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Hollow Villages and Rural Restructuring in Major Rural Regions of China: A Case Study of Yucheng City, Shandong Province

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Abstract: The agricultural land resources of China are relatively limited because of its large population. Therefore, balancing the land use for industrialization, urbanization, and food security is a big challenge. In recent years, rural hollowing in China has resulted in numerous of abandoned rural houses, and the areas with abandoned houses need to be restored into agricultural land with effective land consolidation techniques. This study used the method of benefit-cost analysis and the data collected through field surveys conducted in Yucheng City in the northwest of Shandong Province in March 2009, to examine how hollow villages (HVs) to be created and how to solve the problem. The qualitative and quantitative analyses indicate following results. 1) The situation of HVs is becoming increasingly severe under rapid industrialization and urbanization in Yucheng City. 2) Poor infrastructure in rural areas and incomplete urbanization are the main factors that have led to the rural hollowing in many major rural regions of China. 3) In order to resolve the problem caused by HVs and increase agricultural land, reconstructing rural communities in the countryside is necessary. 4) A new mechanism in the provision of compensation funds by developed regions to the villages in less-developed regions must be established.

Keywords: hollow villages (HVs); village regrouping; rural restructuring; Yucheng City

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1 Introduction

Urbanization and industrialization have brought both positive and negative effects in China (Liu *et al*., 2009a). The negative effects include village depopulation, rural decline, and so on. Developed countries have faced these problems in the last century and have taken measures to solve them. For example, land consolidation policy has been developed and implemented in Germany; revival plan for depopulated villages has been implemented in France; key settlements measures have been introduced in England; and the village regrouping has been carried out in Japan (Long *et al.*, 2009). Since the reform and opening-up policy in 1978, China has experienced impressive economic growth for more than 30 years. Under rapid industrialization and urbanization, many villages have been declining over the years (Liu *et al*., 2010). In some rural areas, the rural population has become increasingly smaller, and the gap between the need and supply of infrastructure in rural areas has become increasingly larger. Thus villagers long for reconstructing their communities with the help of the government.

Hollow villages (HVs) is a proper noun that emerged in China in the early 1990s. The HVs, a micro geographic phenomenon, contains two essential features: 1) a significant loss of land resources in rural areas due to housing developments annexed massive amounts of land in recent years; 2) a decrease in the number of residents in the village due to urbanization. Most village centers

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become hollow in such villages; as a result, their building density decreases, and construction area per capita continually increases (Liu *et al*., 2009b).

In recent years, due to special stages of development and national conditions, scholars in China have paid more attention to urbanization and HVs which waste a significant amount of land. There are 1.3×10^9 people in China; however, its agricultural land is only approximately 1.2×10^8 ha, with arable land per capita merely being approximately 0.09 ha (40% of the world average). Although China is the largest developing country in the world, its urbanization rate was merely 46.6% in 2009. At least 20 years are needed to reach the level of developed countries (Song, 2007; Xiao *et al*., 2009). Thus, a significant amount of land is needed for future urbanization. In the past, a lot of agricultural land was sold for urban construction. Thus, the arable land can not be shrunk any further or the food security will be threatened. In this context, restructuring HVs to increase the land for farming and urbanization is proposed.

Since the 1990s, researchers in China have paid attention to HVs, with particular attention to its definition and features, as well as measures to tackle it (Cheng *et al*., 2001; Xue, 2001; Feng and Chen, 2003; Wang *et al*., 2005). As to mechanism of the emergence and evolution of HVs, some researchers suggest that, in the rural collective ownership of land system, the costs of acquiring a piece of land to build a house is far less than the benefits of building a new house. As a result, villagers tend to build more houses as long as they have sufficient money to do so. Such preferences in decision making cause the widespread emergence of HVs (Wu and Chen, 2008).

