, although diversified property rights

configuration methods coexist, there are effective institutional arrangements to keep interests of different conservancy supply stakeholders. Clear and diversified property rights configuration methods and institutional innovations encourage stakeholders' enthusiasm and keep the normal operation of polycentric rural water conservancy supply institutions. Diversified property rights configuration methods in the new socialist countryside era are helpful for the institutional stability and sustainable development of rural water conservancy supply system.

Property rights configuration of rural water conservancy supply system should consider different stakeholders' interests (Yang et al, 2003). Any property rights configuration method that can increase the effectiveness of conservancy supply should be encouraged and supported. Only clear and effective property rights configuration method can offer stable and sufficient conservancy services for agricultural development. If there is not any effective conservancy property rights institutional arrangements, the effectiveness of rural water conservancy supply will be low.

7.2 CONTRIBUTIONS

The existing literature of public goods supply in China mainly concentrates on macro theoretical discussions but lacked empirical analysis. In order to expand and deepen the research, my empirical study of rural water conservancy supply in Central and Western rural China offers specific cases to give the statement and explanation of rural water conservancy supply in the market reform era and the new socialist countryside era. It offers experience to explain conservancy supply institutions at the micro level.

Rural water conservancy issues are parts of the country's macro strategy of agricultural development and food security (Pereira et al., 2007). Rural water conservancy supply system is a hot topic in China nowadays (Xinhua, 2012). It has gotten the central government and media's attentions. However, this widespread and concerned social hotspot lacks necessary academic discussion and analysis. My study tries to fill the research gap and empirically analyze problems from the academic perspective.

Theoretically, this study belongs to the research area of agricultural political economy which is popular in China nowadays. This study tries to combine theories and ideas of politics, economics and sociology to explain rural water conservancy supply issues in China. It tries to offer a wider application of institutionalism and a new research perspective of public goods supply in

Chinese cases.

This research brings in public goods supply theory to explain accurate rural conservancy supply problems in China. It has proved that both the government and social groups have played significant roles in conservancy supply. Institutional arrangements, institutional operation and property rights distributions can significantly affect the effectiveness of conservancy supply.

Besides that, this research also find that interactions between the government and social groups and interactions between different social groups also can affect the effectiveness of conservancy supply. Social groups can use informal constraints to significantly affect institutional arrangements and institutional change.

This research has shown that Ostrom's argument (2010) of polycentric governance is effective to work out problems of conservancy supply in rural China. However, China's experience has shown that autonomous organizations which Ostrom agued cannot play effective roles in rural water conservancy supply issues without the help and support from the government. Cooperation between the government and social groups in China can maximize all the conservancy supply participants' common interests.

This research offers empirical materials to support the further study of institutionalism in China from the perspective of the government and social groups' relationships. Two institutional operation models make classification of the government and social groups' relationships in rural water conservancy supply in the market reform eras and the new socialist countryside era. The models also can be applied to study relationships of the government and social groups in other aspects.

Empirically, rural water conservancy supply problems have been noticed by many farmers, official media and scholars. But there is little academic research to present the ups and downs of water conservancy supply in rural China. This research focuses on this topic to present the changes of rural water conservancy supply since the reform era. It tries to offer reference and inspiration for other scholars in this research area. It also offers information and materials for policy makers to understand real problems of rural water conservancy supply and tries to inspire them for the further institutional reform of public goods supply in rural China.

In short, this research has both theoretical and empirical implications. It offers a new perspective to observe rural China's public goods supply issues.

7.3 RESEARCH LIMITATIONS AND FUTURE RESEARCH

There are still limitations of this research. The most obvious problem is that there is not much literature and previous studies of China's rural water conservancy supply in both China and the western world. There is also not clear format and theories of how to do an empirical study of the newly agricultural political economy. Therefore, this research is groundbreaking without much documents to refer. It mainly relies on official archives, documents, some second hand literature and interview materials to attempt to do the work. Second, rural water conservancy supply issues have close relationships with the government in China. Therefore, some interviewees especially officials, bank staff and professionals who are still working did not like to state much about accurate persons and cases or something negative about the government in current political environment. It may filter out a lot of useful information and cases. Third, databases of rural water conservancy supply system in China especially current years' data such as current length of conservancy drains, the location map of reservoirs and other conservancy infrastructures are not open to the public. Unfortunately, it is not possible to use quantitative research methods and data to prove some key arguments of this research.

