Analysis of land fragmentation in P.R. China

(Case study in Taizhou City of Zhejiang province)

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Abstract

Since 1980s, land fragmentation is increasingly taking place within the P.R. China. It has affected the agriculture production particularly in managing agriculture production unit (household), the use of production method and hence production efficiency. This research focuses on aspects of causes and factors affecting land fragmentation in China. Its main objective is to help policy makers to gain insights into policies contributing to the problem and to decide which measures are appropriate for reducing it.

This research contains critical theoretical studies on land fragmentation about the definition of land fragmentation, different kinds of land fragmentation and the effects of land fragmentation from both positive and negative aspects. The literature review section and case study focus on the various studies which examine land fragmentation in Central and Eastern Europe countries. The field work was chosen in three agriculture villages in Taizhou City in Zhejiang province which are located in southeast of China. The findings of this research study reflect that the causes of land fragmentation in China contain both internal facts and direct causes. The farmland is scarce resource in China as compare to the number of land users. The agriculture production efficiency in most part of China is low and the traditional production culture is based on the production unit of household. These are the two main internal facts of land fragmentation in China. Then the main direct causes of land fragmentation in China are the introduction of Households Responsibility contract System (HRS), land distribution, land reallocation and political forced land consolidation. HRS distributes land contract right to the farmers according to the equality principle based on the household size. It causes serious problem of land fragmentation. Land law and policy related to the incomplete land property right with a short land use right duration affect Land tenure security; and also not well established Rural Land market affects land contract right transfer.

Innovation for reducing land fragmentation can be carried out from both policy and technology sides. In the aspect of policy, this research finds that land contract right transfer is a suitable way to improve HRS. Secondly the main bodies of large scale production units like: Professional production household, Stock co-operation production unit, Commercial agriculture production enterprises require reliable access to fragmented land parcels from household in order to realize large scale production and a better rural land market. In the aspect of technology, we need improvement of LIS that includes the integration of urban and rural cadastral system (including spatial and non-spatial data) and management of fragmented parcels.

Key words: *Land fragmentation, Household contract responsibility system (HRS), Land tenure security, Land contract right, LIS.*

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1 Introduction

Land fragmentation is defined as the existence of a number of spatially separate plots of same land owner, and they can be farmed as single units (McPherson, 1982). Land fragmentation occurs in many different countries. Such land fragmentation may cause both positive and negative consequence. If the production method and production level are suitable to the small fragmented land, it would not affect the efficiency of agriculture production too much. Meanwhile, the fragmented land can also decrease the risk of disasters; private land tenure can protect the interest and income of farmers and stimulate the ambition of production. But it also has a negative effect on a modern agriculture, which uses more technology and more mechanization. Modern agriculture requires large-scale and good shape of crop land. So land fragmentation can be a major obstacle to agricultural development, because it hinders agricultural mechanization, causes inefficiencies in production, and involves large costs to alleviate its effects (McPherson, 1982). In view of these considerations, numerous land consolidation and land reform policies have been implemented to reduce fragmentation in European countries like the Netherlands and France, in African countries like Kenya, Tanzania and Rwanda, and elsewhere (King, 1977; Udo, 1965).

1.1 Current situation of land fragmentation in China

Currently land fragmentation in China finds its origin since the end of the 1970s and beginning of the 1980s with the introduction of the Households Responsibility Contact System (HRS). Before the HRS, rural land was owned and managed collectively; land was only divided into plots to match the soil type, irrigation and drainage condition, and for the convenience of management. Under the HRS, land use rights for arable land were generally assigned to the individual households for a period of 15 years. As a result, land fragmentation became more pronounced than before. (Tan, Heerink et al. 2006)

Introduction of the HRS has had a large impact on land fragmentation. Liu (2000) and Kung (2000) indicate that all land was simply divided and assigned to all households based upon the family size. A nationwide survey of 300 villages conducted by China's State Council in 1988 confirmed this. Nearly 70% of the villages used this land assignment rule in rural China (State Council and People's Republic of China, 1992). Secondly, "Kouliang Tian" (grain ration land) was equally distributed per person, and "Zeren Tian" (responsibility land) was allocated according to the number of laborers in a household. Lastly, rich areas tend to use a combination of the second and third rules, while poor areas had a preference for the first rule of allocation (Liu, 2000). Fragmentation of landholdings is now regarded as a major obstacle to agricultural production growth in China due to its high population pressure and the limited availability of arable land. It has caused a loss of farmland area due to intensive use of land for marking boundaries, and a low efficiency in

irrigation water management because of the irregular shape of numerous plots (Zhang et al., 1996). It also causes time loss in travel and inconvenience in agricultural management (Nguyen et al., 1996).

1.2 Research motivation

A good understanding of the causes of land fragmentation helps policy makers to gain insights into policies that (often unintentionally) contribute to the problem and decide which measures are appropriate for reducing it. Although land fragmentation is a recognized problem in China (Qu et al., 1995; Hu, 1997), little empirical research has been done on its driving factors and their relative importance. A better understanding of the causes of land fragmentation in China is needed.

Meanwhile, the Chinese government has been carrying out the second land parcel survey project in rural area. It is really a good opportunity to establish a complete land parcel database which improves the land tenure security, resolving the problem of land fragmentation benefiting the land use consolidation programs for Chinese land administration system. Using LIS in establishing the land parcel data in Chinese rural area, Land administration system in China would play an important role in the project above.

What more important is that new technologies are in urgent requirement to reduce the production costs and to improve farm households' well-beings. Solving the problem of land fragmentation and turning the fragmented land plots into large-scale production units is one of the most important preconditions of using machine and advanced management techniques on the production.

1.3 Research problems

Since the land distribution and land reallocation processes at the village level are the origin of land fragmentation, as seen above, the different causes effecting land fragmentation require different approaches on management of production units and household land plots,

This research intends to focus firstly on identifying causes of land fragmentation at the village and household levels in China. Secondly it deals on analysis of needs for management of fragmented land plots forming production units. The research mainly focuses on two main research problems.

a) What are the causes of land fragmentation in China, and how do they affect on management of fragmented land by using production units minimizing effects of land fragmentation? b) How to improve management of household land parcels at the production level in order to minimize the problem of land fragmentation and improve the production efficiency?

1.4 Research objective

The main objective of this research is to analyze and examine management of production units which are formed by assembling fragmented household land parcels at the village and household level in China. Two specific objectives are formulated below:

Sub-objective 1: To analyze causes of land fragmentation based on the current land tenure and HRS systems in rural area of China.

Sub-objective 2: To improve land administration system of fragmented household land parcels and agriculture production units from both policy and technology side.

1.5 Research questions

Based on the above objectives, the following research questions for each sub-objective are formulated.

Table 1- 1 Research objectives and questions

Objectives	Questions
Sub-objective 1: To analyze causes of land fragmentation based on the current land tenure and HRS systems in rural land of China	1. What are causes and driving force of land fragmentation in China? 2. What are the weak points of current land tenure system and land administration system in rural area of China? 3. How HRS causes land fragmentation in rural area of China? 4. What are the effects of land fragmentation on agriculture production and the land use changes in current China?
Sub-objective 2: To improve land administration system of fragmented household land parcels and the agriculture production units from both policy and technology.	5. What kind of methods can be established to combine the fragmented land into large-scale production units in China with less conflicts and cost? 6. How to improve HRS from household level into a high level production unit at the village level? 7. How to improve Chinese6 land law and policy to reduce land fragmentation (from the views of land market, land tenure security, rural credit system)?

	8. What improvements in roles of central state government and village community leader or other stakeholders can be introduced in the process of reducing land fragmentation? 9. What roles and how can LIS plays in the process of managing fragmentized land?

1.6 Research framework

Firstly, this research have a briefly reviews about the problem of land fragmentation and study the case in several Central and Eastern Europe countries, which has similar situation with China. Then it introduces the situations and background of in China about the Household Responsibility System (HRS), the land distribution and reallocation processes under HRS. The history of land reform, land consolidation, land law, land policy in China related to the land fragmentation are mentioned and discussed too.

Secondly, several causes and factors related to the problem of land fragmentation in China are studied such as land reallocation, land tenure system in China, different kinds of land tenure types in rural area of China, land tenure security, land contract right transfer, land market, off-farm income and social warfare of farmers, and the interests of other stakeholders.

Thirdly, this research discusses what kind of methods can be established to combine the fragmented land into large-scale and how to improve HRS from household level into a high level production unit. It also discusses in what way the land information system (LIS) can help the production unit to manage the production unit (parcels of land, labor, and capital); the related land law, policy and rural credit system supporting this method; and what kinds of roles do the state government, Community or village leaders and other stakeholders play in the process of reducing land fragmentation. After the discussion above, the research ends with conclusions and recommendations.

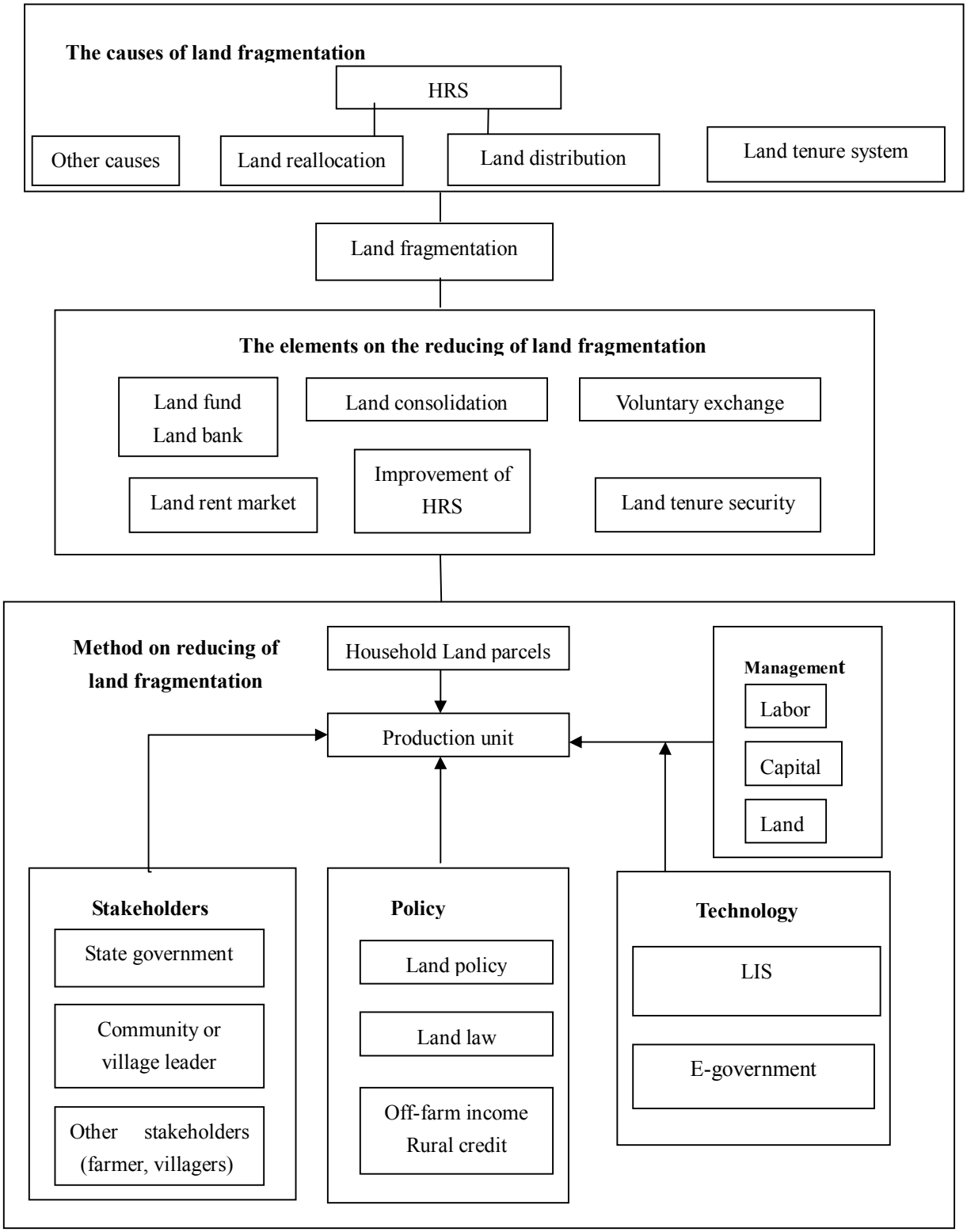


Figure1- 1 Conceptual Research Framework

1.7 Research methods

The research methods in the research include: literature review, comparative case study and fieldwork, and remote sensing analysis, critical and dialectical analysis.

(1) The literature review section and cases study focus on the various studies which examine land fragmentation in the related countries and regions which have similar situation with China, such as the land fragmentation problem in Central and Eastern Europe countries. The topics covered in these studied include explanations of land fragmentation, cost estimates of fragmentation, effects of land fragmentation on agricultural production, and methods used to test the effects of land fragmentation on agricultural production. Two broad viewpoints can be distinguished with regard to the emergence and persistence of land fragmentation, namely ‘‘supply-side’’ explanations and ‘‘demand-side’’ explanations.

(2) Land use data collection and analysis include cadastral data and social statistic data in the research area. It helps to find the status of land fragmentation like: the size, shape, number, and yield of land parcels. The data is than used in the following socioeconomic analysis, trying to find the reasons behind it and whether it related to the land fragmentation, does the fragmentation affects the land use and agriculture production much or not?

(3) Fieldwork in the research area the detail data are collected from government statistic document, cadastral maps and record and interview of farmers. The research area is chosen in Taizhou City in Zhejiang province which is located in southeast of China.

(4) Critical analysis is carried out for the deeper research, focusing on the cooperation of the different causes and driving force of land fragmentation in China. This is to find out which are the main causes are, how they affect, who the main stakeholders (state government, town or village leader, land holder, farmers) are, what their roles are in the reducing land fragmentation. Based on the result of analysis, it has the conclusion and recommendation of improvement of current institution, policy and implementation.

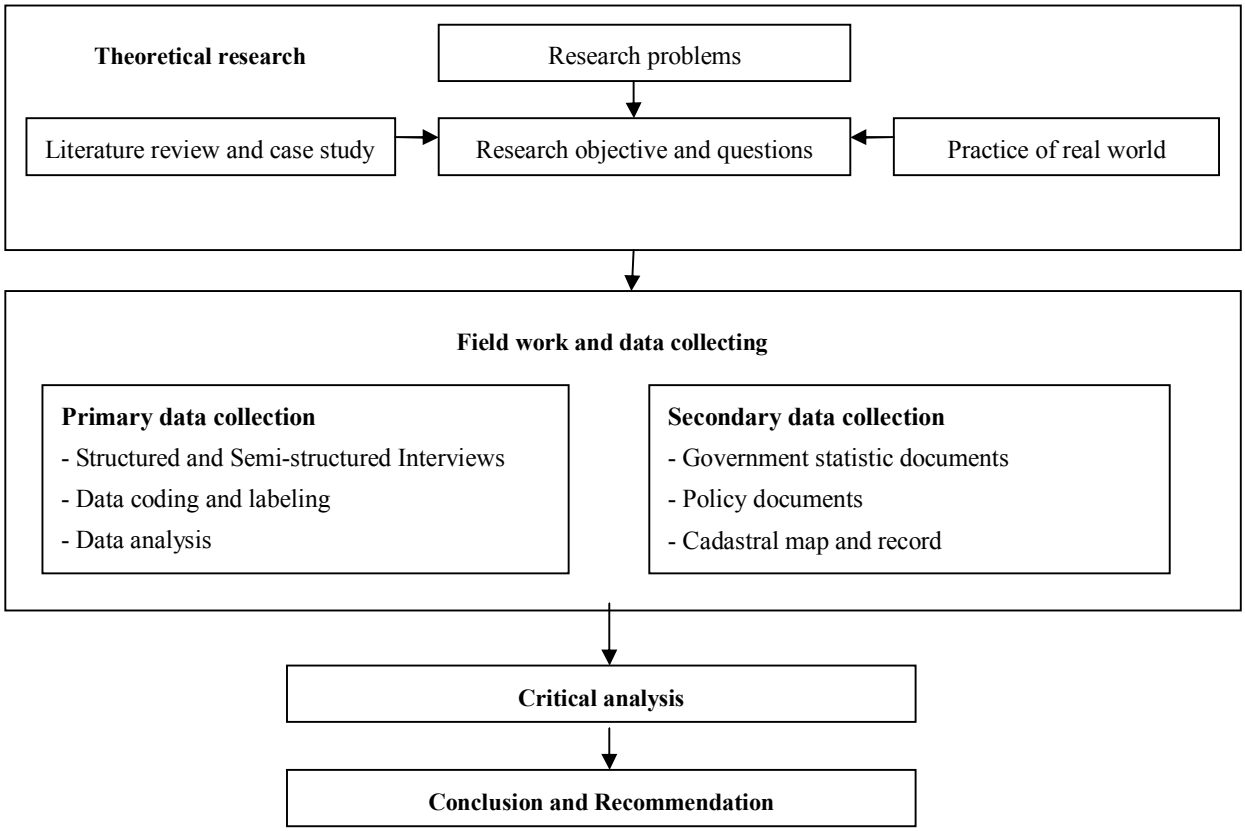


Figure1- 2 Research methodologies

1.8 Field work Area

The fieldwork in this research area is conducted in Taizhou city in Zhejiang province which is located in southeast of China. Taizhou City is located at the middle of Zhejiang Province (latitude 28 N, longitude 122 E). The area of the whole city is 9411 square kilometers with the population of 5,466,200. The urban area contains three districts: Jiaojiang, Huangyan and Luqiao.

Figure1- 3 The location of Zhejiang

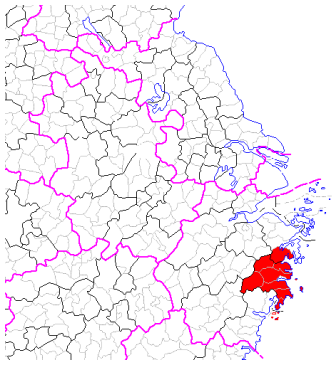


Figure1- 4 The location of Taizhou City

1.9 Structure of thesis

Chapter 1 - Introduction

This chapter concerns about introduction of research work. It presents a general background of research problems with the support of various literatures. Research objectives and questions are presented, and finally it presents the methodology used and gives an overview of the structure of thesis.

Chapter II - Theoretical research concepts

This chapter outlines the conceptual framework, it presents the theoretical background related to the study by reviewing relevant literature on the main issues discussed and it helps to define the basic concepts used in the research. Some case studies in other countries are also presented in this chapter to support concepts.

Chapter III –Causes and factors affecting land fragmentation in China

This chapter introduces the history of land reform, land distribution, land consolidation, land policy in China related to the land fragmentation. Then several elements and causes related to the problem of land fragmentation are discussed such as: land reallocation, land tenure system in China, different kinds of land tenure types in China's rural area, land tenure security, the transfer of land use right, land market, off-farm income and social warfare of farmers, the role of leaders in the village and the state government and the interests of other stakeholders. The discussion focuses on how these causes effect the land fragmentation and on what aspect do they effect.

Chapter IV- Situation analysis of land fragmentation in Zhejiang province

This chapter describes the findings and analysis made. It also explains the research methodology which includes data collection in the fieldwork; it shows the effect of land fragmentation in research area, including the dramatically changes of land use in research area, the situation of cropland abandonment and agriculture production in the study area. The collected data which includes government statistic document, cadastral maps and record, interview of farmers are analyzed using quantitative methods.

Chapter V –Innovation on land fragmentation

This chapter presents improved land administration system of fragmented land plots based on the results of the analysis in previous chapters at village and production unit levels to reduce land fragmentation. It discusses the roles of the state and village communities in implementation process of improved system. It provides details improvement about Land Information System for reducing land fragmentation.

Chapter VI - Conclusion and Recommendation:

This chapter finally concludes the outcomes of the research. It provides the conclusions and recommendations

2 Theoretical research concepts

2.1 Introduction

This chapter outlines the conceptual framework and presents the theoretical background related to the study by reviewing relevant literature on the main issues required for the research. In this chapter, the concepts about land fragmentation are defined to understand the research context. This chapter also provides the fundamental definitions on different kinds of land fragmentation, the effects and causes of land fragmentation on agriculture production. Then some case studies in central and eastern countries are presented in this chapter to support concept. So, the research questions one and four are partly answered.

2.2 The definition of land fragmentation

Land fragmentation is defined as the existence of a number of spatially separated plots of same land owner which are farmed as single units (McPherson, 1982). It is a state of division of holdings into discrete parcels that are dispersed over a wide area (Binns, 1950; King and Burton, 1982) and usually farmed as single units. It occurs in two parallel directions: vertical sub-division and horizontal dispersion. The former process leads to gradual reduction in the size of holdings; the latter process increase the distance between the farm household and land parcels. .

The definition of land fragmentation is different depending on various aspects. In aspect of land tenure, land fragmentation means number of land ownership or number of separated land parcels. In aspect of economy, land fragmentation means whether the fragment land use situation affects the agriculture production efficiency or not. The land ownership may be fragmented, but the land use status may be entire. For example: the large scale agriculture production units in China can collect the fragmented parcels from farm households though land contract right transfer and organize production in high efficiency.

So land fragmentation depends on both the land itself and the people related to the land (land owner and land user). The evaluation about the land fragmentation is also different in different countries according to land use and agriculture production situation such as the population of farmers and the agriculture production method. For example, in a developing country where the agriculture mainly relies on labor and use machine scarcely, the size of land parcel may be small but it is suitable to the agriculture method in that place. We can not consider land fragmentation as a serious problem there.

2.3 The different kinds of land fragmentation

In principle, there are two main kinds of land fragmentation: land ownership fragmentation and land use fragmentation. Land ownership fragmentation means number of separated land parcels in the cadastral registration. It includes number of land ownership and number of land owner. Land use fragmentation means number of separated land parcels are being used by land users and the fragmented land use situation. It includes the number of land user and internal land fragmentation. This implies that reduction of fragmentation occurs by definition when the number of owner and /or users declines, the number of parcels per farm falls and when the share of owners who use the land themselves raises, and also the improvement of land parcel use situation.

Land ownership fragmentation

a) Number of land ownership

It exists on land registration record and may not reflects the land use fragmentation directly

b) Number of land owner

It shows the number of land owners. One land owner may own one or several land parcels, or one land parcel can be owned by one or more land owners. Land ownership fragmentation is not the problem itself, it can not reflect whether the land use situation fragmented or not directly.

Land use fragmentation

a) Number of land user

The land use situation is visible in the landscape, although one cannot tell if a fragmented parceling points to small farms or fragmented farms. One land user may work on one large scale land parcel or several fragmented land parcels owned by several land owners as a whole one. The overlap of use and ownership means that tenancy and transfer of land use right play an important role in agriculture land use. Land users could be land owners themselves or not. The land users who do not own the land parcel or they want to expand the size of farm to realize large scale production. They have to rent the land or get the use right though land market. A certain percentage under tenancy is desirable to allow farms to change size in a cheap and flexible way, so we cannot entirely do without tenancy (De Haan, 1964). But too many land users and too much land rent may increase the cost. The number of land user reflects the level of production efficiency and land fragmentation in one country (see figure 2-2) . The reduction of land fragmentation must consider the reducing the number of land user and increasing production efficiency at the same time.

b) Internal land fragmentation

It shows the number of land parcels exploited by each land user; this is the fragmentation within a farm. Internal fragmentation has traditionally been the main subject of western land consolidation experts who tried to demonstrate the importance of land consolidation.

It considers the fragmentation of (a) parcel size, (b) parcel shape, (c) parcel distance, reducing internal land fragmentation contains decreasing the distance of parcels to the farm saves time, a better parcel sharp raises yields and increased parcel size both saves time and raises yields In figure 2-1, we can see there are 6 land parcels with land ownership. They can be owned by one land owner or 2-6 land owners. In land use practice, these 6 land parcels may be farmed as one large scale farm or 2-6 fragmented farms. So, land use fragmentation is which really affects agriculture production directly.

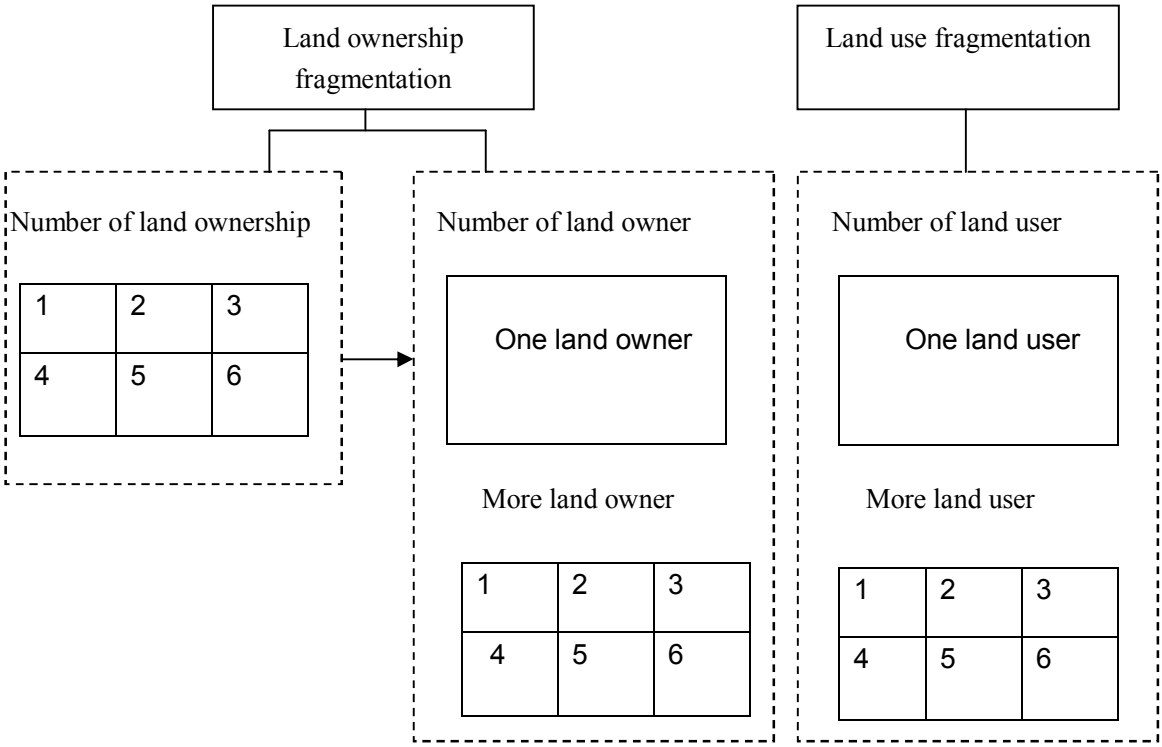


Figure 2- 1 The relation between land ownership fragmentation and land use fragmentation

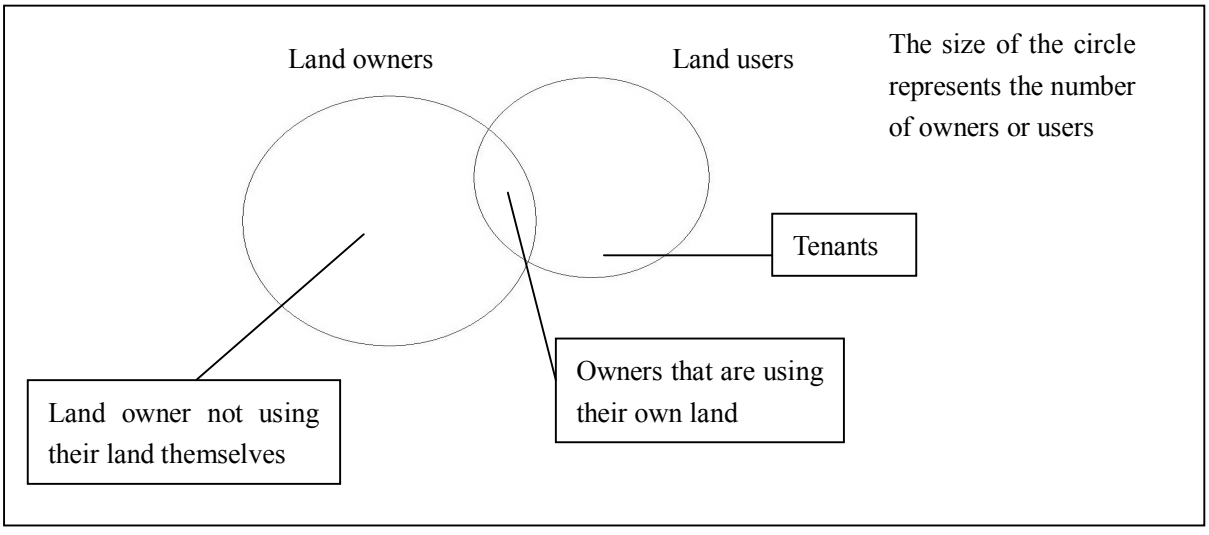


Figure 2- 2 The overlap between land owner and land user

2.4 Effects of land fragmentation on agriculture production

2.4.1 The positive effects of land fragmentation

Land fragmentation mainly has two positive effects. Firstly, when the farmland of one farm is divided into a number of parcels with different location, it is to be expected that the risk of disasters also varies. The chance that a hailstorm or disease will destroy the entire crop in one growing season is small in a fragmented situation. (Dijk 2003). Secondly, when land parcels are distributed to the farms and the land tenure security is well protected, it can protect the interest and income of farmer better, especially in the developing countries where people mainly rely on agriculture production and the method of production is based on small production unit like household which is suitable to the small land parcels. Then, farmers' ambitions of production are stimulated; the output of crop would increase directly.