Rural restructuring is a hot topic in rural studies. Restructuring means a qualitative change from one form of social organization to another (Lovering, 1989). Many scholars consider economy, landscape, population, and political change to be the motivating powers of rural restructuring (Nelson, 2001). In order to adapt to the new situation and avoid crises from the changes mentioned above, rural restructuring needs to be carried out. Unlike studies from the local perspective, many scholars attribute the drive to macro-structural change and consider that the changes of global economy have brought opportunities and challenges to rural areas. As a result, there must be some changes, including rural restructuring (Communs, 1990). Generally, studies from both the local and global perspectives consider that industrialization has a significant influence on the rural restructuring. However, some scholars insist that agriculture has a significant influence on rural restructuring (Wilson, 1995). In fact, in China, rural restructuring usually means ′building a new socialist countryside′. The project of ′building a new socialist countryside′ was initiated in 2005. Since then, thousands of villages have been profoundly affected, and literature related to this topic has become abundant. ′New countryside′ usually means advanced production, improved livelihood, clean and tidy villages, civilized social atmosphere, and efficient management (Long *et al*., 2010). To achieve these goals, improving rural infrastructure, which is very poor in the most villages in China, is usually the top priority of the government and villagers. In the progress of new countryside building, some problems, such as lack of funding, almost contribute to the failure of the project. The fiscal revenue per-capita in China was no higher than 1000 USD in 2009, and the per-capita savings in China was no higher than 3000 USD in 2009. As there are more than three million villages in China, we consider these funds are very deficient. As to the measure, some scholars suggested several practical measures to the restructuring of HVs, including housing renovation in old villages, reconstructing a new village, and so on (Zhang, 1998). In addition, in order to restructure HVs, types of rural settlements need to be classified, and approaches for rural community plan and community development have been considered by some scholars (Liu and Liu, 2002; Li *et al*., 2004; Li *et al*., 2005; Li, 2006; Li *et al*., 2008; Song *et al*., 2008).

However, to date, few theories on HVs exist, especially theories on why HVs are created, what factors affect them, and how to renovate them. If these questions are not answered, changing the status quo of HVs is impossible. This paper focuses on two aspects: 1) the theory of HVs emergence, evolution, and new village restructuring, and 2) a case study on how to solve the problem of HV using HVs theories.

2 Emergence Theory of Hollow Village

2.1 Microanalysis of emergence of hollow village

2.1.1 Benefit-cost analysis under an adequate infrastructure supply

Supposing that the area of a village is fixed and its

population is growing, villagers have both benefits and costs accordingly (Fig. 1). The AB curve represents the benefits that the villagers can obtain from population increase. Here, the benefits are indicated by the quantity and quality of public facilities offered in the community. In this context, the more public facilities are provided, the more benefits the villagers can receive. For example, the villagers can obtain public water supply at Point E, and with the population continuously increasing, they can obtain central heating services or gas supply at Point G, a primary school at Point H, and a cinema at Point I. The slope of the AB curve becomes flat when population size continuously expands, similar to the law of diminishing returns. Notably, there is a threshold of population scale for each kind of public facility. In other words, if the population does not reach a certain size, the supply of public facilities is inefficient. As a result, the more people there are, the more quantity and types of these public facilities can be supplied before reaching a turning point where diseconomy of scale occurs.

The CD curve represents the cost of village population expansion. The congestion cost, which may cause villagers some inconvenience, is assumed as the only cost. From the standpoint of cost, the more people there are, the more costs they will bear. For example, with the population continuously expanding, the amount of green space will decrease, and garbage will increase. As shown in Fig. 1, there is an optimal size for each village. At Point H, the villagers can obtain the maximum net profits. If population continues to expand, the cost will equal the benefit at Point F, and there would no longer be any net profit. If the population keeps on increasing,

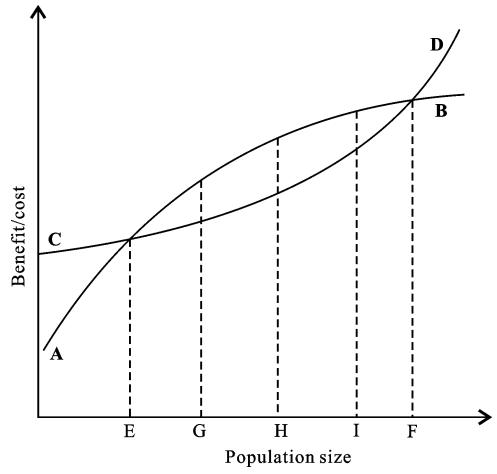

Fig. 1 Benefit-cost analysis under adequate supply of infrastructure

the villagers are likely to move out from the original center of the village and build new houses at the periphery of the village, which can decrease the costs incurred by congestion.

2.1.2 Benefit-cost analysis under insufficient infrastructure supply

The model above is more applicable to the city than the village because of an unrealistic hypothesis. There is a great difference between urban and rural areas in China. Due to substantial government inputs, the system of public facilities is well developed in urban areas; however, this is not the case for rural areas. Firstly, the local government is not able to obtain sufficient fiscal revenue for necessary public facilities because there are no competitive industries in rural areas. Therefore, physical infrastructure and social undertakings are less developed in most rural areas in China. Secondly, the traditional social organizations in rural areas are gradually dying out, and new ones have not been built. As a result, infrastructure systems need to be built by the villagers themselves, which is difficult. Thirdly, infrastructure systems are public goods with externality. Thus, ′free rides′ is unavoidable, and villagers are generally unwilling to build infrastructure systems for public use. Lastly, due to urbanization, many people move to cities, causing the population in rural areas to continuously decrease. As a result, the labor force becomes insufficient for infrastructure construction.