For future search, I will try to collect data of rural water conservancy supply in the past decades and use panel data research to prove key arguments of this research. Besides that, I will compare similarities and differences of rural water conservancy supply in other regions such as North-eastern China or Southern China with that of Central and Western China since various geographical conditions might lead to different rural water conservancy supply problems. The two institutional operation models of conservancy supply also can be applied in other research topics and research areas of rural China.

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APPENDICES

Appendix I BASIC STATISTICS OF INTERVIEWEES

The major method for selecting interviewees of this research took the snowballing method since knowledge and information of rural water conservancy system has strong professionalism and independence. The snow-ball selecting method has been proved easy to access interviewees, respond actors' changes in interviews and collect enough information. Other selecting methods such as random selecting method are hard to find suitable interviewees and focus on research targets. Therefore, the random selecting method was only used in selecting some farmers.

In order to keep interviewees' selection neutral and effective, I have used some constraints to control the demographic characteristics.

1. Interviewees should have lived in interview districts for over ten years' time (must be adults);
2. There should be over 2/3 of interviewees were over 50 years old until October 1st, 2015 (in order to cover the whole time period of the research);
3. All the interviewees should be proved familiar with rural water conservancy system and its supply (government officials or staff were those who have ever charged of rural water conservancy issues or worked for the water department/station, farmers were long-term engaged in irrigated farming, financial staff members were ones who have treated at least two or more cases about rural water conservancy financial operations).

In total, I have done 182 effective interviews (remove those who cannot meet the requirements such as those who were just interviewed once; those who could not offer enough and effective information; those who were too old and could not remember clearly and those who had obvious different opinions in two interviews).

The interviewees' information is as follow. I have interviewed local government leaders and staff (21 people), conservancy professionals (7 people), village leaders (31 people), farmers (110 people), bank staff (6 people), scholars (5 people) and private investors (2 people) in Xiangzhou, Xunyang, Chang'an, Lingbao and Xinzhou within two years' time (see figure I to find out more detailed information). Since private investors and bank staff were hard to access, I have tried my best to interview all the 8 interviewees that I can meet.

Figure I Basic information of interviewees

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Farmer	F1	Xiangzhou	XZ1	53	Male	08/10/2014	17/10/2014	
Farmer	F2	Xiangzhou	XZ1	62	Female	08/10/2014	17/10/2014	
Farmer	F3	Xiangzhou	XZ1	64	Female	08/10/2014	17/10/2014	
Farmer	F4	Xiangzhou	XZ1	57	Male	23/10/2014	05/11/2014	
Farmer	F5	Xiangzhou	XZ1	46	Male	23/10/2014	05/11/2014	
Farmer	F6	Xiangzhou	XZ1	36	Male	23/10/2014	12/11/2014	
Farmer	F7	Xiangzhou	XZ2	49	Female	09/10/2014	22/10/2014	
Farmer	F8	Xiangzhou	XZ2	65	Female	09/10/2014	23/10/2014	
Farmer	F9	Xiangzhou	XZ2	68	Male	09/10/2014	23/10/2014	
Farmer	F10	Xiangzhou	XZ2	72	Male	12/10/2014	18/10/2014	
Farmer	F11	Xiangzhou	XZ2	76	Male	12/10/2014	18/10/2014	
Farmer	F12	Xiangzhou	XZ2	57	Male	12/10/2014	18/10/2014	
Farmer	F13	Xiangzhou	XZ3	53	Female	13/10/2014	19/10/2014	
Farmer	F14	Xiangzhou	XZ3	80	Female	13/10/2014	19/10/2014	
Farmer	F15	Xiangzhou	XZ3	69	Female	16/10/2014	02/12/2014	
Farmer	F16	Xiangzhou	XZ3	34	Male	16/10/2014	02/12/2014	
Farmer	F17	Xiangzhou	XZ3	58	Male	16/10/2014	27/10/2014	
Farmer	F18	Xiangzhou	XZ3	72	Male	22/10/2014	27/10/2014	
Farmer	F19	Xiangzhou	XZ4	49	Male	22/10/2014	27/10/2014	
Farmer	F20	Xiangzhou	XZ4	68	Male	24/10/2014	05/11/2014	
Farmer	F21	Xiangzhou	XZ4	41	Male	28/10/2014	04/11/2014	
Farmer	F22	Xiangzhou	XZ4	58	Male	28/10/2014	04/11/2014	
Farmer	F23	Xiangzhou	XZ4	62	Female	29/10/2014	06/11/2014	
Farmer	F24	Xiangzhou	XZ4	54	Male	29/10/2014	06/11/2014	
Farmer	F25	Xiangzhou	XZ5	52	Male	08/11/2014	15/11/2014	
Farmer	F26	Xiangzhou	XZ5	45	Female	08/11/2014	15/11/2014	
Farmer	F27	Xiangzhou	XZ5	73	Female	08/11/2014	15/11/2014	
Farmer	F28	Xiangzhou	XZ5	58	Male	10/11/2014	17/11/2014	
Farmer	F29	Xiangzhou	XZ5	69	Male	10/11/2014	17/11/2014	
Farmer	F30	Xiangzhou	XZ5	55	Male	10/11/2014	17/11/2014	
Farmer	F31	Xiangzhou	XZ6	57	Male	13/11/2014	20/11/2014	
Farmer	F32	Xiangzhou	XZ6	52	Male	13/11/2014	20/11/2014	
Farmer	F33	Xiangzhou	XZ6	63	Female	22/11/2014	28/11/2014	
Farmer	F34	Xiangzhou	XZ6	68	Female	22/11/2014	28/11/2014	