2.4.2 The negative effects of land fragmentation

From a strategic economic perspective, land use fragmentation has negative impact on rural income. On the other hand, if land plots in rural area are kept in a fragmented situation, people would have difficult to make and sustain their living, because small land plots are not productive enough. They would have to find employment and housing, thus causing social tensions and a potentially big problem to the government (Dijk 2003).

Firstly, land ownership fragmentation is not a problem in itself. The land registry office might experience some practical complications, for instance when the law requires even tiny ownership parcels to be physically marked in the field, but they are not of direct societal importance. Disadvantages of fragmented ownership are indirect, since they trigger a gap between ownership and use of land. The most obvious drawback is that leased land on the long term is more expensive to use than owned land.

Secondly, land use fragmentation negatively influences the costs and volume of production; hence production costs and volume are related to the parceling structure. Fragmentation in terms of small land use units decreases the income that the farmer can make with his land. Regardless of the limited farm production, in case each farm is physically separated from others by fences, ditches or hedgerows, these elements, together with infrastructure amount to a loss of productive land which is much higher than in large-scale land scopes. The size of a land use unit restricts the maximum volume of produce that the production unit generates, which in turn limits the income of the farmer. This limitation to the income is obviously a disadvantage to the farmer himself, although he may have the possibility to choose for more intensive land use (like labor intensive crops) or additional off-farm income. Raise in income was and still is the main motivation for farmers to participate in land consolidation. In order to improve the income of the farmers participating in land consolidation, production cost should be decreased and production should be increased.

Thirdly, practically speaking, the total length of parcel borders increases with fragmentation. Apart from the land loss by separating elements, parcel borders generally receive less fertilizer and pesticides, and they are more susceptible to wind damage and drought. When parcels are far apart, the time and fuel involved in traveling is another disadvantage. Parcels at greater distance are generally cultivated less intensively. Internal fragmentation negatively affects productive acreage and efficiency.

Table 2- 1 Effects of land fragmentation on agriculture production

Effects of land fragmentation on agriculture production	
Positive effects	**Negative effects**
1. decrease the risk of disasters 2. protect the interest and income of farmer 3. stimulate the ambition of production	**land ownership fragmentation** 1. trigger a gap between ownership and use of land, leased land on the long term is more expensive to use than owned land **land use fragmentation** 2. restricts the maximum volume of produce and increase the cost of production 3. decrease the efficiency of production 4. limited the income of farmer 5. land loss (separating elements, parcel borders)

2.4.3 Critical analysis

Land fragmentation causes both positive and negative effects on agricultural production. Literature studies also show the constraints imposed by land fragmentation on productivity and efficiency in agriculture are mixed and inconclusive. For example, Blaikie and Sadeque (2000) highlight that land fragmentation is becoming a critical constraint in increasing productivity in Nepal, India and other nearby regions. In contrast, farmers in the highly land fragmented regions of Malaysia and Philippines do not consider it as a problem in paddy farming (Hooi, 1978; Wong and Geronimo, 1983; cited in Niroula and Thapa, 2005). Because the large number of farmer and the tradition production method are suitable to small size land parcels.

In case of China, Wu et al. (2005) concluded that land fragmentation does not have any significant impact on productivity, whereas Wan and Cheng (2001) conclude that land fragmentation reduces productivity. Similar contrasting arguments exist on the effects of land fragmentation on efficiency. For example, Schultz (1953) views land fragmentation as the misallocation of the existing stock of agricultural land, implying it as a source of inefficiency. Dovring and Dovring (1960) identifies distance between parcels as the main source of inefficiency created by land fragmentation. Recent studies, from Sherlund et al. (2002) and Tan (2005) conclude that the increase in the number of plots has a positive relation with technical efficiency in rice production in Cote d'Ivoire and China, whereas

Parikh and Shah (1994) and Wadud and White (2000) report that land fragmentation reduces efficiency in rice production in Pakistan and Bangladesh, respectively. (Rahman and Rahman 2009)

From above, we can see that land fragmentation may not effect the efficiency of production too much in some cases, especially in the developing countries where the method of production is based on small production unit like household which is suitable to the small land parcel. But it really has a negative affect on a modern agriculture, which is based on large scale production unit and uses more technology and more mechanization. Modern agriculture requires large-scale and good shape of crop land. So land fragmentation can be a major obstacle to agricultural development, because it hinders agricultural mechanization, causes inefficiencies in production, and involves large costs to alleviate its effects (McPherson, 1982). In view of these considerations, numerous land consolidation and land reform policies have been implemented to reduce fragmentation in European countries like the Netherlands and France, in African countries like Kenya, Tanzania and Rwanda, and elsewhere (King, 1977; Udo, 1965).

2.5 Causes and driving force of land fragmentation

The causes of land fragmentation are many kinds. Two broad viewpoints can be distinguished with regard to the emergence and persistence of land fragmentation, namely “supply-side” explanations and “demand-side” explanations (McPherson, 1982; Bentley, 1987).

2.5.1 Supply-side

The supply-side causes of land fragmentation include both natural and social facts like: land scarcity, population pressure, low land/labor ratio, inheritance and traditional agriculture culture (based on household). For example: many authors with this viewpoint claim that inheritance in a growing population logically leads to fragmentation when farmers desire to provide each of several heirs with land of similar quality (World Bank, 1978; Anthony et al., 1979). Another supply-side factor is the breakdown of common property systems under the pressure of population growth. This breakdown has led to increased fragmentation in developing countries such as Kenya (King, 1977) and Nigeria (Udo, 1965). Likewise, land scarcity may lead to fragmented holdings as farmers in quest of additional land will tend to accept any available parcel of land within reasonable distance of their house.

2.5.2 Demand-side

The demand-side causes of land fragmentation include topography, the difference of land quality, living safeguard, reducing the risk of production, equality, low producing level and production method. For example: when plots differ with respect to soil type, water

retention capability, slope, altitude and agro-climatic conditions, demand-side factors may play a role as well. Supply-side explanations cannot always fully explain land fragmentation. Demand-side explanations view fragmentation primarily as a positive choice made by farmers. This viewpoint presumes that the benefits of fragmentation to a farmer exceed its costs. Some researchers argue that, when alternative risk-spreading mechanisms such as insurance, storage, or credit are not available or are more costly, land fragmentation will persist as a means for risk reduction (Charlesworth, 1983; Ilbery, 1984). In less-developed areas, farmers need land as a safeguard. When land quality is not homogeneous, the scattering of parcels can reduce the risk of loss from flood, drought, fire, or other perils, and farmers can diversify their cropping mixtures across different growing conditions. When food commodity markets fail, land fragmentation may be beneficial for crop diversification, allowing farmers to grow (non-marketed) subsistence crops. Another demand-side explanation was that scattered parcels enable farmers to better allocate their labor over the seasons. If an agricultural labor market is missing, supply of farm labor is determined by household size, and the need for spreading labor requirements over time is greater.

Table 2- 2 Causes and driving force of land fragmentation

Causes and driving force of land fragmentation	
Supply-side	**Demand-side**
1. land scarcity 2. population pressure 3. low land/labor ratio 4. inheritance and traditional agriculture culture(base on household)	1. topography 2. difference of land quality(soil type, water retention capability, slope, altitude and agro-climatic conditions) 3. reducing the risk of production 4. living safeguard (basic income) 5. equality principle 6. farms' capability: low producing efficiency level and production method

2.6 The case study in Central and Eastern Europe countries

This following sections gives an overview of how land tenure was perceived and treated under socialism，how the agriculture production unit worked under socialism (State, Collective, Private). The process and the result of implement the land reform will also be discussed to find whether it could be succeed or not. Based on the research above, it will provide data on land fragmentation and agriculture production situation in Poland and Hungary to find how land fragmentation affects the efficiency of agriculture production and what kind of agriculture production unit is suitable to these countries and protect the interest of farmers. The reason why choose the case of central and eastern countries is the similar background of socialism with China.

2.6.1 Land fragmentation after privatization

Land fragmentation is a negative and direct result from privatization. The restitution system inherently divided the land among relatively many people, leading to small farms. Restituting in old boundaries leads these small farms to be divided into many parcels. And the way of agriculture production is varies in different countries after the land reform. (Dijk 2003)

Some of data can reflect this situation. In Poland, though the state-farm amounts to 48,000 km2 (or 12% of all Polish agricultural land), large-scale collective farm is not successful. Private farms occupy nearly 76.4% of total farm land. But the average size of private farm grows slowly, from an average 5.2 ha in 1950 to 6.3 ha in 1990. 50% of private farmer's size is under 5 ha. In Hungary, collective co-operation farms occupy the most part of farm land nearly 68%, and the size of private farm is smaller only 0.81 ha, and 44.2 % under 5 ha. About 80% of the country's land owners own one or two parcels which are less than one hectare in size. These parcels are often very awkwardly shaped (in their length-width ratio) (Kneib et al, 1999). The household plots were small plots (0.6 hectares) cultivated by members of collective farms or state farm workers. The collectives contributed to their members' private production by providing machinery services and selling feed and roughage to the farms. In this way, a symbiotic relationship between large- and small-scale farms evolved, in both systems leading to a successful agriculture as compared to other Central European countries (Mathijs and Meszaros, 1997). In the current Hungarian situation, we have to make a clear distinction between fragmentation of land ownership and fragmentation of land use. Hungary managed to control extreme forms of land use fragmentation for the time being due to the fact that co-operative farms were not dismantled during land reform and the current legislation allows tenancy agreements to increase farm size (Riddell and Rembold, 2000).

From the figure on the fragmentation in the 1990s we can find that the land tenure and agriculture production pattern are varies in different countries, and the land ownership becomes more fragmented, but the land use is not like this in some countries. Large-scale production organizations still dominate production in several Central European countries. Many new landowners lease their land to the large-scale successor organization of the collective and state farms. We can find that the driving force of land privatization is the efficiency of agriculture and the benefit of farmers. If land reform cause higher efficiency and increase the income, the farmer works will be willing to distribute the land from the state and the collective farm. This depend on the capability of farmer, whether they can manage their own land or not and whether their income is totally come from the yield of farm or not. The facts affect the efficiency is varies include both internal and external causes.

a) If a country has a high labor/land ratio and the state distribute the land to farmers base on the number of labor, it will cause the problem of land fragmentation.

b) If a country has well developed industry which can supply lots opportunities of job and higher income, the farmer will not have strong attribution of farming working. The situation of land abundant will occur, if state government force on land privatization.

So land reform on land privatization and land fragmentation is not as simple as a process to distribute the land to the farmers, it could be recognized as a change of life style and way of working to the people who used to working in a co-operation way and highly specialized in performing a specific narrow task. The collective farm organized the production under the planning economy, the state manages the whole farm over the country, and employee the farmer to work even decides the kind of crops planted on the land. Now they have to make the decision of agriculture production depend on the relationship of support and need of the market.

2.6.2 Land tenure and agriculture production unit under socialism

As a consequence of socialist policy, private ownership as well as private revenues was replaced by communal farms that would allow an equal distribution of wealth. This goal is realized by establishing large agricultural production units in which the total group of workers would supply the labor together and thereafter would equally divide the revenues of their work. Under socialism, state and collective collect the land right (ownership and use right) from the private to establish large communal production units and organize the agriculture production. The large-scale production units came in two types: collective farms and state farms.

a) State farm

From the socialist's point of view, the land would be best to be kept entirely under the state control. State government would like to organize the large scale agriculture production under the control of government. So, in the case of state farms, all rights to land were taken away from the original owners. In state farms all assets, including land, were owned by the state and farm workers were like employees in any other firm and received fixed wages and social security benefits. (Dijk 2003)

b) Collective farm

The establishment of collectives (or co-operatives) farm involved transferring only part of the rights to land from the owners to the collective i.e. the right to use and the right to alienate. The actual ownership tides in principle remained with the members or owners. The separate parcels were physically merged in massive tracks of land that hid the legal patchwork underneath. Collective farms enjoyed somewhat more autonomy than state farms in their decisions. In collective farm workers increasingly received the same social benefits as state farm workers and ownership tides ceased to have influence on productions technology or farm decision-making. (Dijk 2003)

c) The private land

Besides large scale production unit, there are also private farm in socialism countries. The private lands are indeed essential to the system since they prevented starvation of the rural workers that lived under conditions of low wages, shortages and poor distribution. In addition, they provided an increasing share of the fresh food supply (especially vegetables and fruits), were used by the collective management to rent out labor intensive activities, and even supplied urban relatives of villagers (Creed, 1999).

Table 2- 3 The advantage and disadvantage of production unit under socialism

The production unit under socialism		
	Advantage	**Disadvantage**
State farm	1. Organize the use of labor, capital, machines or other production tool working on the large scale of the land 2. The efficiency of production is probably higher than the small scale private plots, especially in the place where the number of labor is not quite enough. 3. receive social benefits	1. Farms have no influence on productions technology or farm decision-making 2. The income of farm workers is based on the work of the collective farm, but it is hard to evaluate the work of farmers. 3. can not protect farmers' interest well
Collective farm	Enjoy more autonomy than state farms in produce decisions.	Same with state farm
Private land	1. The private farm can protect the farmers' interest better, and inspire the farmer's ambition on farm working. 2. Life safeguard, avoid starvation of the rural workers that lived under conditions of low wages, shortages and poor distribution.	1. Small production scale, 2. Low efficiency, 3. Fragment small land parcel

The above three production units were in fact three degrees of government regulation of land tenure, which varied in proportions throughout the region. State farms represented fully erasing private interests and transferring all control to the state. In collectives, only part of the rights on land was transferred, whereas ownership stayed in place as well as (regulated) freedom of choice. There was no interference in rights on land on the private plots, farmers can make the decision of production themselves.

From the aspect of production efficiency, in state and collective farms, the farm workers receive only part of their production yields, most part of their yields were occupied by the state and collective. The advantage of these two forms of production units is that the leader of state and collective farms can organize the use of labor, capital, machines or

other production tool working on the large scale of the land. The efficiency of production is probably higher than the small scale private plots, especially in the place where the number of labor is not quite enough. The disadvantage is that the income of farm workers is based on the performance of the collective farm. And the evaluation of the performance needs some kinds of standards (rate of production or working hours), this will cause unfair sometimes because of the unreliable evaluation. What's more, the ambition of farm workers is not related to the production directly and the investment on the land is mainly based on the order of state, not the relationship of supply and need from the market.

In the production system of socialism, the socialist planners were not blind for the advantages private farming had, at least in parts of agriculture. For example, the Hungarian system eventually evolved into a symbiosis between the large collective farms and the private plots. But even without any private plots, private commercial activities could still exist. The private land owner can co-operate with the collective farm on the agriculture production. For example the so-called *akord* system in Bulgaria mentioned by Creed (1992). The *akord* system meant that parts of the collective's land, for instance a part of a vineyard, were placed under the responsibility of a selected group of workers ('brigade'), through a tenancy contract. The brigade was responsible for tillage, planting, maintenance and harvesting, to use inputs and machines from the collective. The crop eventually was sold to the collective. The profits, but also the risks, were on account of the brigade. In this situation, the yield and profits of the land was totally owned by the land owners, and the income of the production is guaranteed by the state and collective. The farmers feel that they are the owner of their land, so they have the ambition of working and investment on the land. Meanwhile, the land is used in large scale with machines. This kind of production unit is similar with the land contract right stock co-operation organization under HRS in China.

From the discuss above, we can find that state and collective farm can manage large scale of farm, capital, labor , infrastructure and other resources to realize intensive production in order to reach a high efficiency. The private farm can protect the farmers' interest better, and inspire the farmer's ambition on farm working. To protect the interest of farmers, this is the main driving force of privatization of land parcel in the ex-socialism countries. But if the parcels of the private farms are too small and fragment, it is difficult to organize production on it.

There is a choice between fair and efficiency. So many researchers try to find or design a system which has the advantages from both of them. The possible result may be give the legal private proper right (ownership or use right) to the farmers and protect the land tenure security. At the same time, establish a kind of new production unit in which farmer can co-operate the production and use the land together, the income can be distributed equally. Success appeared to depend on forming small to medium-sized production units, farmed by a stable group that exercised some degree of local control and financial independence (Meurs, 1999). Furthermore, collective agriculture must have a concrete advantage over independent farming. Grain-producing peasants, for example, at a bare

subsistence level will appeal to co-operative with state supported mechanization. Where the majority of these conditions were met, significant numbers of peasants voluntarily pooled their land into collective forms of production. Forced collectivization was generally associated with disastrous production results. Independent producers may experience land fragmentation, lack of capital and poor markets as an incentive to join a collective farm. This spontaneous collective production unit has already appears in many country, from western countries to the ex-socialism countries and China as well. It gives the farmer legal land tenure (ownership or use right). Though, the land ownership may be fragment but it can realize the land use consolidation.

2.6.3 Reducing land fragmentation

There are mainly three kinds of methods to reduce land fragmentation in Central and Eastern countries. But all of them have advantages and disadvantages, and only suitable for some situation.

Land funds and land banking

In order to solve the land fragmentation, the farmer who has the best possibilities of exploiting the land should still be able to acquire land from less efficient users. But the high transaction costs can outweigh the difference in exploitation efficiency. And even then, non-economic considerations can resist the transfer from one landowner to another. The deadlock can be avoided by introducing a new type of player in the land market; an owner that is not interested in growing but in distributing its land to established farms. Its land is thus used as a buffer that enables the improvement of farms without intersecting other peoples' interests. The use of such a buffer is referred to as 'land banking'. The buffer itself is a land fund. (Dijk 2003)

Land consolidation

Land consolidation, is a project-wise improvement of all physical limitations on agricultural production, for instance parceling, water management, infrastructure, soil quality and road infrastructure. Parcel reallocation is an integral part of the projects and aims to reassigning every participant less parcels, closer to the farm buildings and of equal acreage or productive potential. Initially, all programs were to aim 'at increasing productivity of agricultural labor in order to strengthen the competitive position of agriculture, to establish a better balance between agricultural and industrial labor, and to reach a higher standard of living for the farming population' (ILRI, 1959).

Task of land consolidation

a) Elimination of land fragmentation
b) Land reclamation and soil improvement
c) Improvement of the farm size pattern
d) Improvement of the pattern of settlement

Voluntary parcel exchange

The voluntary exchange of parcels between three or more owners, thus resulting in improved land use consolidation is called voluntary land exchange**.** Parcels normally are not changed in size or shape. Compared to traditional land consolidation, this instrument is less expensive, less intrusive and less time-consuming. Voluntary land exchange does not need a special legislative background. It can take place in a normal sell-and-buy construction, where notary and cadastral are involved in switching ownership rights between several parties.

From above we find three instruments for reducing fragmentation all take their affect on solving the problem of land fragmentation. But all of them have advantages and disadvantages, and only suitable for some situation. **Land fund and land bank** relay on an efficient land market. From where the farmer that wants to expand his property and the land owner who have no willing working on the land can change their information. If an active land market is not built, land tenure is not well registered and protected by the law, the land fund and land bank will not wok successfully or plays its due role. **Land consolidation** involves the most financial resources, labor, land parcel. It not only changes the fragment land into large ones but also change the pattern of production in order to raise the efficiency of agriculture. Because it is large and complex, land consolidation is usually carried out by the state government and use legal provisions to protect the rights of the participants and the general interest. Compared with land consolidation, voluntary parcel exchange is more flexible, cost and time saving，do not need a special legislative background. But the voluntary parcel exchange is only suitable for a limited number of owners, relatively small differences in soil quality and within a small area. So the problem of land fragmentation can not be solved by only one of them. The combination of using these three instruments base on different situation could be a good strategy.

2.7 Concluding remarks

From the above discussion we can find that land fragmentation appears widely in different countries in the world. The occurrence of Land fragmentation is inevitable, because of both “supply-side” and “demand-side” factors. The causes of land fragmentation includes the natural facts like: agro-climatic conditions, topography, land quality, soil condition, irritation, scare of land; the social facts like: population, number of farmers, land law and policy, property right, land administration and tenure system, land reform history, traditional agriculture culture and method of agriculture production; the economic facts like: off-farm income, production efficiency, land rent market and so on.

From the case study we can learn that, reducing the land fragmentation is not only the change of land ownership and land use situation, but also the change of production method and living condition of farmers. Lot of consequences should be considered. Reducing the land fragmentation by force may cause lots of problems and failed at last. The farmers can choose the land use and production method which fit to the social and

economy situation spontaneously. The efficiency of agriculture production and the benefit of farmers can affect reduction land fragmentation. This depend on the capability of farmer, whether they can manage their own land or not and whether their income is totally come from the yield of farm or not. The relation between farmers' interest, agriculture production and reducing land fragmentation can be seen in figure 2-3.

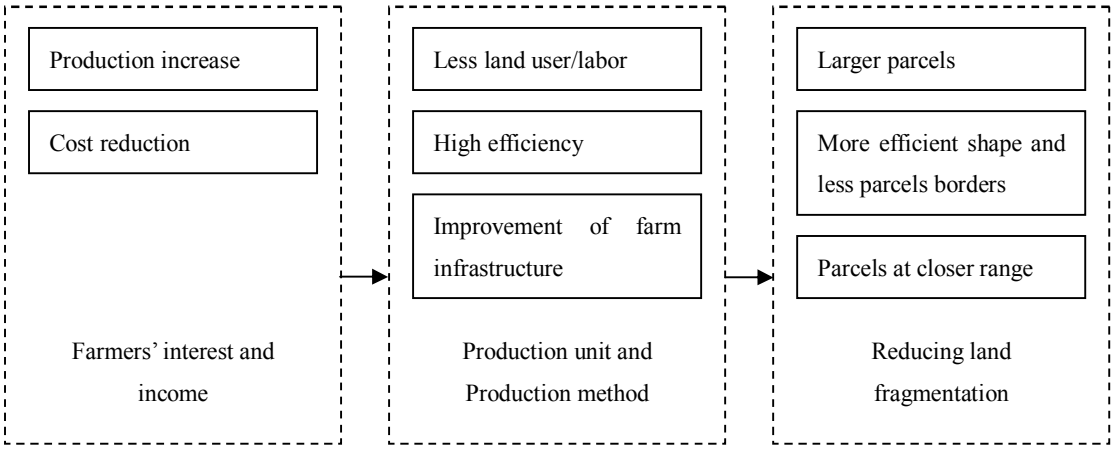


Figure 2- 3 Relation between farmers' interest, production and reducing land fragmentation

3 Causes and factors affecting land fragmentation in China

3.1 Introduction

Land fragmentation is commonly regarded as a major obstacle to agricultural production growth in China. This chapter analyzes the factors contributing to land fragmentation. Some are the inherent factors: like tradition household based agriculture culture; the large population and less farm land condition in China; the less income from off-farm employment and the egalitarian principles used in distributing and reallocating land use rights to households. Some are originated from the introduction of HRS in the third land reform, and the land distribution, land reallocation under HRS. Moreover, the land tenure in rural area and the land law, land policy related to the land tenure security and institution of land use right also affect the land fragmentation. The affect of land rent market is also discussed at last. In this chapter, the research questions 1, 2, 3, 4 have been answered.

3.2 Land tenure system in China

After the introduction of the 'open door' policy in 1978, China has adopted a land use rights tenure system which is similar to the leasehold tenure system in Western countries. Currently, Chinese land tenure system has a very typical situation which can be mainly distinguished into ownership right and land use right. Due to these two rights, the state holds the land ownership while local government on behalf of the state could transfer the land use right by laws (Guo, 2003).

3.2.1 Land Ownership

These are the two kinds of land tenure in China: state-owned land and collective-owned land. According to Chinese Land Administration Law, which was firstly drafted in 1986 and amended in 1998; it clearly indicates that in urban areas of cities, lands are state-owned. They can be assigned, sold and resold, leased or mortgaged. House sites, land allotted for personal needs and hilly land allotted for private use belongs to peasants' collective ownership (Land administration law of China, 2002).

State Owned Land

The state owned refers to the land to belong to the state this does not permit the transfer land ownership this kind of land. State-owned land is taken by the government. The whole property in cities is state-owned, but a large portion of land in towns is still not. The most term of use rights to residential property is 70 years. Such rights can be traded freely among private citizens, the prices determined by the value of market. The system of state

ownership of land didn't give any restraints on the towns' development.

Collective Owned Land

The collective means countryside community has the land, is authorized with all member's countryside community equal share collective all lands. In rural area of China, All village land is collective, including land within the built-up district countryside area, is also a collective. Collective land areas have the part of housing improvement and the agricultural land. In these two kinds of situations, members of the collective are given use rights to concrete land.

Table 3- 1 Land ownership in China

Ownership	Contains
State-owned land	Urban areas of cities Rural land not for agriculture use Rural and suburban area that is confiscated, requisitioned, expropriated (expect for those portions designated or define as owned by collectives); Forestland, grassland, hills, wasteland, mineral resources, mountains, unclaimed land, beaches, flood land and other types of land, which the state has not determined to be owned by collectives.
Collective-owned land	Rural and suburban areas except for those portions, which belong to the State in accordance with the law ; Rural land mainly for agriculture; House sites and private plots of cropland and that of hilly land.

Source: Zhang and Tuladhar, 2006

3.2.2 Land use right

In China, land use rights are the rights for natural persons, legal persons or other organizations to use land rights for a fixed period of time. The fully owned land ownership has major 4 authorities which comprise occupation, use, benefit and punishment. The differences between land ownership and land use right without owned is for a fixed number of years, the farmers could implement fully owned land rights with exception of the punishment by authority. Besides, Chinese land law also states that land and properties which located on land are regarded as two separate entities. Land users may use the land and own the buildings and improvements on it, but the sovereignty of the land remains in the hands of the State or farmer collectives. One of the characteristics of the Chinese land tenure system should be noticed which is private land ownership does not exist in China (Guo, 2003).