In this situation, the AB curve in Fig. 1 becomes a horizontal line in Fig. 2. As the population expands, the villagers lose access to more public facilities. For example, water and power are supplied for the villagers at Point E. However, what they receive at Points G and F remain the same with the expanded village scale. Meanwhile, the CD curve in Fig. 2 is similar to that in Fig. 1. Consequently, with an expanded population, the villagers receive fewer benefits, but bear greater congestion costs. This is unlike the situation shown in Fig. 1.

2.1.3 Emergence of hollow village

The CD cost curve moves down to the C'D' curve in Fig. 3. This indicates that with the increase of population, the villagers choose to move away from the original place of the community to a new place to reduce their costs. Indeed, the villagers tend to build a new house at the periphery of the village while retaining the old one. Consequently, the villagers often have two or more plots of homestead land. If such a decision is taken by many villagers, an HVs will emerge.

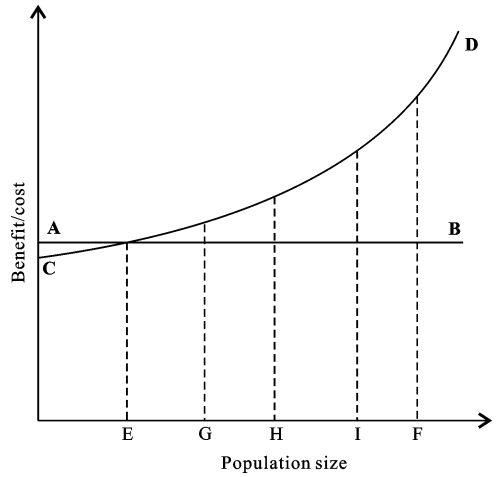

Fig. 2 Benefit-cost analysis under insufficient supply of infrastructure

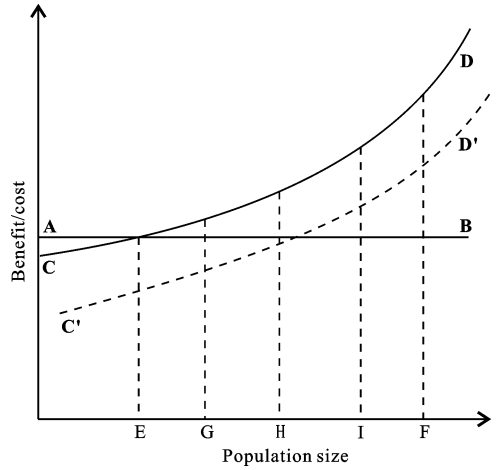

Fig. 3 Benefit-cost analysis of emergence of hollow village

2.2 Macroanalysis of emergence of hollow village

A great development gap exists between rural and urban areas in China. Due to a sufficient supply of goods and services and more job opportunities, people have recently preferred to live in urban areas. As a result, the countryside in China has become depopulated in recent years. However, the urbanization in China is incomplete. Although the villagers are working in cities all year round, they can not afford to buy houses in cities. As a result, they usually chose to maintain their homestead in the village. Apparently, the villagers are too poor to move completely to the city. However, because of higher income in cities, they prefer not to live in the villages, either. In addition, in traditional society, people tend to live together for two kinds of benefits: to stand against invaders and to withstand natural disasters such as floods. As science and technology advance, and economic activities change, people living in rural areas now become more independent and become less concentrated. Consequently, HVs are created.

3 Rural Restructuring Theory

3.1 Funding sources for rural restructuring

As mentioned above, the lack of public facilities in the village and incomplete urbanization lead to the emergence of HVs. In order to solve the problems caused by HVs, the government has to provide restructuring funds to help rural areas. How to raise restructuring funds is a crucial issue. This stage is crucial for the urban development of China, and this process requires land resources. At the same time, a vast amount of farmland is also needed to ensure food security. The feasible solution to this dilemma is to establish a mechanism in which the demand and supply of land can be balanced between developing and developed areas. The developing areas, through renovating the HVs whereby farmland can be restored, can provide land quotas for developed areas with land shortages because of economic development. Meanwhile, the developed areas can provide the developing areas sufficient fund compensation. With this mechanism, the national food security can be ensured by maintaining farmland of no less than 1.2×10^8 ha. Thus, rural development and rapid urbanization ca be realized simultaneously.