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Farmer	F35	Xiangzhou	XZ6	37	Male	22/11/2014	28/11/2014	
Farmer	F36	Xiangzhou	XZ7	52	Male	25/07/2015	03/11/2015	
Farmer	F37	Xiangzhou	XZ7	58	Male	25/07/2015	03/11/2015	
Farmer	F38	Xiangzhou	XZ7	69	Female	27/07/2015	03/11/2015	
Farmer	F39	Xiangzhou	XZ7	67	Male	27/07/2015	04/11/2015	
Farmer	F40	Xiangzhou	XZ7	63	Male	27/07/2015	04/11/2015	
Farmer	F41	Xunyang	XY1	57	Male	10/12/2014	18/12/2014	
Farmer	F42	Xunyang	XY1	65	Female	10/12/2014	18/12/2014	
Farmer	F43	Xunyang	XY1	72	Female	10/12/2014	18/12/2014	
Farmer	F44	Xunyang	XY1	38	Male	11/12/2014	17/12/2014	
Farmer	F45	Xunyang	XY1	36	Male	11/12/2014	17/12/2014	
Farmer	F46	Xunyang	XY2	70	Male	05/03/2015	16/03/2015	
Farmer	F47	Xunyang	XY2	73	Male	05/03/2015	16/03/2015	
Farmer	F48	Xunyang	XY2	56	Male	05/03/2015	16/03/2015	
Farmer	F49	Xunyang	XY2	41	Male	05/03/2015	16/03/2015	
Farmer	F50	Xunyang	XY2	60	Male	07/03/2015	15/03/2015	
Farmer	F51	Xunyang	XY3	71	Male	07/03/2015	15/03/2015	
Farmer	F52	Xunyang	XY3	60	Female	09/03/2015	13/03/2015	
Farmer	F53	Xunyang	XY3	48	Male	09/03/2015	13/03/2015	
Farmer	F54	Xunyang	XY3	33	Male	09/03/2015	13/03/2015	
Farmer	F55	Xunyang	XY3	59	Male	09/03/2015	13/03/2015	
Farmer	F56	Xunyang	XY4	53	Male	20/03/2015	05/04/2015	
Farmer	F57	Xunyang	XY4	65	Male	20/03/2015	05/04/2015	
Farmer	F58	Xunyang	XY4	72	Male	22/03/2015	02/04/2015	
Farmer	F59	Xunyang	XY4	81	Male	22/03/2015	02/04/2015	
Farmer	F60	Xunyang	XY4	46	Male	23/03/2015	02/04/2015	
Farmer	F61	Chang’an	CA1	74	Female	04/01/2015	10/01/2015	
Farmer	F62	Chang’an	CA1	52	Male	04/01/2015	10/01/2015	
Farmer	F63	Chang’an	CA1	48	Male	04/01/2015	10/01/2015	
Farmer	F64	Chang’an	CA1	63	Male	04/01/2015	10/01/2015	
Farmer	F65	Chang’an	CA1	50	Male	04/01/2015	10/01/2015	
Farmer	F66	Chang’an	CA2	60	Male	06/01/2015	13/01/2015	
Farmer	F67	Chang’an	CA2	63	Male	06/01/2015	13/01/2015	
Farmer	F68	Chang’an	CA2	45	Female	07/01/2015	13/01/2015	
Farmer	F69	Chang’an	CA2	47	Female	07/01/2015	14/01/2015	