In urban area of China, according to Land Administration Law, it legalized personal organizations and individuals to access the state-owned land to attempt to develop the land market development in China. The State Council proclaimed “The Provisional Regulation on the Granting and Transferring of the Land Rights over State-Owned Land in Cities and Towns” in 1991 provides a substantial legal guidance to the Land Administration Law. Now land users were permitted the hiring, the transfer, the renting and the mortgage land-use rights (Valletta 2001).

In rural area of China, it is performing HRS (household contract responsibility system) called ‘Chengbao’ in Chinese for the using of farm land and the organization of agriculture production, which authorizes farmers a land use right in a fixed certain years. There are several kinds of special land tenure in rural area of china, based on the different contracts. The term of land use rights varies depending on different land use purpose. Because in rural area of China, farmers do not have land ownership, they only can get land use right or land contract right for agriculture production. So the duration of land use right reflects the land tenure security of land parcel.

Table 3- 2 Land use right and duration

Land use right	Contains
State-owned land	70 years for residential use 50 years for industrial use 50 years for educational, scientific and technological, health, and athletic use; 40 years for business, tourist, and recreational use; and 50 years for multiple purpose use or other uses
Collective-owned land	30 years for cultivated land 30 to 50 years for grassland 30 to 70 years for forest land Longer than 70 years for special woods

3.3 Land tenure system in rural area of China

The land tenure (land use rights) in rural area of China is of various kinds because of the different land use purpose and the different duration according to the contact. The land tenure system may include two or three types of land tenure depend on the different purpose of land use and the organization of agriculture production.

3.3.1 Land tenure types in rural area of China

In rural area of China, Five major tenure types are officially sanctioned by the national government:

- responsibility land (zeren tian),
- grain ration land (kouliang tian),
- contract land (chengbao tian),
- private plots (ziliu di)
- reclaimed land (kaihuang di).

Responsibility land
Responsibility land is allocated on the basis of the number of family members, the number of laborers in each family, or the desire and/or ability of the household to engage in agricultural production. In exchange for use rights, farmers must deliver a mandatory quota of grain or other specified commodities to the state at a below-market price. There may be restrictions on how they can use the land. Users of responsibility plots also face the possibility that some of the land may be taken away and the use rights allocated to other households.

Grain ration land
Grain ration land is typically allocated on the basis of household size to ensure that each household produces enough for its own consumption needs. The use of the land does not usually entail quotas or other obligations.

Private plots
A small amount of land was provided to rural households for private plots during the period of collective agriculture, and farmers retained this land when China reverted to family farming. In some villages households formed today by young newlyweds are also granted private plots. Households have almost complete control over the short-term and long-term management of the private plots, with the exception of the right of title transfer. In some villages farmers can bequeath their private plot to their children.

Contract land
Contract land is rented to households by the villages for a fixed cash payment (chengbao fei). The length of these contracts varies considerably from community to community. While the cultivator of such land may incur a delivery quota, the defining feature is that

rent is paid by the farmer to the village or the small group in return for use rights. Farmers may bid on the land at a community auction or the fee may be set by village authorities.

Reclaimed land
Farmers can also acquire use rights to reclaimed land that was previously uncultivated. There are usually no quotas or fees tied to the use of the land. In some villages rights to develop wasteland are currently being auctioned off (huangshan paimai).

3.3.2 Land tenure system in rural area of China

For efficient management, the above tenure types are packaged into two groups of several land tenure systems, including the **two-field system** (liangtian zhi), which combines responsibility and grain ration land, and the **three-field system** (santian zhi), which adds contract land (Brandt, Huang et al. 2002). In the land tenure system, farmers use different kinds of land tenure for different kinds of land use. The yield of the land cannot be treated freely in some kinds of land tenure, like responsibility land. The state must buy certain quantity of grain in a proper price, which reference the price on the food market.

The advantage of this land tenure system is that farmers can get steady income from the land. The government has to protect the internets of farmers and their ambition of production, and the outcome of crop is bought by government in a suitable price like the yield of responsibility land. The disadvantage of this land tenure system is that it is one cause of land use fragmentation, because of the different purpose of land use. Different land tenures have different permissions of land use right and the different duration according to the contact. Meanwhile, it will be a big barrier of reducing land fragmentation. It is hard to combine land with different land tenures into a big one, and makes the land use right difficult to circulate on the land market.

3.4 Land rights in rural area in China

3.4.1 Rural collective land use right

According to the “Countryside land contract law” 2003, the rural collective land use right varies, it includes land use rights' transfer, subcontract and stock, lease, mortgage, implement, take back.

Land use right transfer
It means that village committees and other agriculture economic organizations offer the collective land use rights to land users in a certain term; the users pay the fare for using the land. But only the land use rights can be transferred, the land still belongs to collective, so it cannot be transferred by individuals. According to some related contracts, we can't

change the purpose of land, so the land users could only work on the development and management of agriculture. Land use rights transfer includes: sale, interchange, donate, inherit.

Land use right subcontract and stock

It means that land owners and users join the stock in the form of the value of the land use according to the laws. There are some regulations that the land use rights subcontract and stock should follow：It must follow the related law, it must assess the price of land, making the agreement of subcontract，it must getting the permission before using the land, it must compensate properly for the former land users, it must transact the procedure of registration.

Land use right lease

It means that the collective land users as lessons, supply the land use rights to lessees, and get the rent. Some characters are described as: It is for the land management lease, the aim is to get the rent. Land use rights lease is for the purpose of agriculture, if it is for other purpose, it should follow some certain conditions.

Land use right mortgage

It means that the land users as mortgager depend on the legal land use rights and won't transfer the way of possession, afford debt surety to creditors. When the debtors can't fulfill the debt, the creditors have rights to sale the land use rights. There are some differences between collective land use rights and state use rights. First, the mortgagers of collective land use rights are the collective land users. Second, when the creditors' sale the collective land uses rights, the land ownership might be transferred; there is the possibility for land acquisition.

Land use right implementation

After authorizing the use of collective land legally, and receiving the "Collective Land Use permit", the land users may obtain the land use right legally, when the land users exercise the right, they should also fulfill certain obligations: (1) The land must defer to authorized the purpose of land, it cannot arbitrarily oversize land area or change land use. (2) During the period of land using, the land users have the duty to obey national and the social public interest needs. (3) During the period of land using, the land users must deal with the neighborhood relations correctly.

Reclaim of Land use right

The reclamation of land use rights in accordance with the law is the reasons for terminating collective land use rights. The reclamation conditions (1) For public construction needs.(2) Not according to land with authorized purpose.(3) Because of abolished, migration reasons to stop the use.

3.4.2 Land contract right

Land contract right is part of rural collective land use rights. Land contract rights (Chengbao) is the right for the members of countryside collective economic organizations (CEOs) to contract land owned by the CEOs or other owners for cultivation or similar uses. land users are authorized to enter into contracts with CEOs or other owners to possess, use and profit from collective land (State-owned farming land, forest land and lawn) for a fixed period of time. The form of Land contract right is HRS (Household responsibility contract system). It was initiated by a group of farmers in a hamlet in China in the early 1980s. The system has two main features. First, since farmland is still owned by the collectives, agricultural collective land ownership is invariable. Next, production and management are entrusted to individual farming households through long-term contracts. During the contract period the farmers pay taxes to the state and the collective reserve payment reserves to local authorities simultaneously maintain own crops. The term of rights to use collective land for cultivation: The term for cultivated land is for 30 years, for lawn it is from 30 to 50 years, and for forest land it is from 30 to 70 years. The term for special woods possibly may be especially longer, subject to pass through from the government authority in responsible for forestry.

Land contract right features

(1) The collective land ownership is the foundation and the premise of the land contract rights. The land contract right is entrusted and relied on collective,

(2) The land contract right is one kind of derivation of land ownership, as soon as setting up, it has independent property rights

Land contract right transfer forms and principles:

Land contract rights circulation forms are: rent, exchange, transfer, stock and so on. Land contract rights circulation principles:

(1) Consultation on basis of equality, voluntary compensational.

(2) Shall not change the land ownership and agricultural purpose.

(3) The duration of the circulation should be limited to the contracting period.

Land contract right displays influential role in Chinese countryside. Chinese law requires that all villagers are authorized to obtain land contract rights to encourage them to increase agricultural products. Chinese law further stipulates that farmers can only transfer land contract rights under very few circumstances to maintain social stability. Therefore, all collective land is divided into small pieces and it has hindered the farmer inevitably to the land investment. This is one of the direct causes of land fragmentation in China.

3.5 Introduce of HRS

In the third land reform in 1980s, the introduction of HRS was a new try. The Chinese government tried to maintain the state and collective land ownership and distribute the land use right to the farmers. It's a kind of land use right privatization. The households had owned part of proper right but not complete. The ambition of farmers increased in some digresses, but not last too long for the unclear future of land policy and unsecured land tenure. Though HRS increased the gain of crop, it causes the serious problem of land fragmentation at the same time. The land distribution and land reallocation under HRS makes the parcels used by different households separately. The equality attitude and strong emotional elements on the land make the problem more serious. What's more, China' s undeveloped land rent market and unclear and uncompleted property right in rural area make it hard to reduce the land fragmentation. The detail will be discussed in the next paragraph.

3.5.1 Land distribution

Introduction of the HRS has a large impact on land fragmentation. There are three main types of land distribution under the HRS.

a) All land was simply assigned to households based upon the family size. A nationwide survey of 300 villages conducted by China's State Council in 1988 confirmed this. Nearly 70% of the villages used this land assignment rule (State Council and People's Republic of China, 1992).

b) kouliangtian (food ration land) was equally distributed per person, and zerentian (responsibility land) was allocated according to the number of laborers in a household.

c) The third is that all land was allocated according to the number of laborers. Richer areas tended to use a combination of the second and third rule, while poor areas had a preference for the first rule of allocation (Liu, 2000).

Land degree institution

According to the egalitarian conceptions, the farm land should be distributed to every household equally, according to the size and quality of land. Plots that were homogeneous in soil and irrigation and drainage conditions, and where the same type of land use was possible, were grouped into one land class within a hamlet. A land class could be further divided into several subclasses, depending on variations in the conditions of the land within the class itself. Each class and subclass was used as an area unit where at least one plot was allocated to each household. In principle, each person should get an equal share of each class of land. If, for example, four classes of land are distinguished in a village, then a family of five persons could get five shares of all four land classes. To reduce the number of plots, the land within the same class for the five members was kept in one place as much as possible. In this way, the household obtained at least four plots. The location of a plot allocated to each household was done by lottery. Differences in family sizes made the plot sizes and/or the number of plots within each class different.

The more varied the water and soil conditions, the higher the number of land classes and the higher the number of plots would be in this process.

According to a survey which was done by Rural Fixed Observation Office in Central Policy Research Division and Agriculture Ministry, P.R. China (2001), the average area per farm household decreased from 0.6 ha to 0.5 ha from 1986 to 2000. In the western and center area of China where economy is mainly relied on agriculture, the average area per farm household decreased from 0.8 ha to 0.7 ha from 1986 to 2000. In the eastern part of China where farmers have higher off-farm income and less farm land, the situation of land fragmentation is more serious. The average area per farm household decreased from 0.4 ha to 0.3 ha from 1986 to 2000.

3.5.2 Land reallocation

Since the introduction of the HRS, the egalitarian conceptions results in frequent land reallocations to correct for demographic changes within villages. To the extent that such reallocations led to subdivision of existing plots, it may have contributed to land fragmentation. Meanwhile the land tenure and right are gained and lost during village-wide reallocation. According to a research, nearly three-quarters of all changes in landholdings were related to village-wide reallocations. The land tenure security is reduced by land reallocation, because farmers cannot have long-term to use specific plots of land. During the process of land reallocation households are not usually compensated for any investments they have made in the fields that are transferred way from them.

The situation of implement land reallocation

(1) Much of the remaining quarter occurred when the contracts on contract land expired,
(2) When families divided up their land at the time of a son's marriage,
(3) When village governments responded to changes in the size of particular households without resorting to mass reallocations of land throughout the village. In contrast, in the periodic village-wide reallocations, a great deal of land changes hands simultaneously. For example, village leaders will shift land from a household where a death has occurred or where a daughter has married out of the village since the last reallocation, to a household where an infant has been born or where a man has gained a wife from another village during the same period.

The range and frequency of land reallocation

The frequency of land reallocation is considerable different exist among provinces in the average number of reallocations per village since household farming was introduced, with a national average of 1.7 times. Local leaders in Liaoning, Shaanxi and Hubei provinces adjusted land more frequently, while those in Yunnan and Sichuan provinces intervened relatively infrequently. Land had been reallocated once in one-quarter of the villages, and twice in 20 per cent of the villages (see table 3-4).

Table 3- 3 land reallocation in different part of China

	Average number of reallocation per village	Size of most recent reallocation (% of land)	Percent of households affected by most recent reallocation	Reallocation decision made by township (% of village reporting)
Zhejiang	1.2	60.8%	91.8%	6.2%
Sichuan	0.3	28.6%	58.6%	3.1%
Hubei	2.8	55.0%	71.1%	3.1%
Shaanxi	2.8	34.8%	62.8%	6.2%
Shandong	1.9	74.5%	71.2%	0.0%
Yunnan	0.4	31.3%	61.4%	66.7%
Hebei	1.5	75.0%	82.5%	33.3%
Liaoning	3.4	91.1%	93.1%	25.0%
Total	**1.7**	**57.6%**	**74.4%**	**14.4%**

Source: Land rights in rural China: facts, fictions and issues. The China journal, No.47, January 2002

In different villages, land reallocation is different in size and scope. According to a survey, on average, a reallocation involved slightly more than one-half of a village's land and three-quarters of its households. In villages where there was more than one reallocation, the amount of land reallocated was about the same each time. On average, slightly more than half (53.4 per cent) of all cultivated land in sample of villages had been reallocated at least once. The distribution is also bimodal; a nearly equal percentage of village leaders (about 40 per cent) reported that nearly all or, contrarily, none of the land had been reallocated since the beginning of household farming (see figure 3-1) .

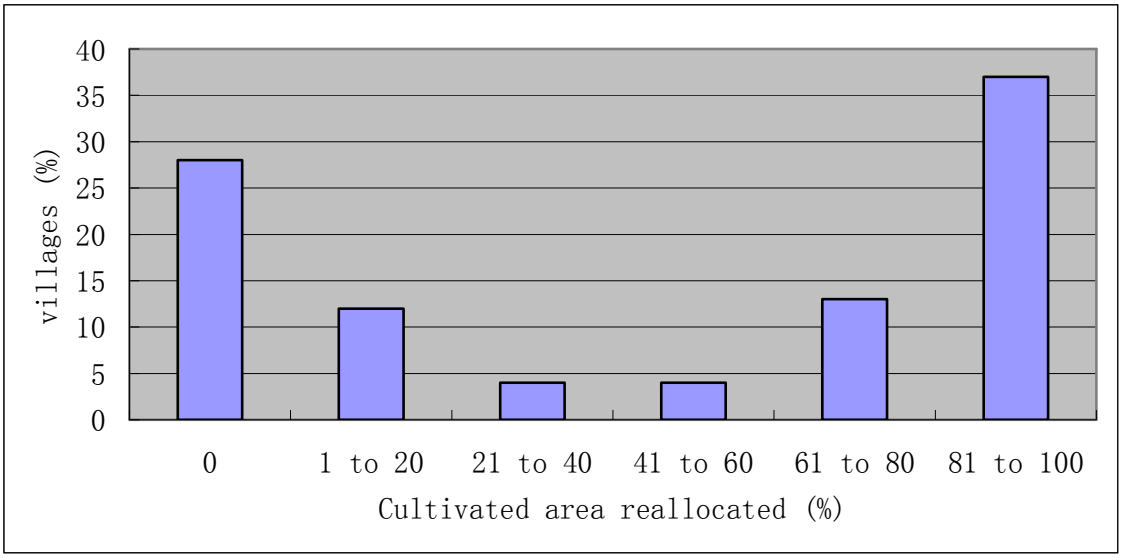


Figure 3- 1 Share of cultivated area that has been reallocated since 1983

Source: Land rights in rural China: facts, fictions and issues. The China journal, No.47, January 2002

The endless reallocation of farmland resulted several problems:
(1) The situation of a small and fragmented farming structure further deteriorated
(2) Farmers worried about the risk of losing their land as well as investment, had no incentives to improve land conservation and agricultural infrastructure.
(3) The process of land redistribution itself was costly, requiring much labor and time in organization and implementation.

3.5.3 Land consolidation programme

In order to reduce land fragmentation, village-level land consolidation and land redistribution programme is implemented to increase plot sizes in China since the mid-1980s. In some areas, particularly plain areas in coastal provinces like Jiangsu and Shandong, it is comparatively easy to implement such programme. In other areas, it may take lots of transaction costs to consolidate land plots contracted to individual households. This holds in particular for areas in Central and Western China where land fragmentation is high due to topographical factors and rural households depend largely on agricultural production for their incomes. Farmers have to gather frequently to discuss how to implement the policy in a satisfactory way for each household. This may cause a loss of labor time both on-farm and off-farm. In addition, government funds are needed to assist in the engineering part of the programmers. (Tan, Heerink et al. 2006) So, land consolidation which is not suitable to the agriculture production situation and the willing of farmers may fail at last.

3.5.4 Critical analysis

From the analysis above, we can find the main causes and facts affect land fragmentation in China are the HRS, and the land distribution, land reallocation, land consolidation under this system. Firstly, through the land distribution tiny and fragmented farming units emerged as farmland was distributed to individual households that would farm it independently. The principle of land distribution was derived directly from collective ownership. Farmland in a village was owned by all of its members collectively. As a result, every member had equal claim on land property rights, and the norm for distributing land was based on the size of the peasant family and the degrees of land. The land /man ratio in China is so small. So given the abundant population and limited land, the amount distributed to each household was very small. Moreover, farmland differed from parcel to parcel in terms of soil fertility, irrigation conditions, location and so forth. A household had to obtain parcels from each of the grades. Thus, the total was not only insufficient but also fragmented and scattered around villages. Large areas of cultivated land were wasted in the form of paths and boundaries separating households' holdings.

Secondly, the frequent land reallocation makes the fragmentation more serious. According to the system, a person's eligibility for land depended only on his or her villager status, no matter when this was obtained. On the one hand, babies and villagers' newly married

spouses from other villages were all eligible claimants, having equal rights to share equal amounts of land; on the other, when a villager died, his or her right would automatically disappear. As population increased, villages had to readjust the distribution structure, which further subdivided the farmland.

Thirdly, government-initiated land consolidation programmers may help to reduce the land fragmentation, but the costs of such programmers in terms of government finance and transaction costs to farmers are high. The main problems of implement land consolidation program are the attitude of farmers, the clear definition of land tenure and the cost of transaction. Since most income of farmers in china is depend on agricultural production, land is quite important for them. The time and money cost on the coordination between households are quite large. Land consolidation is not as simple as combine the plots together but the change the organization of agricultural production at the same time. So, it's better to implement land use consolidation while improving the land administration system and HRS in China.

3.6 Land tenure security in rural area of China

3.6.1 Land administration laws

In 1993, the Central authority has published a policy instruction, the extended farmer land use right to a non-interrupt and the fixed deadline are 30 years. This was first time, farmers' land use rights have substantial lengthens, and afterward it has some kind of degree actual execution situation at least. In 1998, the 30-year was embodied in formal law for the tie as a result of the adoption of the "land administration law". This law is clear about the duty that land be contracted to peasant households for a term of 30 years. At the same time, China started the huge movement to implement the new policy, including issuance of land rights documentation to farmers and widespread propaganda 30 year time rights. In 2002, the National People's Congress established a "rural land contracting law" to devote completely to the relationship rights and farmers' land use rights. In 2007, China adopted a "property law", the first synthetically folk property code in modern Chinese history. Reality of laws characteristic farmers' rural land use rights as property rights or real rights (but is not contract right legal limits front), supplying the better protection small peasant household's land right.

These land laws improve the security of land tenure, but not enough for reducing land fragmentation. The new "Land Administrative Laws" issued in 1998 also have some impact on land fragmentation. According to these laws, farm households can use their contracted land for an additional 30 years. Land was again redistributed within a few years after the laws' implementation. Once the land has been allocated, it may be used for 30 years. The purpose of extending the contract period is to increase land use security so that land becomes a life safeguard in farmers' minds. This asks for a land allocation that must be more considerate and equitable than ever. It must be well balanced in the

process of the distribution. In doing so, the land was divided into several plot classes in terms of soil type, water access, drainage condition, road access, and any other conditions which the farmers consider to affect agricultural yield and land management. Land has become more fragmented as a result after the gradual implementation of the 30-year contracts.

3.6.2 Property right of land in China

The collective ownership of farmland did not exist in practice in rural China: rural collectives never had exclusive property rights on land under the so-called collective system. During the commune era, collectives were prohibited from selling the land they owned (except to the State) or from buying land from other owners. Farm products could only be sold to State commercial institutions at administratively low prices; thus farmers were denied the right to benefit from farming. Farmers' land use rights such as production decisions were also weakened by the rigid State procurement system.

Under HRS, farmers still failed to have complete rights on land. They lacked the right to transfer their contract land, and their rights to use and benefit from the land were further weakened by administrative interference and continued State procurement. As a result of these infringements of property rights, the State was the real landowner - the biggest landlord in rural China (Din and Cheng, 1994).

Though the government tried to increase the land tenure security and give the complete land property right to farmers, it is still not act well, sometime even increase the land fragmentation because of farmer’s rely on land for a living. But in a view of long term, the clear definition and protection of land tenure security and complete proper right to the farmers should be one of factors of land rights transfer which is quite important to realize land use consolidation and the reducing of land fragmentation.

3.7 Land Market

Another factor affecting land fragmentation is the reemergence of land market. In present China, farm households cannot buy or sell agricultural land, but in many villages it is possible nowadays to transfer land contract right or hire land from other households or from the village collective. Particularly farm households involved in off-farm employment outside the village are often inclined to rent their land to other households in the same village. In case of unemployment, the households that rented their land out can fall back on it for making a living. (Tan, Heerink et al. 2006) The emergence of a rental market for land does not necessarily lead to an increase in land fragmentation. When there are no major bottlenecks in markets for risk insurance, food commodities or agricultural labor, farmers are likely to prefer an increase in the scale of their plots by hiring land neighboring their own land parcels. The current problem is that a well functioned land market in rural area of China has not been established. The land market in current is still weak and in a low level. It can not support land contract right transfer which can reduce land fragment

because of the lock of land transfer information, land transfer transaction place, intermediary agent, examine and monitor from government. Most of land contract right transfers occurred in the range of village level, the duration of transfer is short and the procedure is substandard which is not reiterated in cadastral department.

3.8 Conclusion remarks

Through the discussion above, we can come to the following concluding remarks. The causes of land fragmentation and the elements affect land fragmentation in China are various.

(1) In a long history, the agriculture tradition in China is based on household. The whole family is seemed as a production unit. It organizes the use of labor, capital, and land in a household, coordinates the conflicts efficiently and flexibly. So, farmers are adapt to work on the small parcels which owned by their household. The forced combination in the second land reform which in order to establish a new form of production unit and reduce the nature land fragmentation has been proved to be failed and unsuccessful.

The other internal factor is the large population and the huge number of farmers in China. Though the off-farm income is increasing in recent years, most of farmers' income still comes from agriculture production. The combination of fragmented land and agriculture modernization will make lots of farmers lose their job from land, and the industry in China can not provide enough jobs to these unskilled people. So, it can be a problem which cumbers the reducing of land fragmentation.

Moreover, since land is quite important to the farmers, it's important to get the use right to the land equally in their mind. Traditionally egalitarian conceptions have a major influence on land allocation and thus on fragmentation. Because land was considered both a production factor and a social welfare security, land became the common property of the collective after 1958, with each villager having equal rights. In other words, land was shared equally in the farmers' understanding (Zhang, 2001).

(2)The disadvantage of land tenure system in rural area of China is one cause of land use fragmentation, because of the different purpose of land use. Different land tenures have different permissions of land use right and the different duration according to the contact. Meanwhile, it will be a big barrier of reducing land fragmentation. It is hard to combine land with different land tenures into a big one, and makes the land use right difficult to circulate on the land market.

(3)The negative aspect of HRS is land fragmentation. HRS maintained egalitarianism but was less successful in economic efficiency in a long term. The negative aspects of HRS will inevitably become more and more of a constraint on the further development of China's agriculture.

(4) Land market can help to reduce land fragmentation. A well developed Land market relies on the efficient land administration system, the security of land tenure and the support of land law and policy. All of these are still needed to be improved in rural area of China especially.

(5) Moreover, because some important Land law and policy related to land tenure security, such as the HRS and the 30-year contract policy, it can affect the land contract right transfer which can reduce land fragmentation greatly. The clear definition and protection of proper right to the farmers should be one of factors of land rights transfer.

The following figure shows detail causes and factors affecting land fragmentation in China, the relationship between them and how they affect the problem of land fragmentation in China

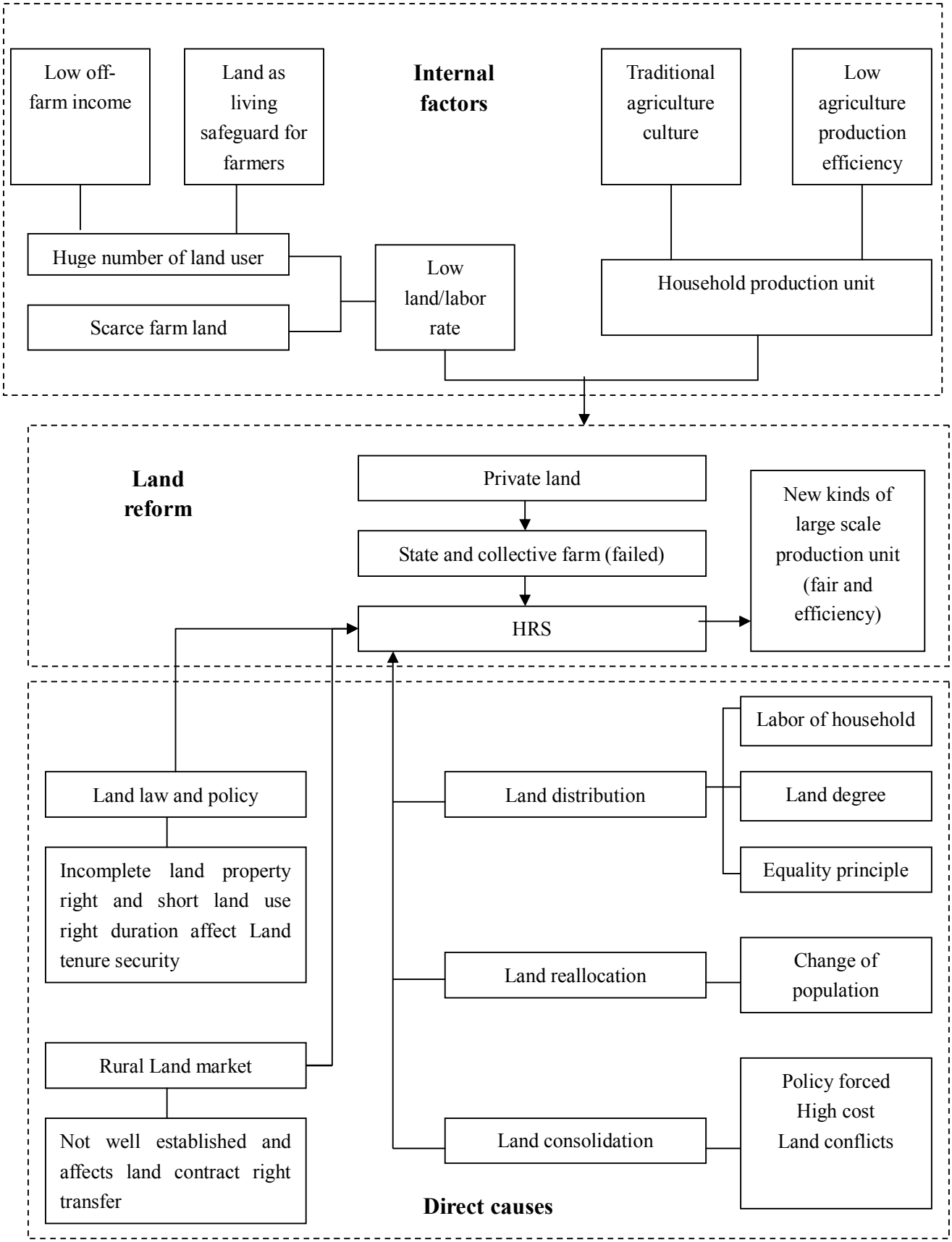


Figure 3- 2 Causes and factors affecting land fragmentation in China

4 Fieldwork of land fragmentation in Zhejiang province

4.1 Introduction

In the previous chapters, the theoretical research concept about land fragmentation and causes and facts affecting land fragmentation in China have been introduced and discussed. In order to have detail understanding about the problem of land fragmentation, it needs to get the first hand information about the situation in China. In this chapter, for a comprehensive evaluation on the effects of land fragmentation in China, a city called Taizhou City which located in the southeast of China has been chosen for this research study.