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Farmer	F70	Chang'an	CA2	76	Male	07/01/2015	14/01/2015	
Farmer	F71	Chang'an	CA3	40	Male	10/01/2015	18/01/2015	
Farmer	F72	Chang'an	CA3	65	Male	10/01/2015	18/01/2015	
Farmer	F73	Chang'an	CA3	63	Male	10/01/2015	18/01/2015	
Farmer	F74	Chang'an	CA3	72	Male	10/01/2015	18/01/2015	
Farmer	F75	Chang'an	CA3	48	Male	10/01/2015	18/01/2015	
Farmer	F76	Chang'an	CA4	74	Female	03/06/2015	12/06/2015	
Farmer	F77	Chang'an	CA4	51	Male	03/06/2015	12/06/2015	
Farmer	F78	Chang'an	CA4	72	Male	07/06/2015	12/06/2015	
Farmer	F79	Chang'an	CA4	65	Male	07/06/2015	12/06/2015	
Farmer	F80	Chang'an	CA4	66	Male	07/06/2015	12/06/2015	
Farmer	F81	Lingbao	LB1	51	Male	20/01/2015	28/01/2015	
Farmer	F82	Lingbao	LB1	57	Female	20/01/2015	28/01/2015	
Farmer	F83	Lingbao	LB1	65	Male	20/01/2015	28/01/2015	
Farmer	F84	Lingbao	LB1	62	Male	20/01/2015	28/01/2015	
Farmer	F85	Lingbao	LB1	73	Male	20/01/2015	28/01/2015	
Farmer	F86	Lingbao	LB2	44	Male	25/06/2015	10/07/2015	
Farmer	F87	Lingbao	LB2	49	Female	25/06/2015	10/07/2015	
Farmer	F88	Lingbao	LB2	65	Male	26/06/2015	10/07/2015	
Farmer	F89	Lingbao	LB2	67	Male	26/06/2015	11/07/2015	
Farmer	F90	Lingbao	LB2	56	Male	26/06/2015	11/07/2015	
Farmer	F91	Lingbao	LB3	71	Female	28/06/2015	14/07/2015	
Farmer	F92	Lingbao	LB3	62	Female	28/06/2015	14/07/2015	
Farmer	F93	Lingbao	LB3	58	Male	29/06/2015	14/07/2015	
Farmer	F94	Lingbao	LB3	46	Male	29/06/2015	13/07/2015	
Farmer	F95	Lingbao	LB3	77	Male	29/06/2015	13/07/2015	
Farmer	F96	Lingbao	LB4	43	Male	03/07/2015	12/09/2015	
Farmer	F97	Lingbao	LB4	56	Male	03/07/2015	12/09/2015	
Farmer	F98	Lingbao	LB4	71	Male	04/07/2015	12/09/2015	
Farmer	F99	Lingbao	LB4	58	Male	04/07/2015	12/09/2015	
Farmer	F100	Lingbao	LB4	43	Female	04/07/2015	12/09/2015	
Farmer	F101	Xinzhou	WZ1	58	Male	26/01/2016	13/02/2016	
Farmer	F102	Xinzhou	WZ1	56	Male	26/01/2016	14/02/2016	
Farmer	F103	Xinzhou	WZ1	49	Male	26/01/2016	17/02/2016	
Farmer	F104	Xinzhou	WZ1	72	Male	29/01/2016	20/02/2016	

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Farmer	F105	Xinzhou	WZ1	78	Male	29/01/2016	20/02/2016	
Farmer	F106	Xinzhou	WZ2	63	Female	05/04/2016	17/07/2016	
Farmer	F107	Xinzhou	WZ2	65	Female	21/04/2016	17/07/2016	
Farmer	F108	Xinzhou	WZ2	45	Male	22/04/2016	17/07/2016	
Farmer	F109	Xinzhou	WZ2	51	Male	06/05/2016	20/07/2016	
Farmer	F110	Xinzhou	WZ2	73	Female	06/05/2016	20/07/2016	
Government leader or official	G1	Xiangzhou	XZ1	53	Male	10/10/2014	07/11/2015	
Government leader or official	G2	Xiangzhou	XZ1	67	Male	15/10/2014	07/11/2015	Retired
Government leader or official	G3	Xiangzhou	XZ1	49	Female	10/10/2014	07/11/2015	
Government leader or official	G4	Xiangzhou	XZ2	72	Male	14/10/2014	10/12/2015	Retired
Government leader or official	G5	Xiangzhou	XZ5	46	Male	12/11/2014	13/12/2015	
Government leader or official	G6	Xiangzhou	XZ7	48	Male	26/07/2015	15/12/2015	
Government leader or official	G7	Xunyang	XY1	76	Male	09/12/2014	14/03/2015	Retired
Government leader or official	G8	Xunyang	XY2	37	Male	14/12/2014	17/03/2015	
Government leader or official	G9	Xunyang	XY2	44	Male	15/12/2014	18/03/2015	
Government leader or official	G10	Chang’an	CA2	56	Male	05/01/2015	15/06/2015	
Government leader or official	G11	Chang’an	CA4	41	Male	05/06/2015	13/06/2015	
Government leader or official	G12	Lingbao	LB1	45	Female	21/01/2015	14/09/2015	
Government leader or official	G13	Xinzhou	WZ1	38	Male	23/01/2016	22/07/2016	
Government leader or official	G14	Xinzhou	WZ1	43	Male	23/01/2016	22/07/2016	
Government leader or official	G15	Xinzhou	WZ2	65	Male	24/04/2016	25/07/2016	Retired
Government leader or official	G16	Xiangyang City	XYC	48	Male	02/12/2014	15/11/2015	

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Government leader or official	G17	Xiangyang City	XYC	36	Female	02/12/2014	15/11/2015	
Government leader or official	G18	Xiangyang City	XYC	28	Male	03/12/2014	15/11/2015	
Government leader or official	G19	Xiangyang City	XYC	78	Male	07/11/2015	10/01/2016	Retired
Government leader or official	G20	Wuhan City	WHC	42	Male	23/01/2016	18/07/2016	
Government leader or official	G21	Wuhan City	WHC	35	Male	24/01/2016	18/07/2016	
Village leader	V1	Xiangzhou	XZ1	53	Male	08/10/2014	17/10/2014	
Village leader	V2	Xiangzhou	XZ1	47	Male	08/10/2014	12/11/2014	
Village leader	V3	Xiangzhou	XZ1	51	Female	23/10/2014	12/11/2014	
Village leader	V4	Xiangzhou	XZ2	37	Male	09/10/2014	22/10/2014	
Village leader	V5	Xiangzhou	XZ2	46	Male	12/10/2014	18/10/2014	
Village	V6	Xiangzhou	XZ3	55	Male	16/10/2014	02/12/2014	
Village leader	V7	Xiangzhou	XZ4	51	Male	28/10/2014	04/11/2014	
Village leader	V8	Xiangzhou	XZ5	53	Male	10/11/2014	17/11/2014	
Village leader	V9	Xiangzhou	XZ5	76	Male	08/11/2014	15/11/2014	Retired
Village leader	V10	Xiangzhou	XZ6	67	Male	22/11/2014	28/11/2014	Retired
Village leader	V11	Xiangzhou	xz7	44	Male	25/07/2015	03/11/2015	
Village leader	V12	Xiangzhou	XZ7	48	Male	27/07/2015	04/11/2015	
Village leader	V13	Xunyang	XY1	47	Male	10/12/2014	18/12/2014	
Village leader	V14	Xunyang	XY2	56	Male	05/03/2015	16/03/2015	
Village leader	V15	Xunyang	XY2	52	Male	05/03/2015	16/03/2015	
Village leader	V16	Xunyang	XY2	43	Female	07/03/2015	15/03/2015	
Village leader	V17	Xunyang	XY3	45	Male	09/03/2015	13/03/2015	
Village leader	V18	Chang’an	CA1	54	Male	04/01/2015	10/01/2015	
Village leader	V19	Chang’an	CA2	56	Male	06/01/2015	13/01/2015	