The main purpose of this chapter is to describe three main parts: primary data collection and fieldwork interview, methodology for analysis of primary data including processing secondary data and images that are collected. Through methodology of statistical and quantitative analysis, the current situation and facts related to the research are analyzed and discussed.

4.2 Fieldwork interview and data collection

4.2.1 Introduction of research area

There are 3 districts in the administrative division of Taizhou City, they are Jiaojiang, Luqiao and Huangyan. The Hongjia town is located in the south of Jiaojiang district. The town contains 37 villages and 1community. The total population is 730 thousand, and there are 480 thousand local people. The total financial income was 349 hundred million Yuan in 2008. there are 17.6 thousand mu farmland for agriculture production and 91 companies for industry.

Figure 4- 1 The location of Hongjia town

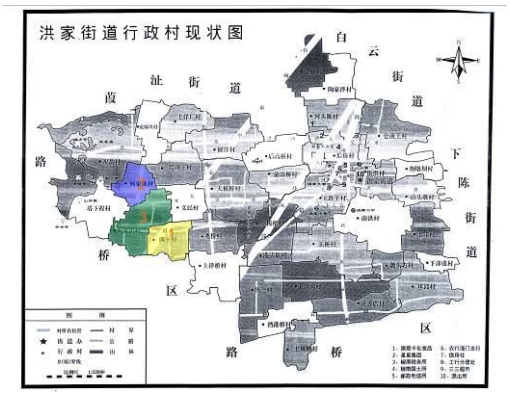


Figure 4- 2 The location of research villages

Three villages in the Hongjia town were chose for the field work interview.
Village 1: Xi wang (in yellow)
Village 2: Yang jialong (in blue)
Village 3: Zhu jiadian (in green)

The rapid development of economy in Taizhou City causes the great need of labor in off-farm industry. Lots of town enterprises have been established and lots of farmers change their income resources from agriculture production to off-farm industry in the village or city. The ambition of continue to invest and work on the farm land which is distributed by HRS is decreasing. Meanwhile, the problem of land fragmentation and increasing cost of farming make the income of farming less than before. With the transfer of labor from agriculture production to other industries, land abundant has occurred in some place, though it is not allowed by law according to the land administration law 1998. So farmers want to transfer and circulate their land contract right to other agriculture production unit to solve this problem in order to make use of the farmland. The transfer of land contract right supplies an effective way to realize land use consolidation which can reduce land fragmentation. Meanwhile new kinds of large scale agriculture production unit which fit to the large scale production are established like: professional agriculture household, land contract right stock co-operation production organization, and commercial agriculture production company.

4.2.2 Purpose of Fieldwork

The main purpose of fieldwork is to collect useful data which relates to the land fragmentation in China, in order to support and prove the theorist analysis. Through primary and secondary data including the interviews' results during the fieldwork the current situation of land fragmentation, the causes of land fragmentation and the facts affect the reducing of land fragmentation, such as land use contract right transfer are provided.

4.2.3 Fieldwork task and methodology

Fieldwork methods: These include collection of primary and secondary data. Primary data collection includes on-spot inspection and semi-structured interviews using questionnaires.

Task1: Fieldwork preparation
This task includes prepare and design of various questionnaires forms for interviewing various stakeholders. Appointments to the stakeholders were made prior to fieldwork execution.

Task2: Fieldwork interview and data collection
This task consists of interview to stakeholders and collecting data from related departments.

Task3: Data organizing and analysis
This task organizes all the data and results of last task, and tries to find some useful information from it.

4.2.4 Fieldwork implementation

Design questionnaires
There are mainly three kinds of stockholders planned to interview: The city and town land cadastral department, the village leader and farmers. All questions are designed with semi-structure questions on the basis of the theories and policies considering land use rights. The questionnaires are flexible and focus on the facts which are interested in the research. The questionnaires were formulated for different groups, and were set to be the Close-ended style Questions and Open-ended style Questions to gain the information. The interview is intended for a one-hour. The format also contains open type of questions to get respondents' views.

Fieldwork interview and data collection
There are several government departments have been visited, including Taizhou Statistic Bureau, Taizhou Land and Resources Bureau, HongJia town government office. The interview to the village leader and farmers were carried out smoothly with the co-operation of village leader.
Through the fieldwork interview, several spatial and non-spatial data were collected.

(1) Social and economic data
Social and economic data includes GDP, population, income, etc. The sources of these social and economic data were from official statistics report 2000-2008. It shows the development of economy and the change of income resources which affect the agriculture production and land use.

(2) Land related government document
The government documents about land law, land policy on land use, land contract right transfer, land fragmentation were collected from local government, cadastral office, and land bureau. Such as: the issuance of land contracts and certificates, etc. What's more, the literature report about the land reform and improvement of HRS were also collected for future analysis.

(3) Land Use data
The data about change of land use structure in agriculture was collected from year 2000-2008. It shows the share of land used in crop production and other high economic value plains. The large scale production unit can organize large scale land to reach higher production efficiency. The situation of land fragmentation agriculture production can be seen from the map of village.

(4) Land tenure and parcel data

Through the survey of village leaders, the data about number of land parcel, average parcel size, distance between parcels, land distribution, land reallocation, tenure security and contract right transfer was collected.

(5) Interviews

In this research, interview is one of the main tools to understand the motivations, mechanisms, and characteristics of land fragmentation development and agriculture situation. The interview to the village leader and farmers can get the first hand information about land tenure, land use, income resources, and land right transfer in the research area.

The village interviews took about two week. There are totally 150 responses were obtained. After checking and choosing, there are 120 responses for three villages can be used in data analysis. Three village leaders had been interviewed, one in each village. Three authorities in Taizhou cadastral department had been interviewed. The most important date in this research is the social-economic data; agriculture production and land use data; land tenure and land fragmentation situation; land use right and land contract right. The obtaining of this data had followed a scientific and systematic method in both fieldwork and image processing.

Category	**Number of Samples**		
Farmers	Total questionnaires		Useful questionnaires
	Xi wang 1	50	42
	Yang jialong 2	50	40
	Zhu jiadian 3	50	38
	Total	150	120
Village leader	3		
Authority	3		

Table 4- 1 Number of samples in research area

4.2.5 Deficiency of fieldwork

Firstly, some of the reliable datasets can not be collected. For example, the socio-economic data of the village is not quite accurate. Some villages officials may change the GDP value to get a good report on economy development. Some problems like land abundant were not well described, because the village leaders do not want to answer such questions. Secondly, not every villager could be interviewed, as interviewing is time-consuming procedure. Although the questions were designed for approximate one hour duration, it was always time consuming to meet local residents. Thirdly, the quality of data cannot research a high level. The quality of data depends upon the quality of the interviewer. In an interview situation, the quality of the data generated is affected by the experience, skills, and commitment of the interviewer. Meanwhile, the education level of the interviewer is not high; they may not understand the question well.

4.2.6 Methodology for data analysis

The causes and facts affect land fragmentation are various. Seeking to an understanding which land issues are most related to land fragmentation and land use right transfer the data analysis can be done from several aspects. The socio and economic data is collected from statistic department of Taizhou City from 2000 to 2008. Using Excel to make line and bar figures can reflect the change and tendency of economic development and agriculture production. The land use and agriculture production data is collected from local cadastral department and village organization, like topography map and cadastral record which is listed in table. The detail analysis of land parcel number and size change shows the land fragmentation situation and its trend. The data about land tenure and land right are collected by interview of Taizhou cadastral department, local town government, village leaders and farmers. The tables which have related questions are distributed and filled. The answers can be recorded by written. The analysis of land tenure situation shows land tenure types and land tenure security under the land distribution and land reallocation of HRS. It will be quite important and useful to find the disadvantage and weak point of HRS and the possible improvement of this system. The analysis of land right includes acknowledge of land use right of collective land and land contract right.

4.3 Data analysis

4.3.1 Socio, economic analysis (GDP, income，insurance)

There is a close relationship between economic development and agriculture production. The income resources from off-farm change the farmers' situation of living on land and affect the decision of transfer land contract right transfer.

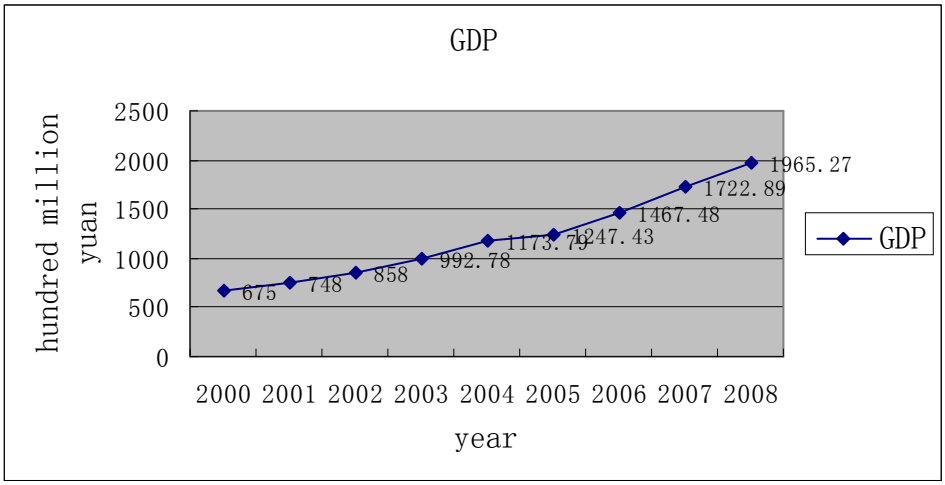


Figure 4- 3 The GDP value in Taizhou city from year 2000 to 2008

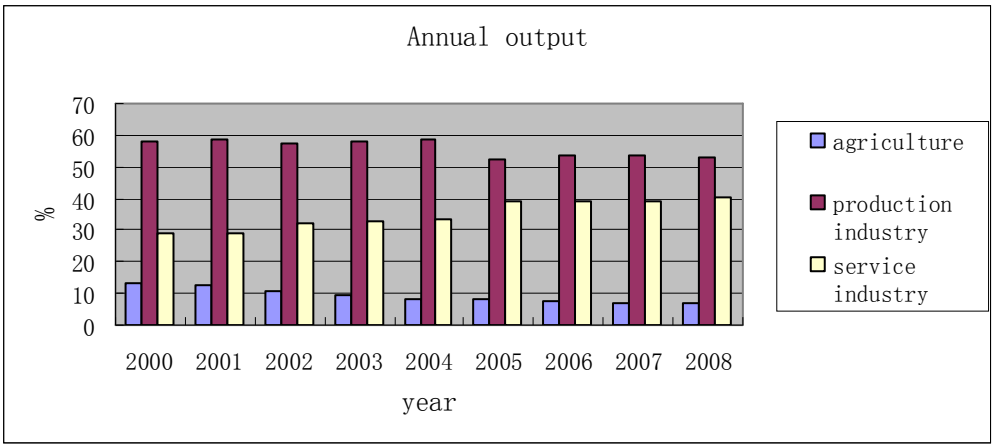


Figure 4- 4 The annual output value in Taizhou city from year 2000 to 2008

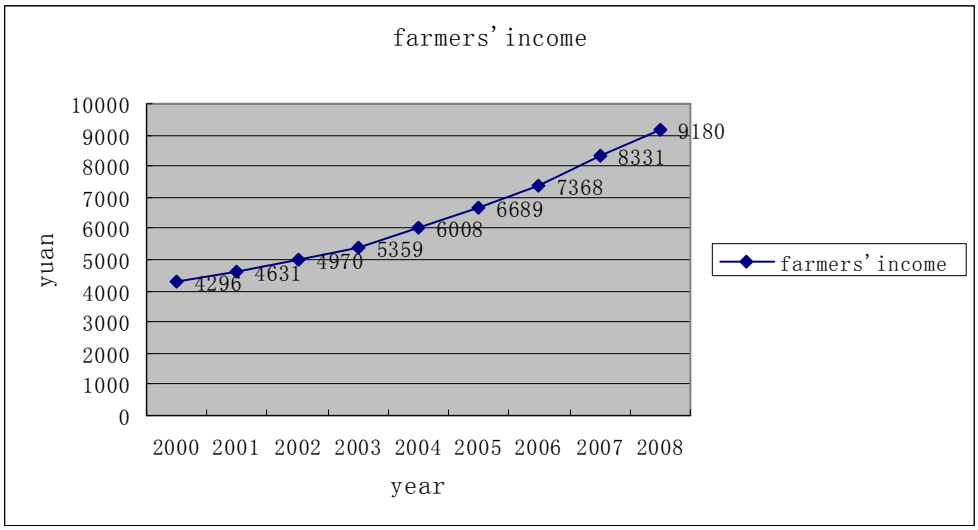


Figure 4- 5 Farmer's income in Taizhou city from year 2000 to 2008

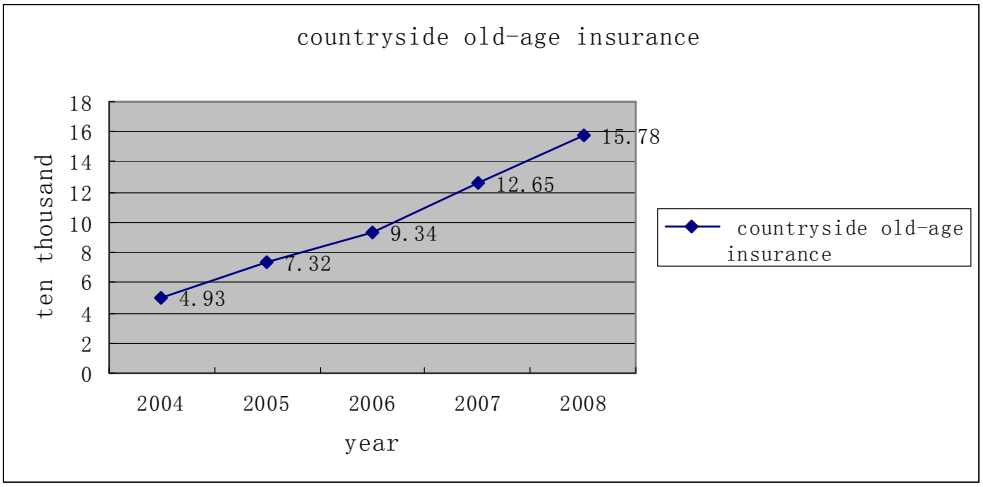


Figure 4- 6 Number of countryside old-age insurance in Taizhou city from year 2004 to 2008

Taizhou City's GDP value grew rapidly from 67.5 billion yuan in 2000 to 196.5 billion yuan in 2008. The average annual increase is 13.1%. GDP value is an important indicator of the level of economic development. To a certain extent, the increase of GDP reflects the development trend of a city. It shows that the proportion of agriculture production is decreasing annually; other industry has become the main resource of economy growth. (See figure 4-3)

The ratio of agriculture output decreased yearly, from 13.2 % in 2000 to 6.8 % in 2008 of the whole economy. Meanwhile, the output of production industry kept on increasing steadily from 2000 to 2004; it occupied about 58% of the whole economy. From year 2005, it reduced to 53% of the whole economy. The output of service industry increased from 29% in 2000 to 40% in 2005, and kept steadily. (See figure 4-4) The resource of income becomes various; farmers do not rely on agriculture production only, other income like private business, working outside of village, distribute bonus from collective and rent house become more attractive. The off-farm income occupies the main part.

The income of farmers increased from 4296 Yuan per-year in 2000 to 9180 Yuan in 2008. The average annual increasing rate is 7.5%, but it is still lower than the increasing rate of GDP value. (See figure 4-5)The total income of farmers is increasing, but still less compared to the urban resident. There is a big gap of income between urban residents and rural farmers, although some rural people work in city.

The number of farmers who joined the countryside old-age insurance grew from 49.3 thousand in 2004 to 157.8 thousand in 2008. But it is still low, compare to the population of farmer in Taizhou City. (See figure 4-6) The insurance in the countryside has been established but still weak, most of farmers can not enjoy the insurance after they are old. So, farmers still want to occupy the farm land, because the land can play important role in social security of life.

Comparing the income situation about three villages, the average income is between 1000-2000 Yuan. In the village which has high income, the village corporations are well established and developed. They not only created the interests directly, but also supply lots of employment. The farmers in this village has a higher willing to transfer the land use right, in order to separate from agriculture production.

Non-agricultural population and the off-farm income reflect the structure of the economy. Generally, the high level of economic development will cause the farmers less rely on agriculture for earn of living, and more labor will change their employment to other industry in order to search higher income. It means that the number of land user is reducing and cause an opportunity to reduce land fragmentation.

4.3.2 Land use and agriculture situation analysis:

The total size of agriculture land in Taizhou City is not changed too much during the last ten years. It increased from 276.82 thousand ha in 2003 to 286.01 thousand ha in 2005. Than it decreased to 280.16 thousand ha in 2007, and recovered to 283.69 in 2008. (See figure 4-7) But the size of crop planted land was decreased from 277.5 thousand ha in 2000 to 144.62 thousand ha sharply, than it grew slowly to 173.87 thousand ha in 2008. (See figure 4-8)

More farm land was used to plant high economy plant and other agriculture use. The portion of crop planted land decreased from 73.5% in 2000 to 52.1% in 2003 sharply, and recovered to 61.3% in 2008. The portion of non-crop planted land increased from 26.5% in 2000 to 48.1% in 2003, and fell to 38.7% in 2008. (See figure 4-9) The value of crop output was decreased from 1161.2 thousand ton in 2001 to 757 thousand ton in 2003, than it grew slowly to 934.7 thousand ton in 2008. (See figure 4-10)

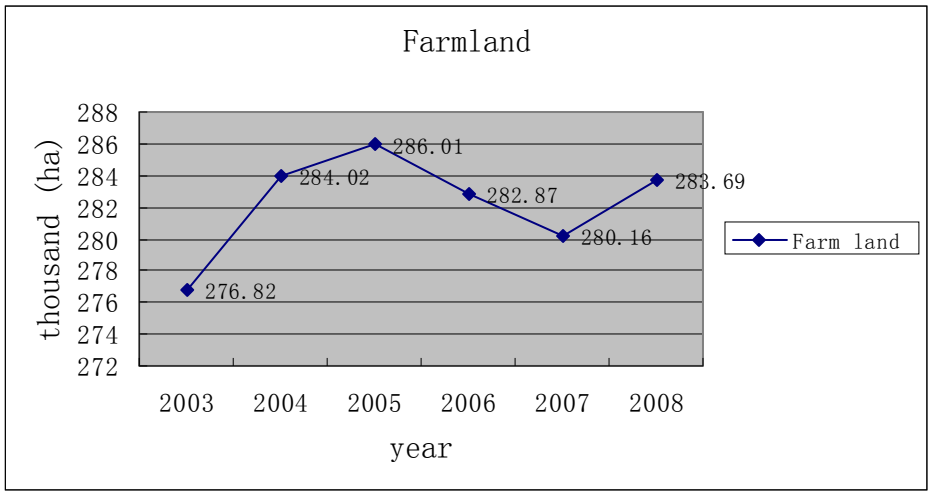


Figure 4- 7 The change of total area of farm land from 2003 to 2008

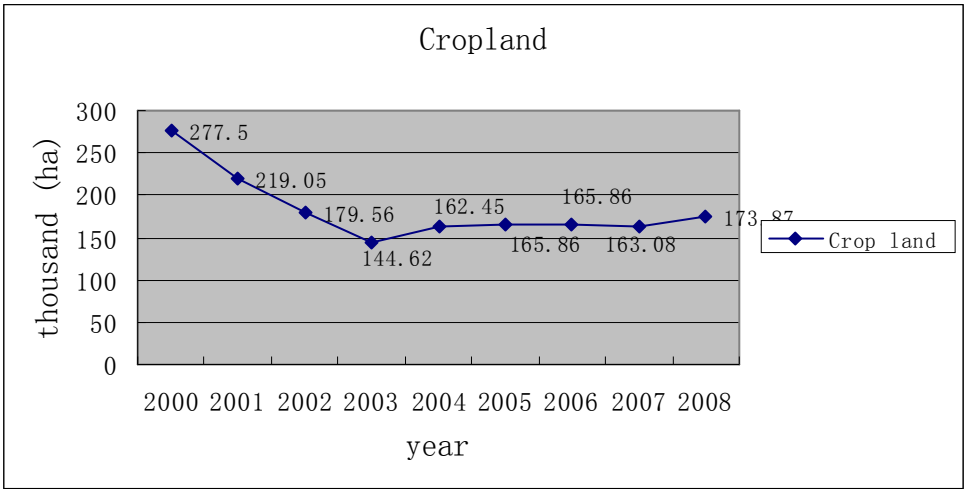


Figure 4- 8 The change of total area of crop land from 2000 to 2008

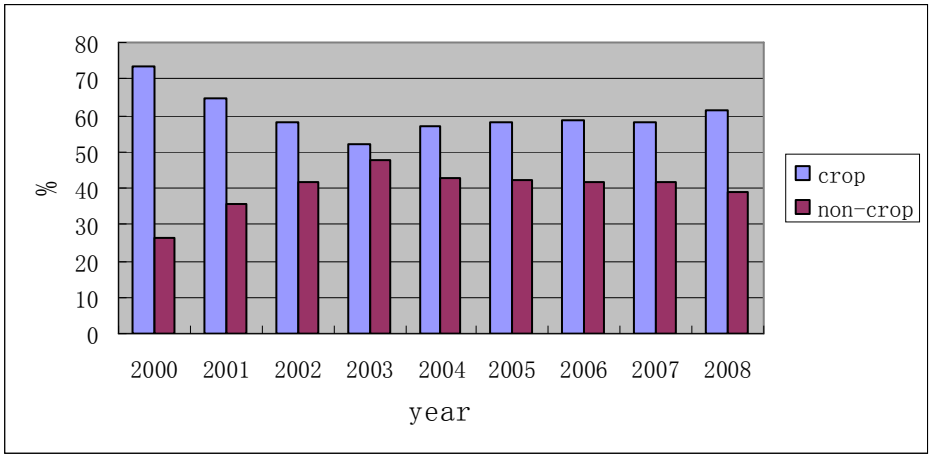


Figure 4- 9 The change of land use situation from 2000 to 2008

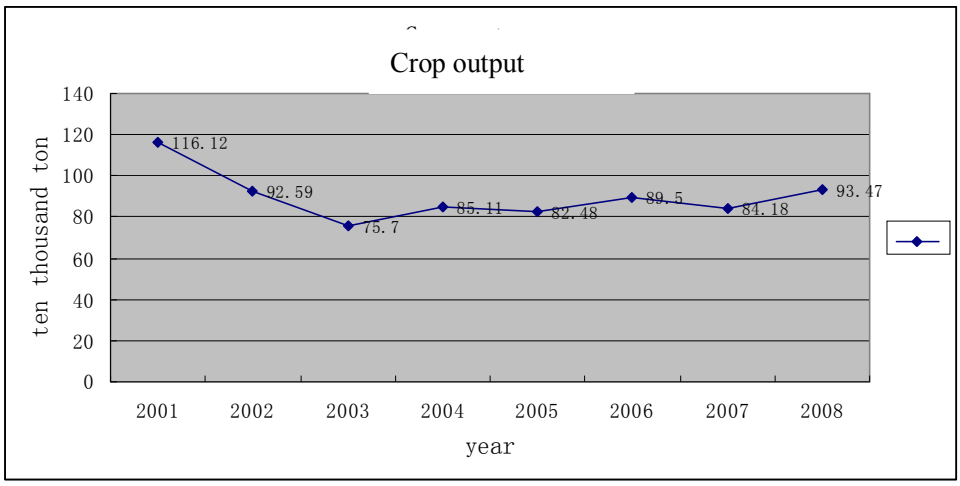


Figure 4- 10 The change of crop outcome from 2001 to 2008

From above, we can find that the total size of total agriculture land in research area is not changed very much. But the agriculture structure has changed a lot. In 2003, the size of farmed land and the size of crop planted land reached the lowest level (276.82 thousand ha and 144.62 thousand ha). Meanwhile, the crop outcome also become low (75.7 ten thousand ton) in 2003, after 2003 it become more steady. The possible reason may be that the great transfer of labor from agriculture production to other industries, large scale land abundant occurred at that time. After that the state government began to implement several political and financial methods like subsidize the agriculture production and speed the land contract right transfer, in order to stimulate the agriculture. Some large scale production units were established at that time which can combine small land parcel together and manage large scale farm land. We can find the total size of crop planted land restored little by little after series of method. What's more, the non-crop planted land for high economy plant and other agriculture use increased shows that the farmer has more right to decide the use of land according to the market need. It also reflects that because the land becomes more fragmented, the cost of crop agriculture becomes higher compare to the price of crop, farmers prefer to plant high economy plant instead of crop.

4.3.3 Land tenure and land fragmentation situation analysis

Land tenure situation

According to the survey data includes image from Google Earth of 2007 and the local cadastral record, the land tenure, land use and land fragmentation situation of three different villages is described as follow.

Village 1 (Xi'wang village):

The Xi'wang village carried the first land distribution in 1978, and the second land reallocation was done in 1988. The land distribution in 1978 was based on the population; the farmland was distributed to the household according to the number of family members. The land was evaluated as 4 degree like: good quality land, less good land, river and pool, Reclaimed or mountain land. Each family got at least 2 parcels, one good quality and the other less good land. Some families got 3-4 parcels, because the size of parcel is small. The average size of land parcel was about 1.5 mu. The private land 70 mu was distributed equality; each village member can get about 0.1 mu, no matter old or child. The duration of first land contract land for responsibility land was 10 years. The farmers had to sold 200 kilo/ mu of crop outcome to the state in a fixed price every year. The river and pool for fishing and reclaimed or mountain land for fruit planting was rent to the farmers who needed spontaneous. The duration was 15 years. Because the duration of contract expired, the land reallocation occurred in 1988. The responsibility land was distributed according to the number of labor, and the private land was not distributed again. After land reallocation, the farm land became more fragmented, each family got at least 4 parcels, and the size was smaller. The contract duration prolong to 30 years.

Table 4- 2 Land tenure and land use situation in Village 1 (Xi'wang village)

	1978	1988
Population	728	774
Household number	200	216

	1978 *(mu)*	*1988 (mu)*
Responsibility land	530	550
Private land	70	70
Total farm land	600	620
House building land	80	90
River and pool	80	60
Reclaimed or mountain land	140	130
Total land	900	900

(1 mu = 667 square meter)

Village 2 (Yang jialong village):

The Yang jialong village's economy is mainly depending on the agriculture production. So the farm land takes a large scale of total land. This village took the first land distribution in 1982, and distributed the land to the household base on the number of labor. Each household can get average 3-4 parcels, some has more labors can get 7-8 parcels. The average size of parcels was between 0.5 -1.5 mu. After the land reallocation the total number of land parcel was more than 500.

Table 4- 3 Land tenure and land fragmentation situation in Village 2 (Yang jialong village)

	1982	1999
Population	584	630
Household number	180	201

	1982 *(mu)*	1999 *(mu)*
Responsibility land	511	507
Private land	20	20
Total farm land	531	527
House building land	50	55
River and pool	20	20
Reclaimed or mountain land	30	29
Total land	631	631

(1 mu = 667 square meter)

Village 3 (Zhu janlong village):

The Zhu janlong village is a larger village than the two villages above. It took the first land distribution in 1982, and distributed the land to the household base on both the number of labor and the population. The average size of the land parcel is between 2-3 mu. After the second land reallocation the land use structure in this village was not changed very much. The farmers in this village have a high off-farm income. There are 9 village cooperations which can support employment to the farmers. What's more, 40% farmers own private business. So they are willing to keep the current land use situation, do not want too much change.

Table 4- 4 Land tenure and land fragmentation situation in Village 3 (Zhu janlong village)

	1982	1999
Population	795	901
Household number	235	260

	1982 *(mu)*	1999 *(mu)*
Responsibility land	980	1000
Private land	56	56
Total farm land	1036	1056
House building land	110	120
River and pool	90	90
Reclaimed or mountain land	104	74
Total land	1340	1340

(1 mu = 667 square meter)

Land fragmentation situation

The land fragmentation situation in the research area is reflected in different aspects like: the number of land parcel, the shape of land parcel, the size of the parcel, the distance between land parcels and the household, the structure of irrigation system.

Figure 4- 11 The image of current land fragmentation situation in Village 3 (source: topography map from local cadastral department)

The image of current land use shows how the problem of land fragmentation affects the land use and agriculture production in the research area. Firstly, from imagine, we can see that the shape of land parcel is various. Most of them are rectangle, long and narrow. In the village area, the shape of land becomes irregular. Secondly, the size of the parcel is small; some of them are decided into two or more small ones, it become more serious near the village area. Agriculture machine can not be used in such small land. Thirdly, the distance of some land parcels are far away from the household. In order to make the traveling distance short, the house of the farmers are scattered. So the whole construction land of the village can not be gathered. It also makes the inefficiency of land use, and barrier the village's future development. Fourthly, the land fragmentation also makes the Irrigation system more complex. From the image we can see the irrigation system which is showed as blue. The original irrigation system which was built in the collective farm period is large and regular, and was convenient for agriculture use. After the land distribution, farmers began to build new irrigation system which is not well planned usually in order to fulfill the new shape of land parcel.

From above, we can find that the cadastral record of three villages and topography map from local cadastral department show that the land distribution and land reallocation under HRS have caused serious problem of land fragmentation and further affect the land use and the agriculture production. The small size and the irregular shape of land parcel make the land difficult to use, and the distance between the parcels makes the construction of house scattered and the complexity of irrigation system. And the government has realized this problem and carried our policy includes finance and insurance to support land contract right transfer and large scale production unit.

Land fragmentation reducing and establish large scale production unit

In order to reduce land fragmentation, state government carried out series policy to stimulate land contract right transfer and establish large scale production unit. In 2004, the governments got free of the agriculture plan or quota of the responsibility land, and remove the agriculture tax. Meanwhile, the financial support to the large production unit stimulated the ambition of land contract right transfer. The credit system in the rural area also supplies agriculture insurance to large scale production unit.

In the research area, there are about 6676 mu farm land have been transferred. All of 37 villages have the land transfer occur. The average rate of household land transfer is about 61.3%. The highest rate of household land transfer in village can reach 86.4%, and the lowest is 18.2%. 43.4% land transfers occur between the farmers in the same village, and 56.6% occur between the farmers in the different villages. According to the investigation, in 2007 the rent price of the large scale and organized land transfer was 463 Yuan/mu; the highest can reach 600 Yuan/mn. This price was much higher than the price of spontaneous land transfer between land farmers which was only 169 Yuan/mu. There are mainly four methods of land contract right transfer in the research include: contract right transfer, lease, land exchange, stock co-operation. 78.9% farmers prefer to use contract

right transfer directly to realize the land transfer.

There are mainly three kinds of large scale production unit: professional agriculture household, land contract right stock co-operation production organization, and commercial agriculture production company. The government gives certain kinds of support to them. For example: Farmers can use their land contract right of parcels as stock to establish stock co-operation production organization. The state government, province government and local government support 35%, 30% and 25% scale of the insurance fee. The farmers who join the new production unit only took 10% of the total fee. Large-scale of land contract right transfer occurred after serious of policy.

4.3.4 Land right analysis

(1) Land ownership

a. The definition of collective land ownership

Table 4- 5 The definition of collective land ownership in farmers' mind

Options	No. of respondents out of 120	Percentage (%)
The collective land ownership power is incomplete, is not in the complete significance ownership	80	67
The collective land ownership object limits are unclear, state and collective land ownership limits are unclear, between the collective land ownership also has the unclear scope	83	69
Rights and obligations of collective land ownership is not clear, lack of operation	75	63
Collective land ownership is for multi-level, the main body such as the village group, legal status is unclear is undefined	78	65
Other	6	5

The definition of collective land ownership is not clear. According to the land law, the collective land is owned by the whole collective. But in the practice, the farmers do not have the right to manage the collective land, political power intervene the collective land rights too much, such as local government and village leaders. 65% farmers believe that the concept of collective land is fuzzy and need to be further defined. 67% farmers think collective land ownership power is incomplete, 69% farmers point out collective land ownership object limits are unclear, 63% of them consider collective land ownership's rights and obligations is not clear, lack of operation.

b. The understanding of collective land ownership

Table 4- 6 The understanding of collective land ownership in farmers' mind

Options	No. of respondents out of 120	Percentage (%)
Collective land is owned by state and communities.	36	30
Collective land is owned by leaders of villages	24	20
Collective land is indeed for all the villagers.	60	50

50% farmers believe the ownership of collective is for all the villages. But there are still lots of farmers feel they do not have the right to decide the use of the collective land. 30% farmers think the government has the power to own the land. The other 20% farmers think the collective land is owned by the leaders of village. From above we can find the collective land can not be used under the willing of the land owner: the villages. It makes the farmers doubt the main body of the collective land owner.

c. Reform of land owner right

Table 4- 7 Opinions about rural collective land ownership reform

Options	No. of respondents out of 120	Percentage (%)
According to the existing pattern of possession of agricultural land contracting, delegate land use rights to farmers permanently, farmers become final, complete owners for land property rights.	75	62
Carrying on revises on the existing land laws and policies	22	20
Government establishes land registration for farmers. Fulfill transfer registration formality if the land ownerships exchanges through the transfer and the transaction	33	28
Other	0	0

According to the interview, farmers have different opinions about rural collective land ownership reform. 62% farmers prefer be given to permanent land use right, and secure land tenure.48% farmers hope government do more work on protecting the land rights and interests by improving land law and policy , and establish a good land registration system in rural area..

(2) Land use right.

a. The understanding of land use right

Table 4- 8 The understanding of land use right

Options	No. of respondents out of 120	Percentage (%)
Creditor right	58	49
Property right	62	51
Other	0	0

According to the interview, farmers are not quite sure about the definition of land use right. 51% farmers consider land-use right is a kind of property right. But other 49% farmers choose creditor rights or other; they think they just rent the land from the collective and can only product on the land. The possible reason may that the government policy intervene the use of land too much before. The farmers used to do the agriculture production under the government's plan, and the capability of realize and protect the land right is weak.

c. Land use rights constitute

Table 4- 9 The understanding of Land use rights constitute

Options	No. of respondents out of 120	Percentage (%)
Self-use and management right like: Subcontract, transfer, lease and other	41	34
Exclusive possession right like: Mortgage, inherit	7	6
Priority land use or contract right	66	55
Other	6	5

Farmers have different understanding of collective land use rights constitute. 55% farmers think the land contract right is the priority of land use right. The agriculture production is the main land use. 34% farmers think collective land use rights constitute should include self-use and management right includes subcontract, transfer, lease and other rights. Only 6% farmers think it includes exclusive possession right like mortgage, inherit.

c. Duration of land use right

Table 4- 10 Duration of land use right

Options	No. of respondents out of 120	Percentage (%)
At least 30 years	24	21
70 years	30	25
No deadline but permanent land use right to farmers	66	54
other	0	0

Farmer are willing to have long duration of land use right. According to the interview, 54% farmers prefer permanent land use right to farmers. 25% farmers choose 70 years, other 21% choose at least 30 years. The duration of land use right reflect the security of land tenure play an important role in farmers' decision and ambition of working on the land.

d. The difficulties and method to give farmers long-term and secure land use rights

Table 4- 11 The difficulties to give farmers long-term and secure land use rights

Options	No. of respondents out of 120	Percentage (%)
Adjusting the land during contract period	36	30
Government don not have effective land administration system in rural area.	30	25
Farmers do not have to the ability of using the law to safeguard their own rights and interests	18	15
Farmers do not have legal "two certificates" which can prove they have the right of land use	30	25
Other	6	5

Farmers reflect several difficulties in protecting the security of their land use right. 55% farmers think the weak point of government's land administration work was the main difficulty like: adjusting the land during contract period and ineffective land administration system in rural area. 40% farmers find problems of themselves, such as the ability of using the law and lock of legal certificates.

Table 4- 12 The method to give farmers long-term and secure land use rights

Options	No. of respondents out of 120	Percentage (%)
Through land use right transfer, realize land regulation marketability. Using a standardized land use right transfer market method to replace the administrative adjustment method	60	50
Accelerating the rural non-agricultural industries to expand off-farm employment opportunities and increase off-farm income.	30	25
Reassigning land resources to address the legitimate additional population land	10	8
Before giving the farmers long-term and protected right, we need to adjust land finally. Land allocation must forecast that farmers' future land requirement.	14	12
Other	6	5

About the problem of and efficiency on the land use right occupy, 75% farmers agree land use transfer through land market to get the high efficiency land use, and increase the off-farm income. Other 20% farmers prefer to use land reallocation to protect equality, but

the time should not be too much.

Table 4- 13 The suggestion on rural collective land use rights reform

Options	No. of respondents out of 120	Percentage (%)
Strengthen rural land collective ownership, weaken land-use rights	18	15
Strengthen land-use rights weaken rural land collective ownership	90	75
Give private land ownership to farmers	6	5
Other	6	5

About the suggestion on rural collective land use rights reform, most farmers about 75% prefer to strengthen land-use rights weaken rural land collective ownership. 5% farmers even suggested giving the private land ownership to farmers. Other 15% chose strengthen rural land collective ownership, weaken land-use rights.

(4) Land contract right transfer

a. The main causes of land contract right transfer

Table 4- 14 The main causes of land contract right transfer

Options	No. of respondents out of 120	Percentage (%)
The higher off-farm income	66	55
The employment in the city, and lack of labor in agriculture	54	45
The land parcels are fragment and difficult to use	72	60
The higher agriculture production efficiency in large production unit	48	40
Other	8	7

The causes about land transfer are various. 60% farmers think the land parcels are fragment and difficult to use, and 40% think the efficiency in large production unit is higher than the household. About 55% and 45% farmers think the higher off-farm income and the employment in the city were the main causes.

b. The weak point of current land right transfer system, which blocks the land transfer

Table 4- 15 The weak point of current land right transfer system

Options	No. of respondents out of 120	Percentage (%)
The lack of clear land property rights	36	30
Land resource are scarce, the growth of rural land market development is slow	54	45
The lack of a reasonable evaluation system of land transfer prices	43	36

The lack of intermediary organizations in land transactions	70	58
The lack of the effective management and supervision for collective construction land transfer in government	54	45
Other	7	6

There are several weak points of current land right transfer system, which blocks the land transfer. 30% thought the unclear definition of property right in the land law made the farmers' right hard to be protected. The undeveloped land market, lack of a reasonable evaluation system and lack of intermediary organizations in land transactions took about 45%, 36% and 58% separately. The other 45% thought government should play an important in the land transfer process.

c. Main issues about land transfer

Table 4- 16 The main issues about land transfer

Options	No. of respondents out of 120	Percentage (%)
Irregular distribution of income, farmers are not effective in protecting the rights and interests	54	45
Government and village's administrative intervention is big	48	40
The size of land transfer is small, and the duration is short.		68
The information of land transfer is lock, usually occur in the same village	72	60
The transfer dispute is frequent	82	58
Other	6	5

45% and 40% farmers think they can not protect their right during the land transfer. The government and village's administrative intervention is big. 68% and 60% farmers think there were some problems of land transfer itself like: the small size of transfer land, the short duration and the lock of transfer information.

d. Solutions to solve land contract disputes

Table 4- 17 Solutions to solve land contract transfer disputes

Options	No. of respondents out of 120	Percentage (%)
Co-ordination between the litigant	90	75
Intermediary organizations mediation	42	35
Village committee or civil administration government office mediation	94	78
Asking rural land contracting arbitration facilities for adjudication	82	68
People's court prosecution	18	15

75 % farmers want to solve the land contraction dispute themselves. 78% and 68% think government and rural land contracting arbitration facilities should supply necessary support. 35% farmers think it needs the help from intermediary organizations mediation

According to the data and analysis of fieldwork, land contract land transfer is an effective way to solve land fragmentation, but still has problems:
(1) The problem of land fragmentation makes the contract land difficult to transfer. The land fragmentation makes the small and irregular size land hard to combine into a large scale land. So, the attraction of contract land transfer is decreased

(2) On one hand, agricultural enterprise and agricultural specialized household are willing to expand the production land, but on the other hand, the farmers who do not have enough off-farm income and social insurance for living are afraid to loose the land use right. Meanwhile, they thought the price of land transfer is too low and it's not wealthy to do it.

(3) The procedure of land transfer is not standard. Most land transfers are between the villagers spontaneously, only a few transfers are organized. Meanwhile, most of transfers are only agreed orally, and do not have official certification. It makes the responsibility and right unclear and easy to cause land dispute and conflict.

(4) The duration of land right transfer is too short, Most of the duration of land transfers are only 1 year, the longer one could be 3-5 years, and only few of them could be more than 10 years

(5)There is lock of the information of land right transfer, most of land transfers are between the neighbors in the same village. The leader of village interfere the process of transfer for interest.

(6) The policy system waits for consummating. The land stock production cooperation lacks the related legal safeguard. The causes of this problems can be distinguished by political and economic, socio-cultural, demographic, legal/ judicature and economically efficient land markets reasons.

4.4 The current situation and problems of LIS in China

In 1984, most place of China carried out the survey of land use situation. Meanwhile, hundreds of cities and town had finished the urban area cadastral survey. The area was about 15000 square kilometer. In 1986, after the establishment of natural land resource bureau, the state government began to introduce LIS to the land administration wok in China. The project of natural cadastral information survey work was called "golden land". Many big cities like: Shang hai, Shen zhen， Guang zhou, Ning bo had inputted the urban cadastral survey data into LIS and the functions were used in many different aspects.

At present China's cadastral system had formed two sets of relatively independent cadastral management models according to the investigation regulations: Urban cadastral management model and rural land utilization present situation investigation management model (i.e. rural cadastral management model). Many cities have established the urban cadastral information system and rural land utilization management information system.

Urban cadastral data includes urban cadastral survey data, land registration data, land degree data, and land use data. Urban area cadastral survey is used to examine the right of land parcel, and the detail data of parcel like: location, size, shape and number. Rural land utilization situation data includes land use situation survey data, land registration data, land degree data. Land utilization situation data is used to reflect the current land utilization situation, analyze the character of land cover and better method of land use. The data and function which these two systems provide had been used in municipal purpose, like: rural land administration, and urban construction.

Although, LIS has been introduces and establish in China and begins to play a useful role in the cadastral management, it still has several problems which need to be improved.
(1) The cadastral data in the rural area is not completed
(2) The integration of spatial and non-spatial data
(3) The integration of multi-scale, multi-platform and multi-data format cadastral data.
(4) Two separated LIS databases: urban cadastral database and rural land utilization situation database
(5) Two separated land Classification uses in two separated LIS databases
This two separated cadastral systems and databases did not consider the national land as a whole one, and causes problems like: (a) The data of two databases can not be exchanged because of the different code of land class and the data format; (b) Lots of data redundancy because of the same object was considered as two land classes in two systems; (c) Hard to update the survey data in time; (d) Conflict in distinguish the land class with the development of urban area, because the boundary between urban and rural area is fuzzy and change time to time.

4.5 Concluding Remarks

Firstly, according to the survey data, the rapid development of economy has great impact on the land use and agriculture production. The outcome of agriculture production occupies less participation in the total outcome. The development of second and third industry supplies employment and off-farm income which is higher than agriculture income. Meanwhile, the social welfare like countryside old-age insurance has established in the rural area of China. All of these facts make the farmers less rely on the land to earn a living. It means that the number of land user is reducing compare to the number of parcels. The driving force of reducing the land fragmentation is established. The spontaneous of land contract right transfer occurs widely in the rural area of China.

Secondly, the land use change data shows that the total agriculture land in research area

is not changed very much during the last ten years. But the area of crop planted land was decreased and the outcome of crop was decreased as well. Meanwhile, more agriculture land was used for non-crop planted, which has a higher economic income than crop planted.

Thirdly, the land tenure types in the research area include: responsibility land (zeren tian), grain ration land (kouliang tian), contract land (chengbao tian), private plots (ziliu di)， reclaimed land (kaihuang di). The number of land parcel per-household increased during the first land distribution and second land reallocation. The average size of per-parcel was decreased from 2-3 (mu) to 1.5-2 (mu). The parcels are not located at the same place, the distance between the household and the parcels is far. All of these make the farm land more difficult to use, and the cost of farming includes time money and labor is increased. So the attraction of agriculture is going down, especially compare to other industry.

In order to stimulate the agriculture, the state government began to implement several political and financial methods. For instance, on financial support, the government has begun to subsidize the agriculture production. Meanwhile the land policy related to the land contract right transfer and agriculture co-operation has been carried out in order to establish large production unit which can combine small land parcel together and manage large scale farm land.

Fourthly，In the part of land right analysis, land ownership, land use right, land contract right in rural area and land right transfer have been discussed. According to the survey data, we can find that realize of land right is getting more and more completely in the rural area. Farmers pay much attention to the security of land tenure. Though they are still not clear the notion of collective land, they focus on the duration of land contract right, and the land contract right transfer. In China, The farmer possesses the land use right based on leased contracts. The land law and land policy related to the land right like land contract management law makes the land right transfer more normalize. This will stimulate the development of land tent market which can play important role in the reduction of land fragmentation and establishing large-scale land use method.

What's more, LIS has been introduced and established in China, but it still has problems which need to be improved, in order to support land contract right transfer and management of fragmented land parcels. The innovation of LIS is discussed in the following chapter.

5 Innovation patterns on land fragmentation

5.1 Introduction

Since the 1990s，the price of crop was not increased too much and the income from agriculture production became low compare to other industries. Farmers began to find jobs in the town and city; labors began to transfer to other industries. This has a negative effect on the agriculture production. So the method of agriculture production which is based on household needed to be improved in order to increase the efficiency. There is a need to improve HRS in order to establish large scale production unit which can combine the fragment and small size land parcels into large ones and fulfill the management of large scale agriculture production.

5.2 Improving HRS and reducing land fragmentation

Methods of improving HRS and solving problem of land fragmentation contains several aspects like large scale production unit、the policy、the investment and the Land Information System (LIS) for management of fragmented land. On the aspect of policy, the emphasis of HRS improvement is required by carrying out land contract right transfer and land use consolidation. On the aspect of technology, the establishment of LIS is needed for establishing Urban and rural integrated cadastral system.

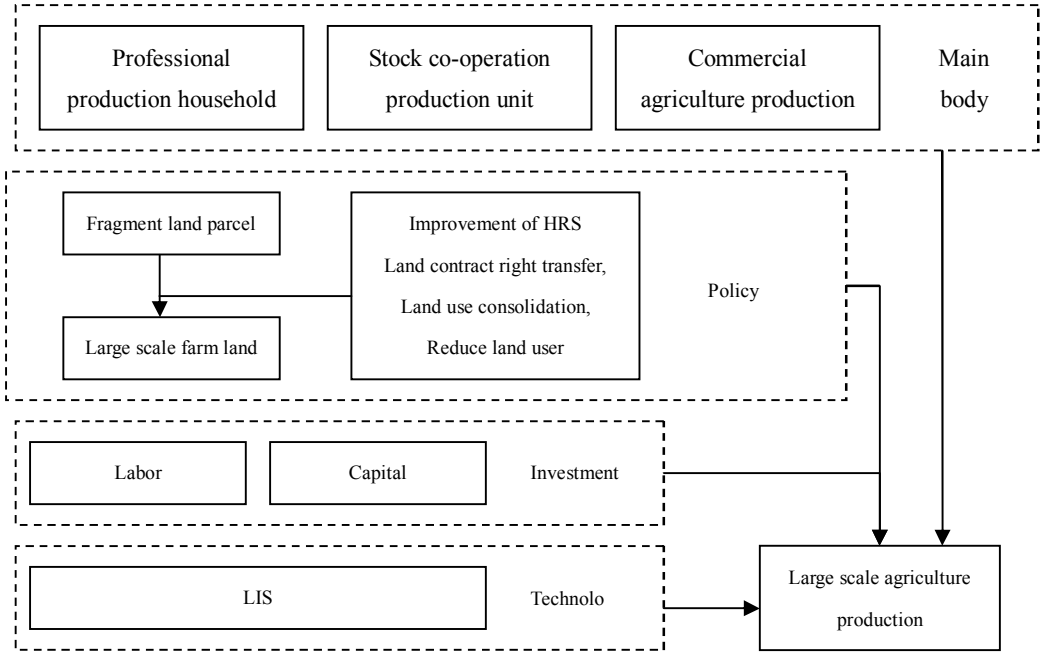


Figure 5- 1 The method of improving HRS and solving problem of land fragmentation

5.3 Land contract right transfer

5.3.1 The definition and forms of land contract right transfer

Land contract right transfer means the people who hold land contract right of land parcel transfer it to other people for agriculture purpose in order to realize land use consolidation. There are several kinds of land contract right transfer: Land exchange、Land transfer、Land rent、Land stock co-operation、and Land mortgage.

(1) Land subcontract

Land subcontract is that in the term of land contract, the contractor transfer partial or complete land contract right to the third party for agriculture production. Under this kind of land circulation form, the main body of land contract right has not changed, the relation about right and responsibility between the original contractor and Contract award side are invariable. The original contractor and the contract award side's relations cannot relieve. The duration of subcontract can be flexible according to present's economy, technical and social conditions, but can not surpass the deadline of land contract.

(2) Land exchange

Land exchange is that in the term of land contract, the contractors exchange the use right of contract land parcel for their own need. After the land exchange, the original rights and obligations of land contract is still undertook by the original contractor, some are shift after the land exchange. It has great effect on reducing land fragmentation, and it realizes the combination of small land parcels into large one. It is also a kind of complete land transfer behavior.

(3) Land transfer

Land transfer is that in the term of land contract, the contractor transfers the part or the complete of land contract right to the other people. Once the transfer behavior completes, the original contractor's land contracting right loses naturally, the relationship about the rights and obligations of land parcel between the original contractor and the contract award side also ends.

(4) Land rent

Land rent is that in the term of project contract, the contractor rent part or complete land contract right to the other agriculture producer, and gathers the rent. The relationship between the land contractor and contract award side is land contract right relations. But the relationship between land contractor and renter is belongs to the creditor's rights relations.

(5) Land stock co-operation

Land stock co-operation is that in the term of land contract, the contractor change the land contract right into stock right, than join the agriculture production co-operative. The

co-operative can transfer or rent the land contract right to the other farmers or agriculture Production Company, or invest on the land and do the production itself and get the interests according to the stock they hold.

(6) Land mortgage

Land mortgage is that in the term of land contract, the contractor mortgages the land contract right to get the loan. Land contract right becomes the guarantee of mortgages. If the mortgager can not fulfill the debt according to the agreement, the land contract right will turns over to the financial organ. The financial organ can transfer or rent the land contract right to the other farmers.

5.3.2 Innovations to improve land contract right transfer

(1) Complete land contract right

Once farmers got the land parcel though land distribution and land reallocation, they should get the complete land contract right which includes the occupy、use、profit and part of disposition right. And the complete land contract right can do the transfer、subcontract、stock co-operation、mortgage and inheritance legality. For example: farmers can mortgage the land to financial organ in order to get the loan which can be invested on the development of production.

The government should guarantee the land contract right which farmers got and issue the land registration certification of land parcels. According to “land management law” and policy from state government, the contract right of land parcel can be transferred with the agreement of land owner and land user follow certain standard transaction procedure, but the ownership and utilization of collective land can not be changed. If the main body of contract land does not follow the land utilization plan, changes the utilization of collective land or abundant the farm land. The village collective can terminate the land contract.

(2) Improve the cadastral management system

A well established cadastral management system is quite important to guarantee the program of land contract right transfer. After the establishment of land resource department and three degree land management bureau in the whole country, China has a complete cadastral management system. But the cadastral work in the rural area is still weak and does not have well function to support the large scale land contract right transfer work. The cadastral system in the rural area needs quite a lot of improvement. The improvement of cadastral management work contains several aspects.

(a) The complete cadastral survey in the rural area of China

Use suitable survey technology to carry out comprehensive survey in the rural area, like: the number of land parcel, land quantity, shape, area, size and land use situation, in order to build a complete cadastral database in rural area of China.

(b) Land utilization situation survey

(c) Land price evaluation

(d) Land registration in the rural area of China

According to the result of cadastral and land utilization survey, the peasant household can apply land contract right certification from the cadastral department. The certification should be issued when the farmers got the land contract right of parcel. Land holders can carry on the land transfer, land rent, land mortgage on the land transfer market and their right can be guaranteed by law.

(e) Improve current LIS in China and establish urban and rural integrated cadastral system to support land contract right transfer. This will be discussed in the follow paragraph.

(3) Monitor and management of land contract right transfer

Once both parties involved have reach the agreement of land contract right transfer, they should sign the land transfer contract. In the contract, it should define the right、responsibility、duty of both sides and the way of paying the transaction cost and tax. After the contract had been sighed, the contract of land contract right transfer can go though the verification formalities at the rural cadastral management department. The result of verification should be delivered to the same level rural land contract management institution to make a record. If it needs the notarization, the contract should be delivered to Notary organ to go through the notarization formalities. After the contract becomes effective, both sides must fulfill the agreement and solve the conflicts in the process with the mediation from rural cadastral management department. The rural cadastral management department must discoverer the problems in the process of land contract right transfer in time, do the mediation and solve the conflict following the land management law and policy. The management procedure should be fair and transparent to the public.