Interviewee Type	Code	District/ County	Town	Age	Sex	First Interview Time	Second Interview Time	Notes
Village leader	V20	Chang'an	CA2	68	Male	07/01/2015	14/01/2015	Retired
Village leader	V21	Chang'an	CA4	41	Male	03/06/2015	12/06/2015	
Village leader	V22	Chang'an	CA4	58	Male	07/06/2015	12/06/2015	
Village leader	V23	Lingbao	LB1	46	Male	20/01/2015	28/01/2015	
Village leader	V24	Lingbao	LB2	35	Male	25/06/2015	10/07/2015	
Village leader	V25	Lingbao	LB4	48	Male	03/07/2015	12/09/2015	
Village leader	V26	Xinzhou	WZ1	54	Male	26/01/2016	14/02/2016	
Village leader	V27	Xinzhou	WZ1	53	Male	29/01/2016	20/02/2016	
Village leader	V28	Xinzhou	WZ2	41	Female	05/04/2016	17/07/2016	
Village leader	V29	Xinzhou	WZ2	38	Male	21/04/2016	17/07/2016	
Village leader	V30	Xinzhou	WZ2	56	Male	22/04/2016	16/07/2016	
Village leader	V31	Xinzhou	WZ2	77	Male	06/05/2016	20/07/2016	Retired
Professional	P1	Xiangzhou	XZ1	48	Male	26/09/2014	05/11/2015	
Professional	P2	Xiangzhou	XZ2	37	Male	26/09/2014	05/11/2015	
Professional	P3	Xiangzhou	XZ3	46	Female	28/09/2014	10/11/2015	
Professional	P4	Xiangzhou	XZ6	71	Male	05/10/2014	11/11/2015	Retired
Professional	P5	Xunyang	XY2	54	Male	06/03/2015	17/03/2015	
Professional	P6	Xinzhou	WZ1	53	Male	25/01/2016	25/02/2016	
Professional	P7	Xinzhou	WZ1	63	Male	25/01/2016	25/02/2016	Retired
Scholar	S1	Xiangyang City	XYC	53	Male	06/11/2015	11/01/2016	
Scholar	S2	Wuhan City	WHC	51	Male	19/01/2016	21/07/2016	
Scholar	S3	Wuhan City	WHC	43	Male	20/01/2016	21/07/2016	
Scholar	S4	Xi'an City	XAC	67	Male	09/01/2015	14/06/2015	Retired
Scholar	S5	Beijing City	BJC	41	Male	02/05/2015	10/11/2016	
Bank staff	B1	Xiangzhou	XZ1	56	Male	20/10/2014	13/01/2016	
Bank staff	B2	Xiangzhou	XZ1	64	Male	31/10/2014	14/01/2016	Retired
Bank staff	B3	Xiangzhou	XZ6	57	Male	28/07/2015	13/01/2016	
Bank staff	B4	Chang'an	CA2	66	Male	05/01/2015	15/06/2015	Retired
Bank staff	B5	Xinzhou	WZ1	47	Male	27/01/2016	03/08/2016	
Bank staff	B6	Xinzhou	WZ1	72	Male	28/01/2016	03/08/2016	Retired
Private investor	I1	Xiangzhou	XZ5	71	Male	11/11/2014	11/01/2016	
Private investor	I2	Xinzhou	WZ1	65	Male	26/04/2016	25/08/2016	

Appendix II THE GENERAL FRAMEWORK OF INTERVIEWS[98]

Part one: personal information

1. What is your name?
2. How old are you?
3. What is your job? Do you have any other jobs rather than farming when you have spare time (mainly for farmers)?
4. Are you a native resident (born) here? If not, how long have you lived here?
5. Would you please offer the general income and cost changes from 1950s to now (according to their age, mainly for farmers and village leaders)?

Part two: conservancy development related questions

1. Is there any significant change of rural public goods supply? When and how?
2. Can you feel supply methods' changes of rural water conservancy system in the past decades (according to their age)?
3. If yes, how many kinds of major conservancy supply methods were there and how many times of significant change that you can feel?
4. Can you describe the features of different conservancy supply methods and the major changes? When and how?
5. Could you offer some cases of conservancy supply issues which have left you deep impression? Why these cases?
6. Was there any new technology or external conditions to affect the supply effectiveness of rural water conservancy system in the past decades?
7. Would you please offer the actual irrigating water amount, irrigating channels, irrigated areas, conservancy facility amount, conservancy cost and other conservancy related indexes of your land/area (farmer/others)?
8. Do you think major policies of rural conservancy supply changed in the past decades? How? Can you give some comments (mainly for officials, professionals and scholars)?
9. How did positions of professionals change in conservancy supply issues in the past decades? When and how? Can you give some comments (mainly for officials, professionals and scholars)?