(4) Speed land contract right transfer and land use consolidation

The peasant households entrust the village collective economy organization to help transfer land contract right. The village collective economy organization should accept the request, protects the land contract right of farmers and signs the agreement about the deadline of transfer, the tax and cost of land transfer. The interests of land contract right transfer belong to the peasant household, the village collective economy organization can get few intermediary service fees according to the government policy. In the duration of land transfer, the village collective economy organization can invest on the infrastructure of farmland and get the interest of investment. This kind of income should be used in the collective economy organization's public utility and the development of agriculture production. The members of this collective economy organizes have the first contract right to get the contract land which was entrusted to the village.

Through land use consolidation, the scale and size of farmland can be increased, and can also improve the land utilization structure, the agricultural production condition and the ecological environment. Land use consolidation makes the possibility of large scale agriculture production; attracts more commercial companies to invest on the land. In order to realize the land use consolidation, the village collective economy organization can apply the financial support from the local government, encourage the enterprise, individual

and so on social fund participate in land use consolidation. Meanwhile, it can also organize the procedure of land use consolidation in the range of own villages, solve the conflict between the farmers. The village collective economy organization can organize and coordinate farmers to consolidate the fragmented land into large scale farm in their own village. It is helpful to realize the large scale land contract right transfer and decrease the transaction cost effectively. In concrete operations, take the land stock cooperation for example, the village collective first carry out the evaluation of land ,than set the number of stock to each farmer according to the land price. Than fragmented land parcels are consider as one part of share to co-operate with the professional agriculture production which supply the capital and professional management as share. In order to solve the problem of land fragmentation and realize the professional large scale production, the land contract right transfer and land use consolidation are not enough. It needs the investment on the agriculture production; the village collective can stand for the whole village to co-operation with some commercial companies and investors.

(6) The improvement of land market

Establish land price evaluation system of land market

Land price means the land contract right transfer price. Only there is a land price evaluation system which can make a reasonable transfer price, the peasant household legal income and interest can be protected, and the land contract right co-operation and land mortgage can be carried out in a standard way. The experience of land price evaluation in the urban area can be used in the rural area. But the relative high price and the lock of land price evaluation institutions make the method used in the urban area is not quite suitable to the rural area. The better and suitable way to solve this problem is that taking the collective economy organization as a unit to establish the land price evaluation institutions, in order to carry out the work of land degree division and land price evaluation. Here are the detail steps:

(a) Divide the land degree according to the land productive forces like: soil fertility, soil texture, topography landform, smoothness, irrigation condition

(b) Evaluate the land contract right price based on the crop output value. The result of land contract right price evaluation should report to the local land management department, and recorded in the certification of land contract right of this land parcel. This kind of evaluation should be carried out 3-5 years one time in order to keep it update.

Establish and improve the intermediary organization

Land contract right transfer is quite a complex transaction process; it may involve several main bodies and their interests. Such kind of professional work needs the help of Intermediary organization. Because the peasant household spontaneous land transfer has several flaws, and in the present, there are no enough land transfer intermediary organizations. In current, Most of land contract right transfer between farmers are introduced and organized by the collective economic group or the village leaders. They play a role as intermediaries in the transaction. They can help to realize the land transfer in a relative low transaction cost. Because village collectives are not professional and

independent intermediary organizations, it may cause problems. The disadvantage is that the collective economic group or the village leaders can not protect the farmers' own interests and do the decision on the aspect of the whole collective. This will cause unfair to the farmers during the land contract right transfer. In order to solve this problem, it requests to establish corresponding service systems like: Intermediary organization, real estate market information, consultation, and evaluation institutions. These service systems should be independent during the transaction of land contract right transfer. The peasant household may entrust the intermediary organization to carry on the land transfer and circulation and must sign the agreement which should be reiterated in village collective economy organization. The government must strengthen the land circulation intermediary organization's qualifications examination, limit the land circulation Intermediary organization's management scope strictly. The transmission service expense must conform to the government's requirements.

(7) Increase off-farm income and job opportunity

Increase off-farm income and job opportunity in other industry can help to make farmers less rely on the agriculture production and speeds up the agricultural surplus-labor shift. In this way, the number of land user will decrease as well as the number of fragmented land parcels. More farmers who can enough off-farm income are willing to transfer the contract land to the large scale production unit and make them free from farming. In order to transfer the agriculture labor to the other industry, the government can help farms strength the capability and master the professional technique. Only when farmers are adapter to the employment in the other industry, get steady off-farm income, they may not return to the agriculture production.

(8) Establish and improve the social welfare system and insurance system in the rural area of China

The establishment of social welfare system should depend on the whole social welfare system and the financial support from the state government in order to make the gap between the urban and rural area less. Establish the multi-level insurance funds, develops the countryside insurance business. It includes the insurance of retirement, medical service, disability and agriculture disaster compensation system. All of these can instead agriculture production as the life guard of farmers, make them less rely on the farm land.

5.4 Land information system (LIS)

5.4.1 The improvement of LIS to support reducing land fragmentation

The improvement of LIS in China contains: complete cadastral survey data in the rural area, digitize land registration data, and integrate spatial and non-spatial data and Integrate urban and rural cadastral data in order to establish urban and rural integrated cadastral system and database. The improvement of LIS could be helpful to solve the land fragmentation problem in rural area of China. Because it can support and speed the

process the land contract right transfer, supply the transparent land transfer information in the land market, manage and update the changed land parcel data. All of these functions which LIS owned are quite important in the process of reducing the land fragmentation by improving the land contract right transfer and land use consolidation.

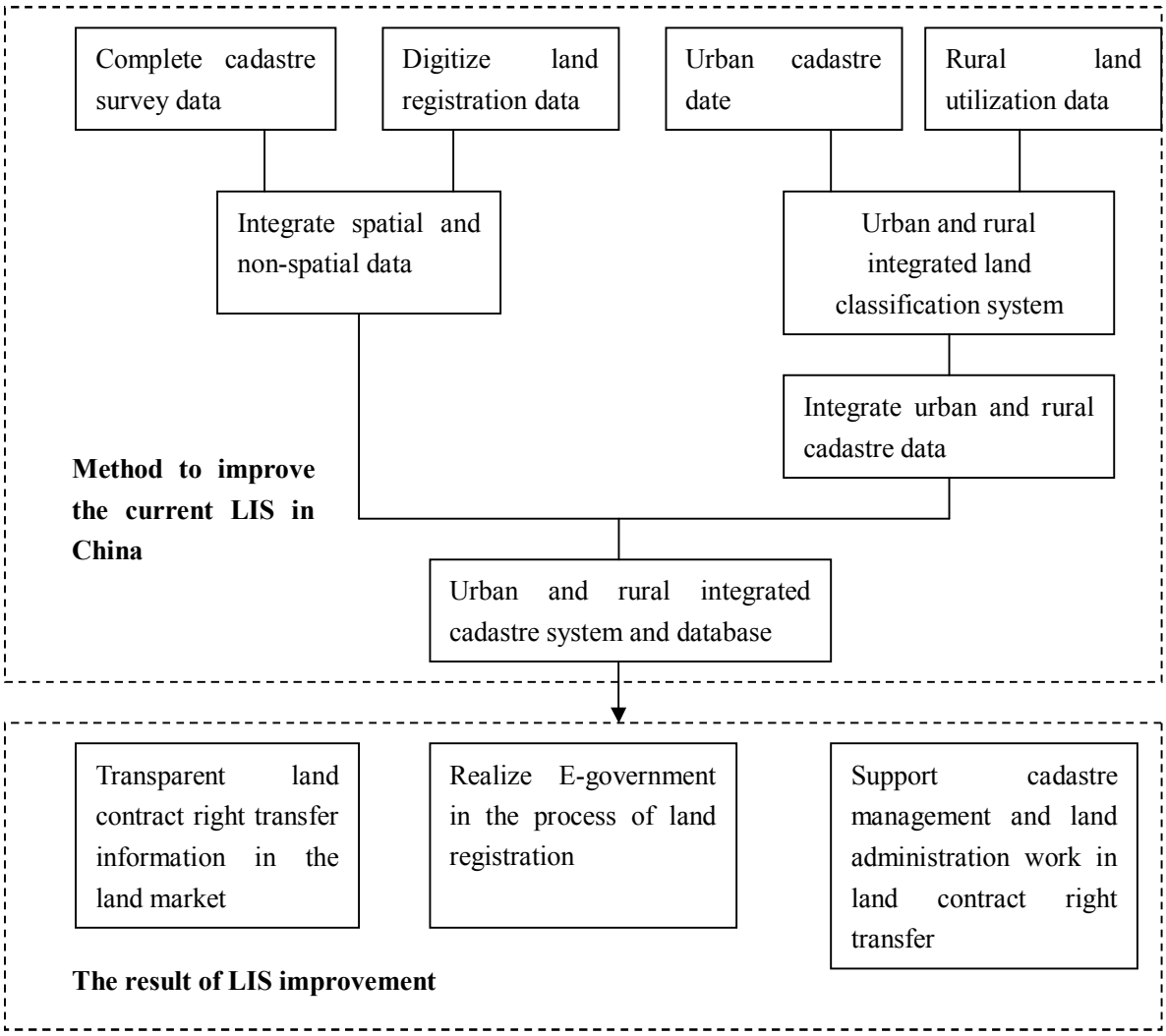


Figure 5- 2 The improvement of LIS in China

5.4.2 Complete cadastral data in rural area and integrate spatial and non-spatial data

Complete the cadastral data in the rural area

Completed cadastral data is the base of LIS for reducing land fragmentation. In most rural area of China, there is no completed cadastral survey data, but only land registration data. In some provinces of China, even the land registration data is not complete and needed to be updated, because of the high cost in the process of land survey and registration. For example: in the fieldwork area, three villages only have cadastral record in paper. In which the land parcel location, size, shape, and the boundary are described in number and word.

So the security and reliability of this kind cadastral data are not qualified for the LIS in future, it only suitable to the current management in the range of local village. So, to establish and support LIS which can play an important role in the process of land contract right transfer, it still needs much more complete cadastral data in the rural area of China. The method includes:

(a) Digitizing the current cadastral data which is recorded in paper both cadastral record and cadastral map like: land survey record、land transaction contract、land parcel sketch、boundary point coordinate record and land right certification

(b) Introduce E-government into the procedure of land registration; realize the “paper less” office automation (OA) in the client service department, and the land registration data can be connected to the cadastral database.

(c) Complete cadastral survey data in the rural area, digitize the current cadastral map、land utilization present situation map、Orthographic projection imagine. Uses GPS, total station instrument, air photograph and satellite imagine to survey the rest area.

Digitize land registration data and realize E-government

In China, land registration was carried out after publish of “land registration rule” in 1989. The land administration department began to use LIS to manage the huge number of land registration data at that time. The following figure shows the procedure of land registration, and what kinds of non-spatial data can be collected and stored in the urban and rural integrated cadastral database

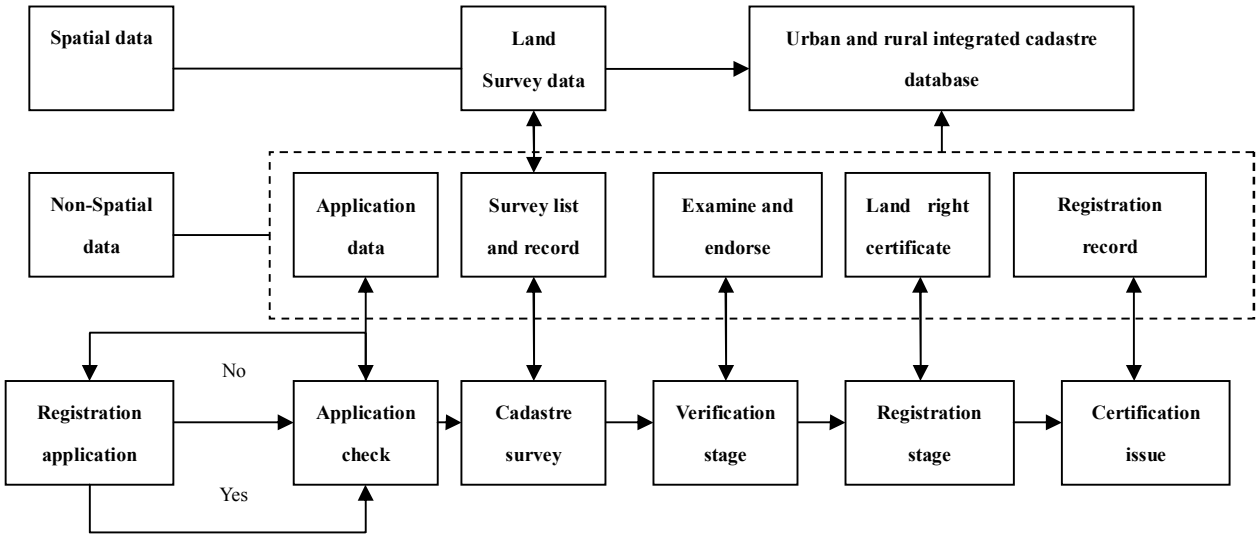


Figure 5- 3 The procedure of land registration in China

The integration of spatial and non-spatial data

In 2001, natural land resources ministry published “The plan of National Land and Resources Administration Management Information System”. This program divides the LIS in China into three parts of function: land survey and assessment information system which includes cadastral survey data, Government management information systems which includes land registration data, information services system which includes land statistic data. Land survey data is the essential data of LIS. It can be used in many

different aspects like digital natural land, digital city, digital region as well as cadastral information system. Land registration data and land statistic data are government management data. It changes time to time, needs to be updated in time. The requirement of data security is higher. Not only the function and requirement of these two kinds of data are different, but also the data formats are different. This kind of LIS is not suitable for the cadastral work in the future, because it artificially reduces the relation between the special data and non-spatial data like: the connection between cadastral survey data and land registration data. What's more, this kind of LIS is weak in the function of GIS. For example, the current land registration function of LIS is using relations database to manage the land registration data. The land registration data is relative independence, using cadastral survey form or cadastral code number to search and query the relational land survey data, and has few connections with the digital cadastral map. So, it is essential to transform the different data formats into urban and rural area integration data format

The method of spatial and non-spatial cadastral data integration

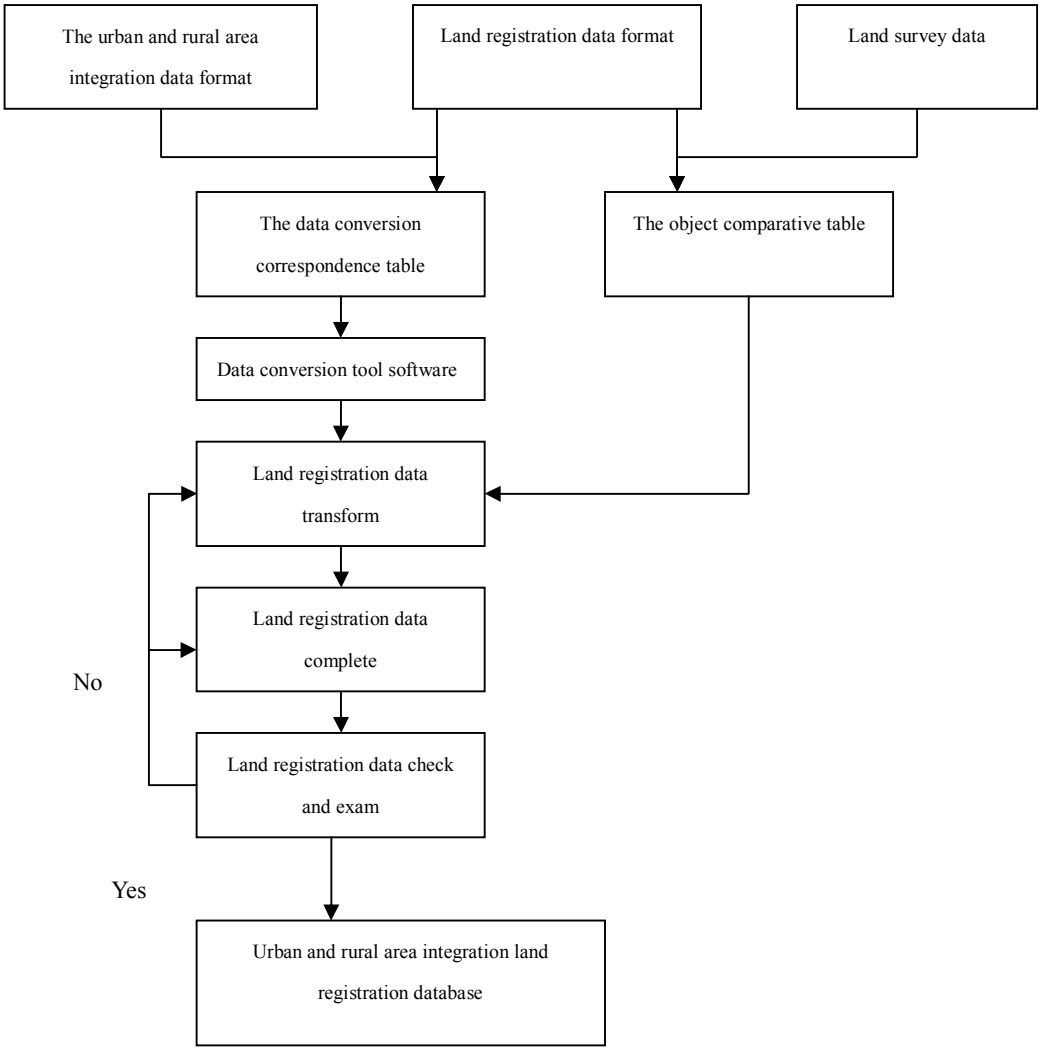


Figure 5- 4 The method of spatial and non-spatial cadastral data integration

The method is that establishing specially data code and software to change the old or other land registration data into the urban and rural area integration data format, which the data can be used and shared in the current GIS software system

(a) Analyzing the existing land registration data, and carries on the contrastive analysis with the urban and rural integrated data format and the land survey data, Establish the data conversion correspondence table and the data comparative table. The data conversion correspondence table mainly reflects the corresponding relationships between the new data format and the old data format. The object comparative table mainly reflects the corresponding relationships between the land registration data and the land survey data.
(b) Compiling the special data conversion tool software, based on the data conversion logic correspondence table. Use the data comparative table to transform the existing or old land registration data into the new data format. Finally, establishing the urban and rural area integration data format land registration database
(c) Using the complete land registration data, like original scanning file and flaw revision to supple and complete the urban and rural area integrated land registration database.
(d) Examine and check the urban and rural area integrated land registration database.

5.4.3 The establishment of new land classification system and cadastral database

Integrated land classification system

The boundary between urban and rural area is changed yearly, but there used to be two separated land classification system in LIS of cadastral department in the past. It affects the management of fragmented land parcels a lot. The database of land utilization situation was based on the “the Classification and Meaning of Land utilization Present situation” which was published in 1984. The database of urban cadastral survey was based on the “the Classification and Meaning of urban land”, which was published in 1989. The problem is that the land utilization situation survey separated the urban area and rural area in to two main different land classes and did the land utilization situation survey and cadastral survey separately.

According to the new “land management law” which was revised in 1998, all of the natural land should be divided into a new integrated land classification system which contains three main classes: the agricultural land, the construction land and the unused land. So, we can find that these two methods of land classification do not conform to the three main classes of land according to the “land management law”. And old land utilization situation data and urban cadastral survey data should be transformed in to new land classes data. The new urban and rural area integrated land classification system is based on the two kinds of land classifications; it can make the smallest cost of revision and make the combination of two systems cadastral data easily and smoothly, fulfill the future land administration and social-economic development. There are 3 first degree land classes:

the agriculture land, the construction land and the non-utilized land; 15 second degree land classes and 68 third degree land classes which are revised from the old land utilization classification. The table of land classification can be seen in appendix.

The method of urban and rural cadastral data integration

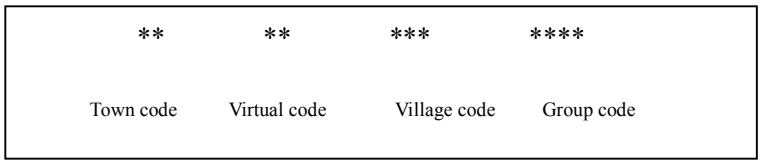
It is essential to combine the two separated cadastral systems and databases and establish an urban and rural area integrated cadastral database. The establishment of urban and rural area integrated cadastral database concludes several aspects likes: (a) The integration of **multi-scale: t**he urban cadastral data usually uses 1:2000 large scale data, most are 1:500 and 1:1000 scale. The scale of land utilization data usually is 1:10000 scale data. (b)The integration of **multi-platform:** the natural cadastral database standard was published in 2001.At the beginning of LIS establishment in China in 90s, there is lock of cadastral database standard. Local cadastral management department used several different kinds of GIS software at that time. For example, in Zhejiang province the Local cadastral management department uses 7 kinds of GIS software to fulfill the different functions in the work like: Arc/Info、MapInfo、GENAMAP、MapGIS. The databases which is uses mainly include Oracle、SQL SERVER. These different GIS software use different data format and database was based on different kinds of models and structures. (c) The integration of **multi-data format:** The data formats used in different databases are different. Not only some special data can not be exchanges in the cadastral system, but also some non-spatial like land registration data can not be connected to the land survey data. Under the traditional paper mode data and information administration, it is unable to realize the integration of multi-scale, multi-platform and multi-data format data. With the help of LIS and the digitized data, it will become possible. The method of cadastral data integration is that establishing the urban and rural cadastral database based on unified data code and data format. Than divide the different classes of data into several layers, combine the layer with the same layer name together and form the urban and rural integrated cadastral database.

(1) Unified Cadastral data code

In order to make the cadastral in urban and rural area data interchangeable, the urban and rural area integration cadastral database establishes the cadastral data code. All of the new cadastral data should follow this standard, and the old cadastral data should be transformed into this standard. It divided the urban and rural area integration cadastral data into 7 main classes, they are: basic Geography data、cadastral survey data、land type data、topography data、land mark data、imagine data、and other data. Different cadastral data classes have different cadastral data codes. It is using 7 figures to stand for the code. Each figure stands for :main class code、subclass code、first degree code、second degree code、third degree code、expansion degree code and kind code.

(2) The rule of Cadastral data code

The code rule for the rural land utilization data (1:1000 scale)



The code rule for the urban cadastral survey data (1:500 scale)

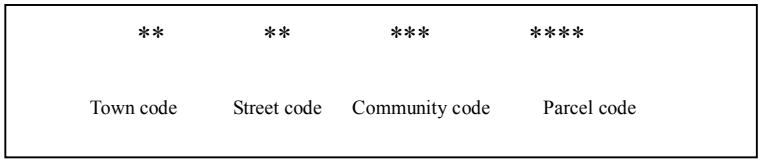


Figure 5- 5 The rule of Cadastral data code

(3) The rule of standard cadastral layer

According to the standard of cadastral layer, the integrated urban and rural cadastral could be decided into several layers. They are survey control point level, contour line level, elevation point level, punctual landform level, striation landform level, administrative area level, administrative demarcation line level, land parcel level and so on.

Table 5- 1 The rule of standard cadastral layer

Layer name	Content	Form	Level name
survey control point level	control point	Point	L_CLKZD
contour line level	contour line	Polyline	L_DGX
elevation point level	elevation point	Point	L_GCD
punctual landform level	punctual landform	Point	L_DZDM
striation landform level	striation landform	Polyline	L_XZDM
administrative area level	administrative area	Polygon	L_XZQY
administrative demarcation line level	administrative demarcation line	Polyline	L_XZJX
land parcel level	parcel	Polygon	L_ZD
……			

(4)The detail steps of urban and rural cadastral data integration

(a) Analyzing current cadastral data: Analyze the data quality, completeness, accuracy precision, scale and so on, in order to confirm the plan of integration.

(b) Data coding: According to the new cadastral data code rule, all of the survey land will be divided into detail administration area like city, town, village and street.

(c) Data transformation: After the cadastral data was coded, it is possible to transform the data into several standard layers. The land classes, coordinate system and data construction in each layer are the same.

(d) Data integration: Check and examine the quality of data after transformation. According to the name of layer, the urban area survey data and land utilization data in the same layer can be integrated in to one layer. All of data in the two databases can be integrated into urban and rural integrated cadastral database by using this method. This kind of method has realized the real sense urban and rural cadastral data integration management and creates a tool for the management of cadastral data in the process of land contract right transfer.

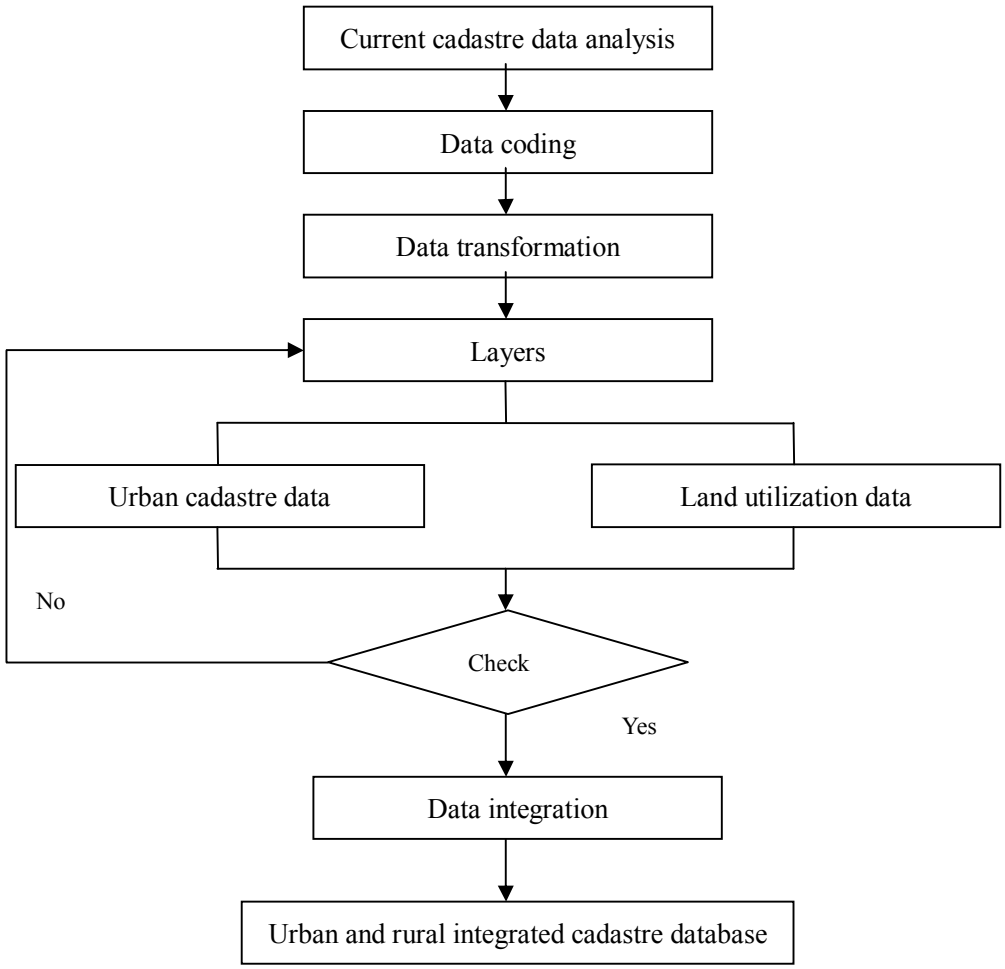


Figure 5- 6 The procedure of urban and rural cadastral data integration

5.4.4 The structure and function of LIS for reducing land fragmentation

The establishment of urban and rural integrated cadastral database and system is just one of the important parts of improvement. How to use and implement LIS based on urban and rural integrated cadastral system to help and speed land contract right transfer and support large scale production unit manage fragmented parcels in order to realize land use consolidation is another challenge.

In the research area, the local cadastral department has already use certain kind of LIS which uses ArcGIS and the service software SDE for GIS function, and Oracle 9 database for cadastral database management. What's more, the using of ICT in some degree has

realize E-government and paper less work in the process of land contract right transfer in cadastral management work in some degree. This LIS uses C/S (client and service) structure. C/S structure is a kind of open structure, and based on the network. The service can store and manage the special and non-spatial data, and the client computer is responsible for dealing with the application of cadastral service from client and delivers the result of data to client. The data which is transferred though network is the useful data required by client not the whole metadata. So the data flow in the network is not too much. LIS which uses urban and rural integrated cadastral system contains several parts, like: the front office (client service department, on-line service platform), the different functions of urban and rural integrated cadastral system (cadastral management, land utilization management, construction management, land planning management), LA department, and IT service department. The whole system follows certain standards and is monitored by government.

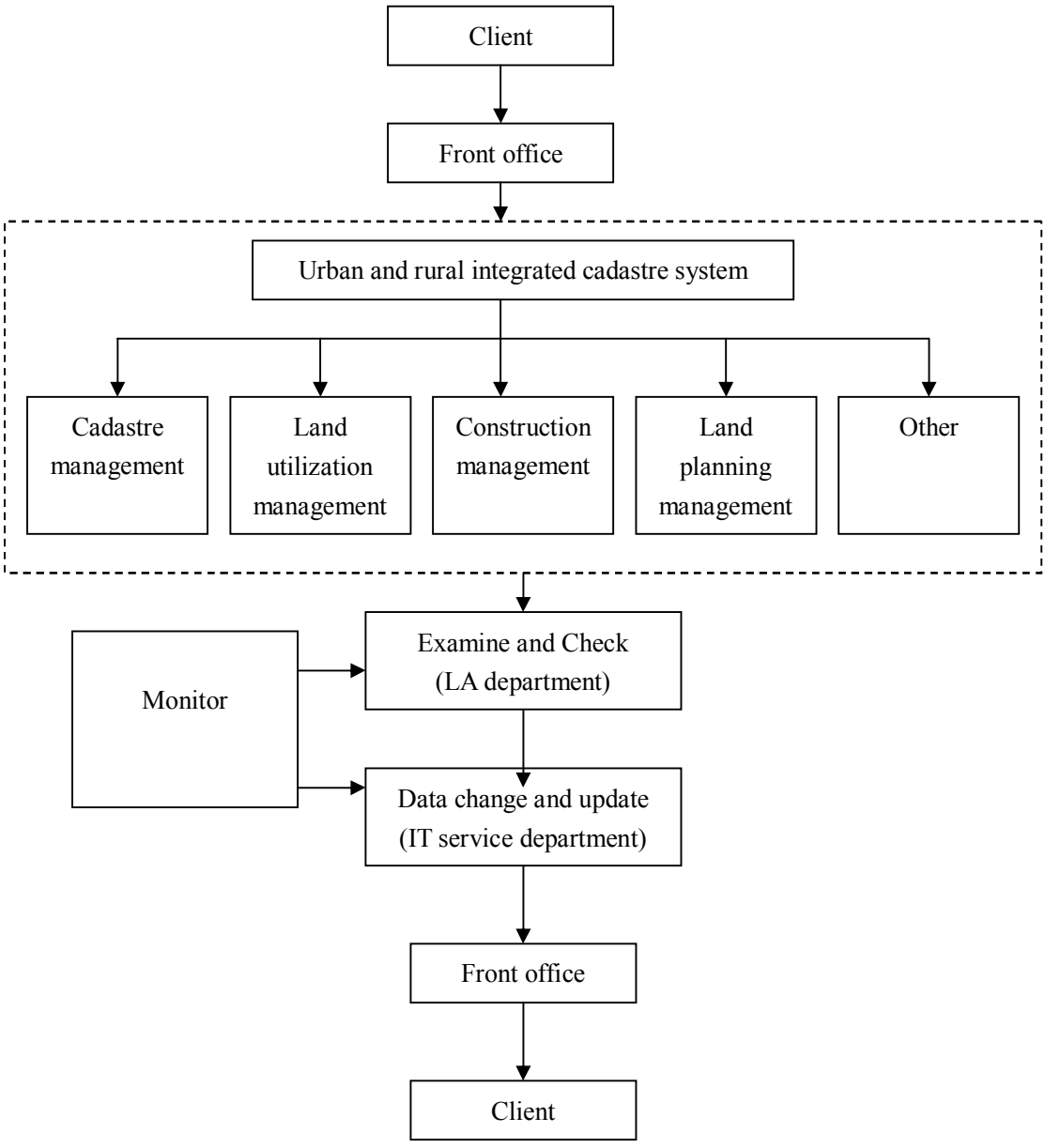


Figure 5- 7 The C/S structure of LIS

The system uses the standard window platform to realize the communication. All of application from clients are received though the window platform, and then transmitted to the corresponding cadastral offices though network. The results from cadastral offices will be transmitted to IT service department for cadastral data update. The issue of certificate and document will be send to the client though the standard window platform by client service department. For data management, Oracle 9 database is based on Object—Relation structure, it can manage complex data like: special data and multi-media data and supply efficient、reliable and secure data management service. And it is suitable to manage huge database like cadastral database. So, it can be chosen to manage the urban and rural integrated cadastral database.

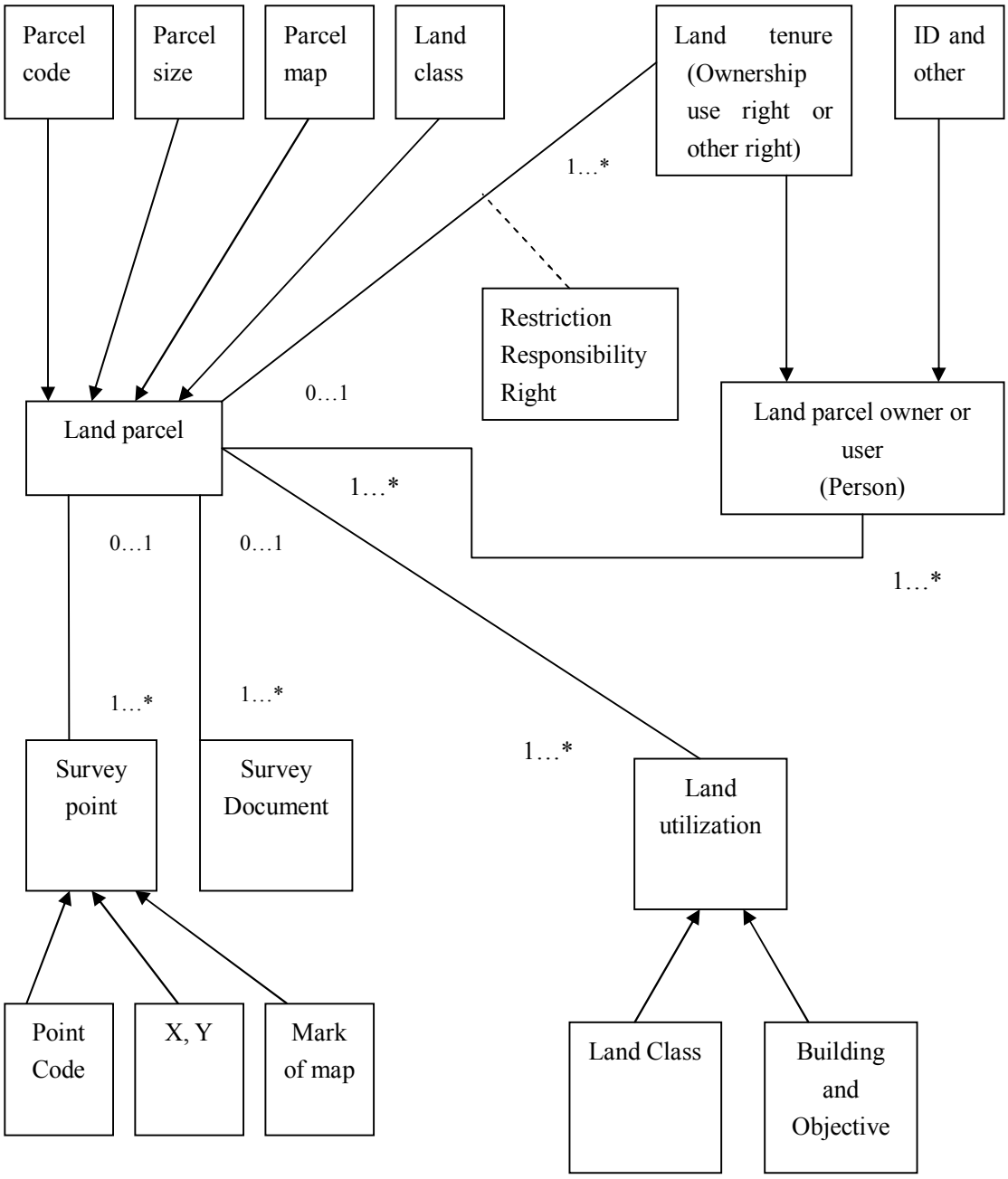


Figure 5- 8 The structure of urban and rural integrated cadastral database

5.5 The implementation of LIS to support large scale production unit manage fragmented land parcels

The management of spatial cadastral data in LIS is based on layers of maps. In the database of maps, one cadastral map contains several layers and in each layer it has the spatial data of Point, Polyline and Polygon. The special data in different layers can be copied and update in a new layer for the need of practice cadastral work. ArcGIS and the service software SDE have great function of data in/out put、data analysis、data statistic and can transfer and manage different data formats. It can be used to combine the same layers from separated urban and rural cadastral data in shape format, unify the coordinate system and scale, and check the topology to improve the quality of cadastral data.

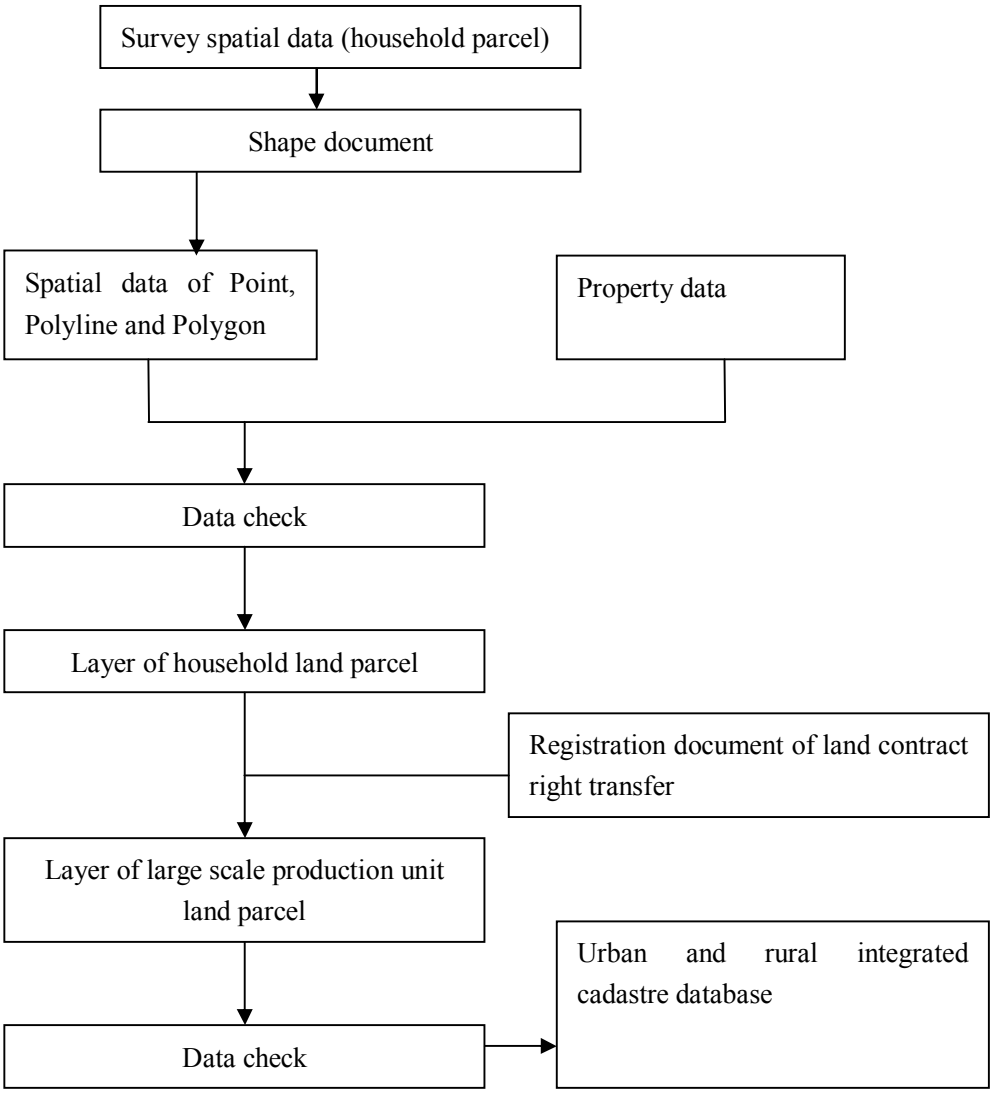


Figure 5- 9 Management of fragmented land parcel in LIS

According to the current need of land contract right transfer, one cadastral map may contain 7 kinds of basic layers: administrative area level, administrative demarcation line level, landform level, land utilization level, land classification level, land parcel level of household, and land parcel level of large scale production unit. In each layer, the property data is connected to the special data. For land parcel of household, the ID of land owner and land user, land tenure type, the type of land use right, the duration of land contract right, and the current land utilization situation, such kinds of non-spatial data are stored in the relationship database of LIS.

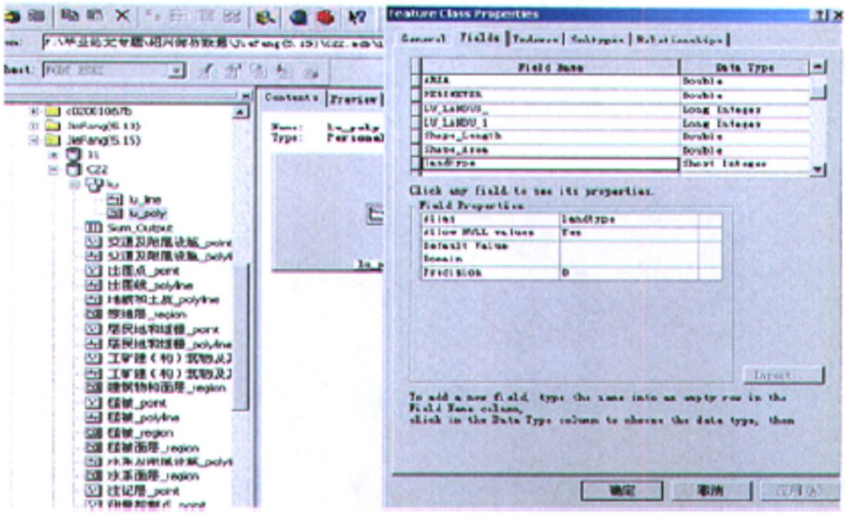


Figure 5- 10 Connect the property data to the spatial date in layer

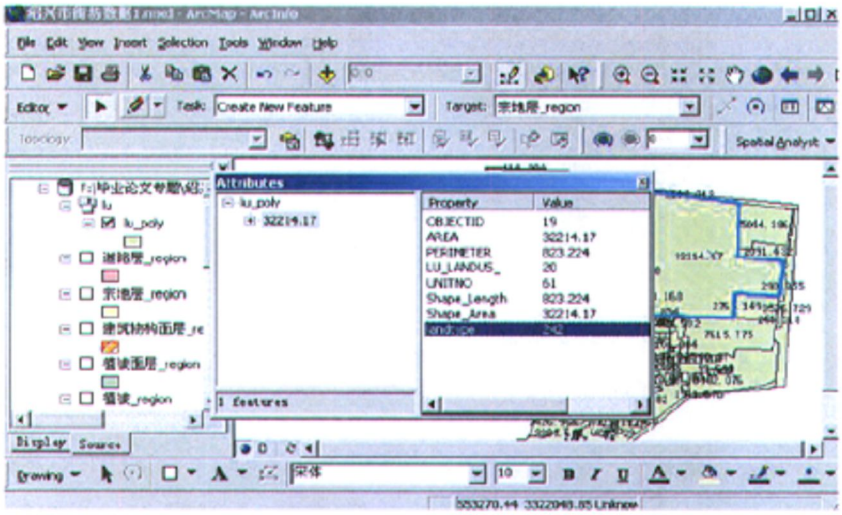


Figure 5- 11 Input the value of the property data

When the land contract right transfer occur, a new land parcel is created in the related layer, and the ID of large scale production unit, the legal person, the registered capital, the manage department of production unit, all of the property data are input and connected to this land parcel. The spatial data of land parcel is updated in the same time. In the layer of land parcel of household, the spatial data of Point, Polyline and Polygon of the land parcel which is transferred from household to large scale production unit is copied into the layer

of land parcel of large scale production unit. And all land parcels which are owned by this production unit can be combined into one land parcel which can be showed in the window of GIS software.

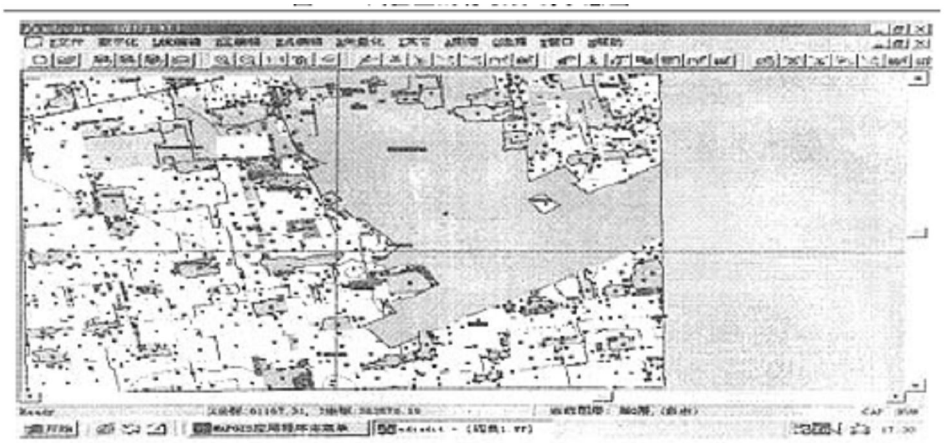


Figure 5- 12 The layer of household's land parcel in one village

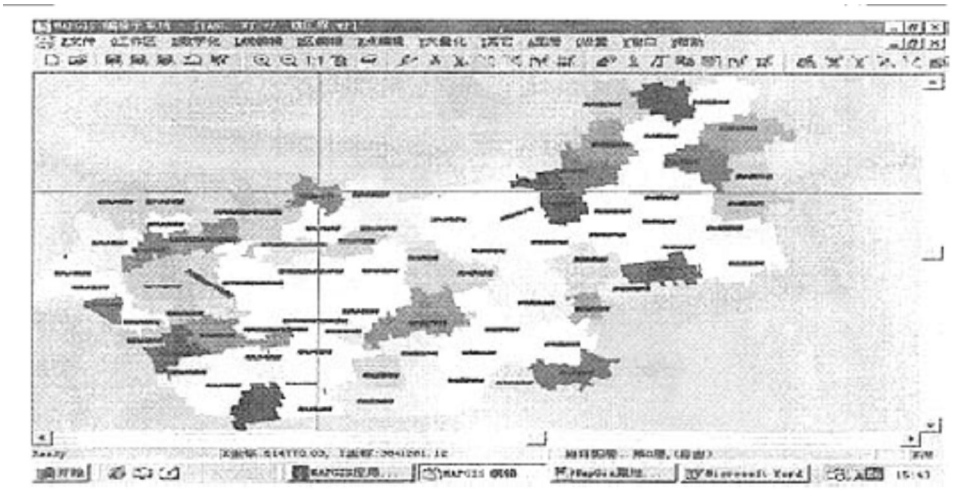


Figure 5- 13 The layer of large scale production unit's land parcel of each village

After the creation of new layer and combination of spatial data of land parcel, LIS can check the topology of this layer, in order to remove possible mistakes and guarantee the data quality. There is a special function for check topology of cadastral map in the GIS software. The name of layer which needs to be checked will be input in the window, for example: the layer of land parcel of large scale production unit.

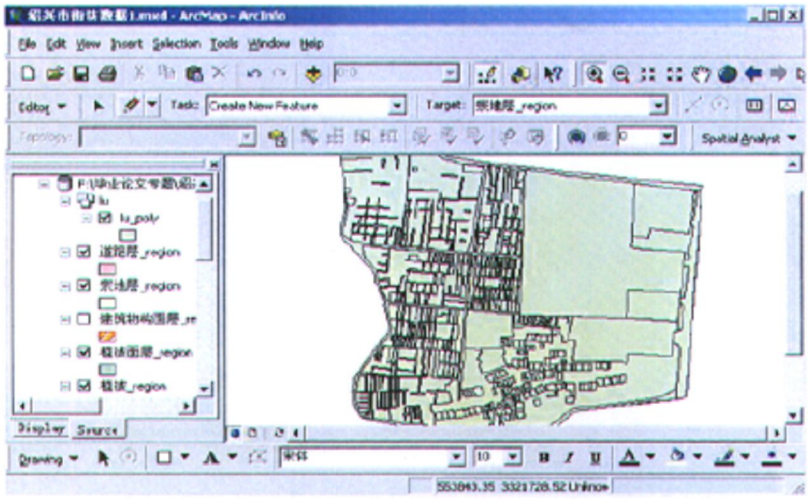


Figure 5- 14 The cadastral map before the check of topology

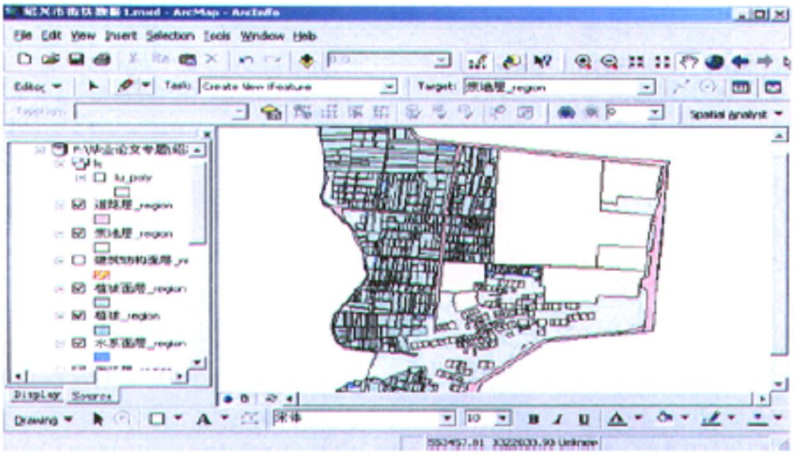


Figure 5- 15 The cadastral map after the check of topology

In the process of land contract right transfer, large scale production unit can apply the transaction of land contract right transfer to the local cadastral department through the network and submit the required information includes: land tenure of certain parcel, ID of land holders, the form and the duration of land contract right transfer, others. The cadastral department will check and examine the application from the information submitted and the data in the urban and rural integrated cadastral system. If the transaction is legal, the cadastral department will issue the certification to the legal person (the large scale production unit), through the window platform of LIS. The cadastral data and record will be updated at the same time. After that, the large scale producing unit can get the certain land contract use right from land holders and organize production on it. What's more, because the duration of land contract right may be different to each fragmented parcel, the property data which connected to the household land parcel can be managed in the relationship database. If the contract duration of some parcels expires, the system will give an announcement to the cadastral department, land owner and land user. The large scale production unit can pay the fee to household to prolong the duration or the household can take back the land contract right from production unit. For example:

There is a land stock co-operation production unit which was established by the village economy organization in Tianhu village of Hongjia town in 2006. There are 297 mu farm lands in the village joined land contract right transfer and 154 household joined the stock co-operation production unit about 60% of the whole village. The land stock co-operation production unit has 360 total shares of stocks, including 70.63 stocks owned by village economy organization and 289.37 stocks owned by farmer households which are evaluated from the land contract right according to the size, the land degree and the contract duration of land parcel.

The legal person of the production unit is the committee voted by the whole village, it owns the land tenure of the whole large scale production unit. LIS helps to manage the land tenure from different households with different kinds of land tenure in the rural area and different contract duration. So, in the land contract duration, the fragmented land parcels are seen as one large parcel hold by the committee of the production unit. If the contract duration of some parcels expire, LIS can announce the production unit to pay the fee of land contract right in order to prolong the contract duration. The village economy organization can manage the production of large scale agriculture production. Farmers who joined the land stock co-operation can take the employment of the production unit spontaneously. The output and interests of production are distributed to the farmer household according to the share of stock they hold.

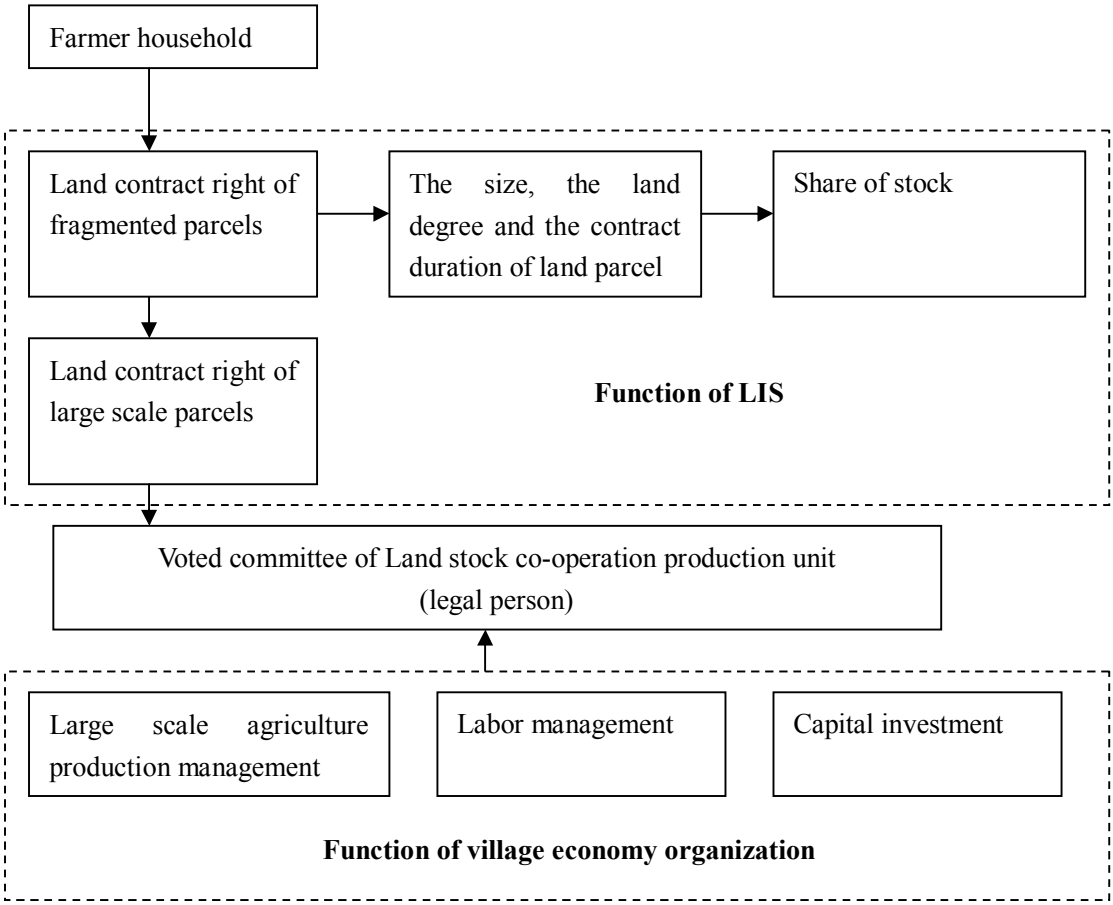


Figure 5- 16 The function of LIS in management of large scale production unit

5.6 Conclusion remarks

The method of solving problem of land fragmentation contains several aspects like: the main body of large scale production unit、the policy、the investment and the technology. In the aspect of policy, the emphasis of HRS improvement is carrying out land contract right transfer to combine small fragment land parcels into large ones in order to realize land use consolidation. Meanwhile, the state government should give the complete land contract right and property right to farmers in order to protect the land tenure security though land law and policy. Land market in the rural area which has complete function should be established in order to supply the land transfer information and intermediary service. State government also has to establish social warfare system, medical insurance system in rural area and supply more job opportunities in other industry to increase the off-farm income in order to reduce farmers' rely on the farm land. So, more farmers are willing to transfer the land contract right to the large scale production unit. What's more, village collective organization and village leaders can help to manage and monitor the procedure of land transfer, organize large scale land use consolidation and stock co-operation production in the range of whole village, and attract the investment from commercial production company.