[98] Interviews of rural water conservancy supply included but not limited to those questions. These questions were used as a general framework to guide interviewees to focus on the topic of conservancy supply but this research also encouraged interviewees to offer their own experience and opinions about rural conservancy supply rather than limited in the structured questions.

Part three: people's cognition and attitudes of rural water conservancy supply

1. Could you offer some comments for the conservancy supply in Mao's era? What were the advantages and disadvantages of the supply method? Do you like the government-driven conservancy supply method? Why?
2. Could you offer some comments for the conservancy supply in the reform era? What were the advantages and disadvantages of the supply method? Do you like the market-driven conservancy supply method? Why?
3. Could you offer some comments for the conservancy supply since the 2000s in the new socialist countryside era? What are the advantages and disadvantages of the supply method? Do you like the polycentric conservancy supply method? Why?
4. Which stage do you like most for conservancy supply? Mao's era, the reform era or current new socialist countryside stage? Why?
5. Did you have the desire to invest conservancy facilities or programs? If yes, when and why? If not, why not (mainly for farmers, village leaders, bank staff, private investors)?
6. Were there any cases for the conflicts or cooperation in conservancy supply in the past decades? Can you describe some? What do you think were reasons for the cooperation or conflicts? How do you think to solve these problems?
7. How do you think the role of the government in conservancy supply issues in different eras?
8. What do you think is the ideal conservancy supply method? What is your expectation for China's rural water conservancy supply development?
9. Do you think the institutional change of rural water conservancy supply in the past decades increase the effectiveness and solve conservancy supply problems? Can you give some comments (mainly for officials, professionals and scholars)?

Part four: social groups' behaviours and norms in different time periods

1. Could you briefly describe the relationship between the government and farmers in the past decades? Is there any significant changes? When and how?
2. Can you feel the relationship change between the village leaders and farmers? When and how? Can you give some comments?
3. How do you feel the relationship between different families (farmers in the same village) in the past decades? Is there significant changes? When and

how?

4. Do you think the social group which you are in put its interests of conservancy supply ahead of others' interests? Can interests change behaviours and norms of a person in conservancy supply issues? Can you give some relevant cases?
5. Whether interest conflicts can affect relationships among different actors (according to different social statuses and positions)? If yes, can you offer some cases?
6. How do you feel social groups' (professionals, investors etc.) involvement in farming and rural public goods supply? When they started to involve and how? Can you give some comments about this?
7. Whether your positions (duty) (professionals and officials) and living standard (professionals) changed (reduced) in the past decades? When, how and why? Can you give some comments and cases?
8. Do you think market-driven approaches of public goods supply increased conflicts among different social actors? If yes, can you give some cases and comments (mainly for professionals, officials and scholars)?
9. Do you think current polycentric supply institutions of rural public goods are stable? If yes, please give your evidence and comments. If not, can you give reasons (mainly for professionals, officials and scholars)?

Could you please recommend me some interviewees who can meet the interview requirements as you and familiar with rural conservancy issues?

Notes: This is not a formal questionnaire for interviews. Interviews of rural water conservancy supply were based on above questions (outline and framework for interviewees to focus). Questions and focuses of different social groups and officials were different. Interviews of this research were quite open and tried to encourage interviewees to talk about their own stories, cases and opinions without any interference and bias to present a relatively comprehensive image about the change of rural water conservancy supply in different eras.

Appendix III RESEARCH ETHICS ISSUES

Since my research involves many interviewees' basic personal information, I have kept the privacy of interviewees and use codes to represent them in my thesis. Situations involved sensitive information also occurred when I took interviews with local leaders and government department staff especially for their positions and working places. I also used codes to represent the information. I have also asked interviewees' consents to use their opinions in my thesis. Since my research place was in China, I have gotten the permission in advance and got support from local governments for my interviews. I have tried my best to make interviews of this research objective and impartial as well as avoid possible ethics problems during the interview time period.