In the aspect of technology, the improvement of LIS is establishing Urban and rural integrated cadastral system which can support large scale production unit to get and manage fragmented land parcels though land contract right transfer. The improvement includes complete cadastral data, the integration of urban and rural cadastral system and the integration of spatial and non-spatial data. The implement of LIS can use layers and database to manage the data of household parcels and large scale farm land in both spatial data and property data.

6. Conclusion and Recommendations

6.1. Conclusion

Land fragmentation is a common problem in many different countries, and it affects the agriculture production in different way and degree. This research on the causes and driving force of land fragmentation bring us a new approach/method on reducing land fragmentation both from new policy formulation and LIS technology implementation.

Concerning about the first research objective: To analyze causes and factors affect land fragmentation based on the current land tenure and HRS systems in rural land of China.

The occurrence of land fragmentation is not accidental; it is inevitable, because of both "supply-side" and "demand-side" factors. The causes of land fragmentation includes the natural facts like: agro-climatic conditions, topography, land quality, soil condition, irritation, scare of land; the social facts like: population, number of farmers (land user), land law and policy, property right, land administration and tenure system, land reform history, traditional agriculture culture and method of agriculture production; the economic facts like: off-farm income, production efficiency, land market and so on.

The causes of land fragmentation in China contain both internal facts and direct causes. Because of low off-farm income and less employment opportunities in other industries, most of farmers in rural areas rely on agriculture for their life safeguard. So, the number of land users is huge. There are nearly 900 million farmers working on the farm in China, according to the national statistic. Meanwhile, the agricultural land is scare in China compare to the number of land users. While distributing the scared land to the land users equally, the number of land parcels becomes huge and size of parcel is small. What important is that the production efficiency in most part of China is low. Most of farmers do not master the modern agriculture technology and the management of large scale production. Meanwhile, the traditional production culture which lasts for thousands years is based on the production unit of household. So, certain degree of land fragmentation is suitable to this kind of production method. Low land/labor rate and household production unit are the two main internal facets of land fragmentation in China.

The main direct causes of land fragmentation in China are the introduction of HRS in the third time land reform and the land distribution, land reallocation and political forced land consolidation. Because of the equality principle of HRS, HRS distribute land use right (land contract right) to the farmers equality. It can protect the interest of farmers and is suitable to the production method at that time. But in a long term, with the development of agriculture production level in China and the change of agriculture production into large scale production, the land fragmentation block the development of agriculture production

in China more and more. Land law and policy related to the incomplete land property right and short land use right duration affect Land tenure security; and not well established Rural Land market affects land contract right transfer. All of these affect the reduction of land fragmentation in China.

Concerning about the second research objective: To improve land administration system of fragmented household land parcels and the agriculture production units from both policy and technology.

Since, land fragmentation affects the agriculture production in China from different aspects, and the current HRS blocks the future development of agriculture production. It is necessary to reduce land fragmentation and improve the HRS, in order to realize land use consolidation and establish large scale production unit.

Based on the analysis of causes and factors affect land fragmentation, we try to find the methods from both policy and technology. In the aspect of policy, land contract right transfer is a suitable way to improve HRS. It allows farmers to transfer the land contract right though different forms like: Land exchange、Land transfer、Land rent、Land stock co-operation、and Land mortgage. Through this way, the main bodies of large scale production units like: Professional production household, Stock co-operation production unit, Commercial agriculture production enterprises can combine the fragment land parcels from household to realize large scale production. The advantage is that the land tenures are still belong to farmers (are still fragment) and can protect farmers' interest, but the land use situation has been changed and consolidated in order to reach a higher efficiency. What's more, other assistant policy method should be carried out at the same time, like: the improvement of land law and policy about the complete land contract right and property right to farmers in order to guarantee the land tenure security; rural social warfare system, medical insurance system should be established and improved and supply more job opportunities in other industry to increase the off-farm income in order to reduce farmers' rely on the farm land; So, more farmers are willing to transfer the land contract right to the large scale production unit. In order to reduce the number of land user; a complete land market can supply the land transfer information and intermediary service.

In the aspect of technology, the LIS is important in establishing cadastral system. It includes the integration of urban and rural cadastral system and the integration of spatial and non-spatial data for managing large production units consisting of fragmented land plots. In the new LIS, it has to integrate data from multi-scale, multi-platform, and multi-data format. This LIS cadastral system can play an important role in the land administration work in the process of land contract right transfer.

6.2. Recommendations

The improvement of HRS and the related land law, policy LIS in order to solve the problem of land fragmentation is quite a large and complex program. How to implement these innovations on both policy and technology, with fewer conflicts and low cost is still need to be focused in the future research.

The state government must consider the different situation in different parts of China. In the eastern part of China where higher off-farm income has, land contract right transfer and establishment of large scale production unit are carried out for quite a few years. The land market in the rural area is also been established though not perfect enough. The experiences from this place can be learned for the future land policy making and introduced to the other places. What's more, the scale of production unit which is suitable to the agriculture production situation of different places is still needed for future research. The establishment of large scale production unit needs investment and capability of management of fragmented land and labor. For current, the large scale production unit based on village is considered a good choice for most part of China. In each village, there are already existing village organizations and village leaders. It is convenient for solving the conflicts in the process of land contract right transfer.

The research of LIS is only on the system level and focuses on the establishment of urban and rural area cadastral system. The future research might be required focus on how to use this system and work better.

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Appendix 1

Research matrix

objectives	questions source	Information requirements	requirements data	method
To analyze causes of land fragmentation based on the current land tenure and HRS systems in rural land of China	Q1: What are causes and driving force of land fragmentation in China?	-Objectives -Different aspects -Internal facts and direct causes -Low land/labor rate -Household production unit -Introduction of HRS -Land law and policy	-Scientific literature -Online sources -ITC library - Field work -Policies and regulations from Local government and cadastral department	- Collect policy documents and Review documents -Interview
	Q2: What are the weak points of current land tenure system and land administration system in rural area of China?	- The current regulations and government decisions on land tenure -land law and guidelines for land right - Governing standards and administrative procedures - Customary practices of land administration	- Policies and regulations from Local government and cadastral department - Scientific literature	-Literature Review and policy documents -Interview
	Q3: How HRS causes land fragmentation in rural area of China?	-Equality principle -Land distribution -Land reallocation -political land consolidation	-Scientific literature - Field work -Online sources -ITC library	-Literature Review about HRS -Interview
	Q4: What are the effects of land fragmentation on agriculture production and the land use changes in current China?	-Cadastral data -Number and size of land parcel -Output of production -Income of farmers	-Scientific literature - Field work -Online sources -ITC library	-Literature Review about land fragmentation - Collect policy documents -Interview
To improve land administration system of fragmented household land parcels and the agriculture production units from both policy and technology.	Q5: What kind of methods can be established to combine the fragmentariness of land into large-scale production units?	-Land contract right transfer -Land use consolidation -Land market -Complete land right and land security -LIS and GIS	-Scientific literature -Online sources -ITC library - Field work - Policies and regulations from Local government and cadastral department	-Literature Review about HRS -Interview
	Q6: How to improve the HRS from household level into a	-Allow land contract right transfer	-Scientific literature -Online sources	-Literature Review about HRS

	high level production unit at the village level?	-organize large scale production unit -related policy -guild of village collective	-ITC library - Field work - Policies and regulations from Local government and cadastral department	-Interview
	Q7: How to improve the land law and policy to reduce land fragmentation	-Complete land right and land security - Procedure of land registration and land transfer	-Scientific literature - Policies and regulations from Local government and cadastral department	-Literature Review about laws and administrative procedures -Interview
	Q8: What roles and how can a LIS/GIS plays in the process of managing fragmentized land?	-Integrated urban and rural cadastral system	-Scientific literature -Online sources - Policies from cadastral department	-Literature Review about LIS -Interview

Appendix 2

Interview schedule of authority part for fieldwork

Objectives of the fieldwork: To collect data that I need for my research

Places: Baoji City, Jintai District

Dates: 11 October – 30 October 2008

Questionnaire code:

Questionnaire	code
Questionnaires for farmers/peasants	1
Questionnaires for government officers	2
Questionnaires for town and village leaders	3

Date	Organization	Persons to be contacted	Activities	Data collecting	Code
2009-9-28~2009-10-1	Chang'an University	Prof. Ma (supervisor)	-Discussion on MSc. Research Proposal -Discussion on field work plan and questionnaires	-Collection of necessary digital data, images and other information regarding policies and procedure	no
2009-10-8~2009-10-10	Taizhou land Resource Bureau and cadastral department	Director of cadastral Director of Land Information system	-Collecting policy documents, laws and regulations on land fragmentation and agriculture production - Interview	-Basic statistics on economy and social situation -land use and land fragmentation data -cadastral record and map -land law and policy	2
2009-10-11~2009-10-13	Hongjia town local government	Director of cadastral Director of agriculture	-Collecting policy documents, laws and regulations on land fragmentation and agriculture production - Interview	-Basic statistics on economy and social situation -land use and land fragmentation data -land contract right transfer situation	2
2009-10-14~2009-10-15	Checking completeness of data and preparation of Interview				
2009-10-16~2009-10-	Interview village leader and	Villagers and	-Collect cadastral record	-land use and land	1 and

20	farmers in three villages	farmers	- Interview	fragmentation data -cadastral record -Interview	3
2009-10-21~2009-10-22	Checking completeness of interview data				

Appendix 3

Questionnaire for Analyzing effects by Land fragmentation in People's Republic of China

For farmers

INTERTATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Researcher: Li you
Department: GIM-LA, ITC
& Chang'an University
E-mail: li20656@itc.nl
Date: October.2009

Section A
Land use and land fragmentation situation, land quality, Irrigation, Agriculture situation

1. What's the number of parcel in your household from land distribution? ___

2. What's the size of each parcel? ___

3. Are the shape of the parcels regular or not?
□Yes, quite regular □almost regular □no, not regular

4. Are the parcels far away from your house or not?
□Yes, quite regular □not quite regular □no, very close

5. What's the land quality of each parcel?
□All of parcels are good □some are good, some not □all of parcels are not good

6. Does each parcel has connected to the irrigation or not?
□Yes □some □no

7. what's the yield of agriculture from parcel farming? ___

8. Your existing land generally are served as
□ housing rental □farming □abundance □other ____

9. What kinds of plant do you farm on the land?
□ crop □ other high economic plant

10. Does the government and village leader have some requirement on land use?
□ yes, have to follow □ some suggestions □ no

11. Do you satisfy with the current use of this parcel?
□ Fully satisfied □ Moderately satisfied □ Not satisfied

12. If not satisfied, what are the reasons for it?___

Section B
Household income and Social welfare situation

13. What's the total income of your household monthly?
□ <1000
□ 1000--2000
□ 2000--3000
□ 3000--4000
□ *>4000*

14. What's the income from agriculture production?
□ <1000
□ 1000--2000
□ 2000--3000
□ 3000--4000
□ *>4000*

15. How many members of the family are employed?
___

16. How many household members work on agriculture?
___

17. What are the main income resources of your household**?**
☐ Agriculture □ private business □ employment outside of village □ distribute bonus from collective □ rent house

18. What's your future choice of employment?
□ Agriculture □ private business □ employment of village □ distribute bonus from collective □ rent house

19. What's your attitude on agriculture production?
□Important □less important □not important at all

20. Do you think the income from agriculture production is high or not?

☐ yes □not quite high □ no

21. What were the reasons to start the business in this parcel?
□ Other income source was not enough to maintain my family
□ Location of this plot is more suitable for this business
□ To utilized the remain vacant space of the plot
□ Other (specify)

22. What do you think about the village employment security system?
□ it plays an important role for increasing villagers' employment opportunity
□ it not really solves the employment problem
□ no use
□ do not understand the employment security system

23. What do you think about the society old-age insurance system?
□ it is necessary, it makes the safeguard for own later life
□ no need
□ it does not matter

24. What were the reasons to start the business in this parcel?
□ Other income source was not enough to maintain my family
□ Location of this plot is more suitable for this business
□ To utilized the remain vacant space of the plot
□ Other (specify)

Section C
Land tenure and Land tenure security

25. How many times of land reallocation totally? ___

26. What's the frequency of land reallocation? ___

27. Are you land user/owner of this land parcel?
□ Yes □ No

28. If no, what is your relationship with the land owner?
□ Relatives □ Tenant

29. What's the Land tenure system in your village? ___

30. Will you continue to invest on the land?
□ yes □ no □ it depends

31. What is rural land collective ownership?
□ Collective land is owned by state and communities.
□ Collective land is owned by leaders of villages.
□ Collective land is indeed for all the villagers.

32. What do you think are the problems of rural collective land ownership?
□ The collective land ownership is incomplete, is not in the complete significance ownership .
□ The collective land ownership object limits are unclear, state and collective land ownership limits are unclear, between the collective land ownership also has the unclear scope
□ Rights and obligations of collective land ownership is not clear, lack of operation
□ Collective land ownership is for multi-level, the main body is undefined
□ The main representative of the collective land ownership, such as the village group, legal status is Unclear
□ Other

33. What is the suggestion on rural collective land ownership reform?
□ According to the existing pattern of possession of agricultural land contracting, delegate land use rights to farmers permanently, farmers become final, complete owners for land property rights.
□ Carrying on revises on the existing land laws and policies
□ Government establish land registration for farmers. Fulfill transfer registration formality if the land ownerships exchanges through the transfer and the transaction
□Other

Section D
Land use right and land contract right

34. What are the limits about farmer land use rights?
□ Creditor right □ Property right □ Other

35. What is the constitution about rural land use rights?
□ Self-use and management right like: Subcontract, transfer, lease and other
□ Exclusive possession right like: Mortgage, inherit
□ Priority land use or contract right
□ Other

36. What do you think is the best choice about term to give farmers land use rights?
□ At least 30 years
□ 70 years
□ No deadline but permanent land use right to farmers
□ Other

37. What do you think are the difficulties to give farmers long-term and secure land use rights?
□ Adjusting the land during contract period
□ Government don not have effective land administration system in rural area.
□ Farmers do not have to the ability of using the law to safeguard their own rights and interests
□ Farmers do not have legal "two certificates" which can prove they have the right of land use
□ Other

38. What measures do you think are good to solve the contradiction about “Not only need a stable land use rights, but also require an average of possession of land”?
□ Through land use right transfer, realize land regulation marketability. Using a standardized land use right transfer market method to replace the administrative adjustment method
□ Accelerating the rural non-agricultural industries to expand off-farm employment opportunities and increase off-farm income.
□ Reassigning land resources to address the legitimate additional population land
□ Before giving the farmers long-term and protected right, we need to adjust land finally. Land allocation must forecast that farmers’ future land requirement.
□ Other

39. What is the suggestion on rural collective land use rights reform?
□ Strengthen rural land collective ownership, weaken land-use rights
□ Strengthen land-use rights weaken rural land collective ownership
□ Give private land ownership to farmers
□ Other

40. Can you buy and sell in the local rural contract land?
□ Yes, we can □ No, we can’t □ I don’t know

41. Can the local farmers carry on the stock cooperation on the rural land contract right?
□ Yes, we can □ No, we can’t □ I don’t know

42. Can you redeem the debt and mortgage in the local rural contracting land?
□ Yes, we can □ No, we can’t □ I don’t know

43. Can the successor inherit legally about income that is earned by the contractor?
□ Yes, he can □ No, he can’t □ I don’t know

44. Has land contract rights transfer changed land ownership nature?
□ Yes, it has □ No, it hasn’t □ I don’t know

45. Has land contract rights transfer changed agricultural use?

□ Yes, it has □ No, it hasn't □ I don't know

46. Do you need to sign the written contract when carrying on the land contracting?
□ Yes, we need □ No, we needn't □ I don't know

47. Has the local management department issued the rural land contract right certificate?
□ Yes, it has □ No, it hasn't □ I don't know

48. Is there the land contracting right of transfer market in the locality?
□ yes, there is □ No , there is not □ I do not know

49. Has the contractor used the contract land but not carried on the contract agreement?
□ Yes, it has □ No, it hasn't □ I don't know

50. Can government adjust the contract willfully during the period of land contracting?
□ Yes, it can □ No, it can't □ I don't know

51. Is it need to get the agreement from government that the litigant adopt the land transfer?
□ Yes, it is □ No, it is not □ I don't know

52. When the goverrnment doesn't agree the contractor to transfer land, does the government need to write the reasons to the contractor within seven days?
□ Yes, it does □ No, it doesn't □ I don't know

53. Does the government have the behavior to hinder the contractor to transfer land legally?
□ Yes, it does □ No, it doesn't □ I don't know

54. What do you think are the main causes about land right transfer?
□ The higher off-farm income
□ The employment in the city, and lack of labor in agriculture
□ The land parcels are fragment and difficult to use
□ The higher agriculture production in large production unit
□ Other

55. What is the weak point of current land right transfer system, which blocks the land transfer?
□ The lack of clear land property rights
□ Land resource are scarce, the growth of rural land market development is slow
□ The lack of a reasonable evaluation system of land transfer prices
□ The lack of intermediary organizations in land transactions
□ The lack of the effective management and supervision for collective construction land transfer in government

□ Other

56. What do you think are the main issues about land transfer?
□ Irregular distribution of income, farmers are not effective in protecting the rights and interests
□ Government and village's administrative intervention is big
□ The size of land transfer is small, and the duration is short.
□ The information of land transfer is lock, usually occur in the same village
□ The transfer dispute is frequent
□ Other

57. What solutions do we have to solve land contracting disputes?
□ Co-ordination between the litigant
□ Intermediary organizations mediation
□ Village committee or civil administration government office mediation
□ Asking rural land contracting arbitration facilities for adjudication
□ People's court prosecution

58. What do you think are the key measures to maintain the farmers' land rights and interests?
□ Formulating and revising the related law and policy, and releasing corresponding executive regulation
□ Encouraging the development of various types of farmers organizations to maintain farmer land rights and interests
□ Improving farmers' awareness of legal standards and the protection ability
□ Other

59. What do you think are the suggestion on the rural land system reform?
□ Carrying on the property rights structure changes to traditional collective land ownership
□ Giving the property rights to farmers
□ Stabilizing and improving the land contracting system
□ Other

Thank you very much for your time and co-operation!

Appendix 4

Questionnaire for Analyzing effects by Land fragmentation in People's Republic of China

For local town government and village leader

INTERTATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Researcher: Li you
Department: GIM-LA, ITC
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Date: October.2009

The interviews have two purposes:
1. To get a cross-section of opinion about the need for the research project.
2. To identify sources of data and get first-hand information.
Personal interviews are a good way to introduce the consultant members of the study team to officials and leaders of organizations, and to learn the best ways to engage the public in the preparation and review of the research.

This questionnaire is intended to be an outline for a one-hour interview. You don't need to fill it out in advance, the format is flexible. We are interested in your views as an individual, which may or may not fully reflect those of your community or organization. The questions include detail to indicate the types of information which the study team needs to prepare analyzing the effects of land use rights in urbanization in Baoji city.

Section A Economy and Social situation

1. What's the population in your town or village?
2. What's the number of agriculture population in Taizhou city in recent year?
3. What's the financial income of your town last year?
4. What's the value of farmer's average income in your town or village?

Section B Land use and land fragmentation situation

5. What's the area of the total agriculture land in your village?
6. What's the area of the total crop land in your village?
7. What's the area of the total non-crop land in your village?
8. Are there any cadastral map or cadastral record in your village?
9. When did the village collective carry out land distribution in your village?
10. What's the frequency of land reallocation in your village?
11. What's the average size of land parcel before and after land distribution in your village?
12. What's the average number of land parcel per household before and after land distribution in your village?

Section C Land tenure and land contract right transfer situation

13. What kinds of land tenure in your village?
14. What's the duration of land contract right in your village?
15. What are the forms of land contract right transfer in your village?
16. What is the average price of land contract right transfer per/mu in your village?
17. What are the main bodies of large scale production unit in your village?
18. What role can village leader play in the process of land contract right transfer?

Thank you very much for your time and co-operation!

Appendix 5

Questionnaire for Analyzing effects by Land fragmentation in People's Republic of China

For Taizhou government office & Taizhou cadastral department

INTERTATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

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The interviews have two purposes:
1. To get a cross-section of opinion about the need for the research project.
2. To identify sources of data and get first-hand information.
Personal interviews are a good way to introduce the consultant members of the study team to officials and leaders of organizations, and to learn the best ways to engage the public in the preparation and review of the research.

This questionnaire is intended to be an outline for a one-hour interview. You don't need to fill it out in advance, the format is flexible. We are interested in your views as an individual, which may or may not fully reflect those of your community or organization. The questions include detail to indicate the types of information which the study team needs to prepare analyzing the effects of land use rights in urbanization in Baoji city.

Section A Economy situation

1. What's the GDP value in Taizhou City from 2000 to 2008?
2. What's the annual output value in Taizhou city from year 2000 to 2008?
3. What's the value of farmer's average income in Taizhou city from year 2000 to 2008?

Section B Social situation: Population and Social welfare

4. What's the population of Taizhou city in recent year?
5. What's the number of agriculture population in Taizhou city in recent year?
6. What's the number of countryside old-age insurance in Taizhou city in recent year?

Section C Land use and land fragmentation situation

7. What's the area of the total agriculture land in Taizhou city in recent year?
8. What's the area of the total crop land in Taizhou city in recent year?
9. What's the area of the total non-crop land in Taizhou city in recent year?
10. What's the crop outcome in Taizhou city in recent year?

Section D Land tenure and land contract right transfer situation

11. What kinds of land tenure in the rural area of Taizhou city?
12. What's the land tenure system in the rural area of Taizhou city?
13. What's the duration of land contract right in the rural area of Taizhou city?
14. What are the forms of land contract right transfer in the rural area of Taizhou city?
15. What are the main bodies of large scale production unit of Taizhou city?
16. What is the average price of land contract right transfer per/mu in recent year?
17. What's the area of land contract right transfer in the rural area of Taizhou city?
18. What's the scale of land contract right transfer in the rural area of Taizhou city?

Section E LA and cadastral system

19. What's the procedure of land registration in the rural area of Taizhou city?
20. What kinds of land tenure certification are issued to farmers to prove the land right?
21. What's the procedure of land contract right transfer in the rural area of Taizhou city?
22. Is there any special place for the transaction of land contract right transfer?
23. What's the main channel of land contract right transfer information?
24. Is there any intermediary organization in the land market of land contract right transfer?
25. What kinds of cadastral system are used to manage rural cadastral data?
26. What kinds of GIS platform and software are used to manage rural cadastral data?

Thank you very much for your time and co-operation!

Appendix 6

The Classification and Meaning of Land utilization present situation

Code	Name of first land class	Name of second land class	Code	Name of first land class	Name of second land class
10	Farm land		54		Saltpan
11		Irrigation land	55		Special purpose land
12		Non-irrigation land	60	Communicant land	
13		Water land	61		Railway
14		Dry land	62		Motor way
15		Vegetable field	63		Country road
20	Garden land		64		Airport
21		Orchard garden	65		Harbor
22		Mulberry garden	70	Water area	
23		Tea garden	71		River
24		Rubber garden	72		Lake
25		Other garden	73		reservoir
30	Woodland		74		Pool
31		Arbor land	75		Wetland
32		Bush land	76		Mudflat
33		Thin forest land	77		Channel
34		Forestation land	78		Water supply construction
35		Forest trace land	79		Glacier
36		Nursery land	80	Non-utilized land	
40	Grazing land		81		wasteland
41		Natural grazing land	82		saline and alkaline land
42		Improved grazing land	83		Marshland
43		Artificial grazing land	84		Desert land
50	Residential and industrial area		85		exposed soil
51A		city	86		Exposed rock
51B		town	87		Ridge between fields
52		village	88		Other
53		Independent industrial land			

Appendix 7

The Classification and Meaning of urban land

Code	Name of first land class	Name of second land class	Code	Name of first land class	Name of second land class
10	Commercial and financial land		50	Residential land	
11		Commercial service land	60	Communicant land	
12		tourist industry land	61		Railway
13		Financial and insurance land	62		airport
20	Industry and storage land		63		Harbor
21		Industry land	64		Other
22		Storage land	70	Special purpose land	
30	Municipal land		71		Military land
31		public accommodation land	72		Diplomacy land
32		Green land	73		Religion land
40	public facility land		74		Prison land
41		Cultural, sport and entertainment land	80	Water area	
42		Government office land	90	Farm land	
43		Science research and education land	91		Irrigation land

Appendix 8

Urban and rural area integrated land classification

Code	Name of first land class	Code	Name of second land class	Code	Name of third land class
1	Agriculture land	11	Crop land	111	Irrigation land
				112	Non-irrigation land
				113	Water land
				114	Dry land
				115	Vegetable field
		12	Garden land	121	Orchard garden
				122	Mulberry garden
				123	Tea garden
				124	Rubber garden
				125	Other garden
		13	woodland	131	Arbor land
				132	Bush land
				133	Thin forest land
				134	Forestation land
				135	Forest trace land
				136	Nursery land
		14	Grazing land	141	Natural grazing land
				142	Improved grazing land
				143	Artificial grazing land
		15	Other agriculture land	151	Poultry-farming land
				152	Agriculture infrastructure land
				153	Lake and pool
				154	water conservation land
2	Construction land	21	commercial service land	211	Commercial land
				212	Financial and insurance land
				213	tourist industry land
				214	Other commercial service land
		22	Industry and Storage land	221	Industry land
				222	Mining land
				223	Storage land
		23	Public facility land	231	Public infrastructure land
				232	Green land
				233	Cemetery land
		24	Public architecture land	241	Cultural, sport and entertainment land
				242	Government office land
				243	Science research land
				244	Education land
				245	Health and Medical land

				246	Welfare and Charity land
		25	Residential land	251	Country house site
				252	Urban single residential land
				253	Urban multiple residential land
		26	Special purpose land	261	Military land
				262	Diplomacy land
				263	Religion land
				264	Prison land
		27	Communicant land	271	Railway
				272	Motor way
				273	Country road
				274	Airport
				275	Harbor
				276	Pipeline
				277	Street
		28	water conservation land	281	Reservoir
				282	water conservation construction land
3	Non-utilized land	31	Non-utilized land	311	wasteland
				312	saline and alkaline land
				313	Marshland
				314	Desert land
				315	exposed soil
				316	Exposed rock
				317	Ridge between fields
				318	Other
		32	Other land	321	River
				322	Lake
				323	Wetland
				324	Mudflat
				325	Glacier