3.2 Optimal population size for future villages

In order to achieve scale economies of rural community public facilities, village population size must be at a sound level; otherwise, operating costs of public facilities would be very high. Village regrouping is an effective way to increase the population size, and helps to integrate industries, space, and organizations in rural areas. However, an optimal population size of the new community must be defined before the regrouping of HVs.

Village regrouping leads to the expansion of the village radius. Farming and service costs rapidly rise because of the increase in village radius. As shown in Fig. 4, the AB curve represents the benefits that the villagers can obtain from village regrouping. This is an inverted u-shaped curve that considers both congestion costs and benefit of public facilities. The cost incurred by the ex-

panding village radius is shown by the CD curve in Fig. 4. In this context, point G is the optimal village radius (or optimal population size) where villagers obtain the biggest net profit. As to the cost caused by village radius expansion, several important facts that need to be clarified. Firstly, with the wide application of agricultural machines, the farming radius becomes larger. Secondly, the farming radius of labor-intensive agriculture is smaller than that of energy-intensive agriculture. Thirdly, with the increase of the income from non-farm work, the larger farming radius can be accepted by villagers. Fourthly, the different landforms and transportation conditions usually need different radius of services. Generally speaking, a large radius of service is required in less-populated mountainous regions. Lastly, a modern means of transport can enlarge the radius of service.

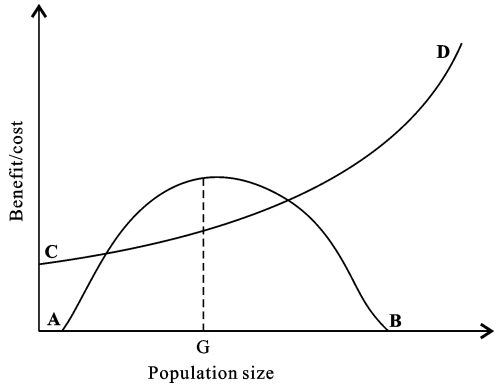

Fig. 4 Effects of farming and service radius on population size

Based on field surveys, the procedure of defining the optimal population size for the new village is as follows. Firstly, a questionnaire is used to determine the village radius that the villagers are willing to accept; this is determined by farming radius and the radius of service. In order to obtain the true will of the villagers, the questionnaire should inform the villagers of all the advantages and disadvantages of village regrouping. Secondly, the number of villages that an area will sustain can be obtained by evenly dividing the area by the above village radius. Thirdly, the number of people a new village can accommodate can be defined by dividing the total population of the area by the number of villages.

Supposing that an area is a square with side length of a, the maximum village radius derived from the questionnaire is r, the number of villages after regrouping is b, the optimal population size of a village is P, and the total population is Q in the area. If the total area is divided by the area of the regular hexagon with radius being r, b can be determined according to Equation (1):

$$[b] = (a^2 / r^2) \times (\sqrt{3} / 6) \quad (1)$$

where, $[b]$ is the integer part of the variable b. Once the value of b is obtained, the optimal population size of the new community can be obtained according to Equation (2):

$$P = Q \ / \ [b] \quad (2)$$

3.3 Site selection for central village

After regrouping, the village scale becomes bigger, and the central village that can provide certain services and public goods comes into being. According to the central place theory, low-level central places are located on the line that connects two higher central places (Wang, 1999). Therefore, villages that are near the state highway, a provincial highway, a country road, or a township road can be selected as the central village. The next step is to regroup the selected village and other villages around it. Through regrouping, the links between the villages and the central community are strengthened, and population of the new village is prone to reaching a reasonable size.

In the future, more and more villagers will be migrating to the cities. Thus, a new village radius replaces the old one. When that time comes, a new restructuring plan is needed. According to the central place theory, the radius of a lower central place is half of that of the higher one. Therefore, the optimal radius of a village in the new round of restructuring should be twice as large as the old one, and the new area of the village is four times as large as the old one.

4 Case Study

4.1 Study area and data collection

A case study was conducted in Yucheng City in the northwestern Shandong Province in March 2009. Traditional farming is the pillar industry in Yucheng City, whereas the manufacturing and service industries are poorly developed. Its problems of agriculture, farmers, and rural areas are quite severe because of long-term limited input into the countryside. Due to poor living conditions and few job opportunities in rural areas, a vast number of farmers, especially young ones, make

their living in big cities. This has contributed to the emergence of HVs. Furthermore, there is insufficient proper supervision. Thus, a large amount of land has been occupied by farmers for building new houses. For these reasons, the construction area per capita in this region is much larger than the maximum level required by the central government of China (150 m^2 per capita).

The investigation was undertaken in 11 towns, among which 60 villages were randomly selected and 43 valid samples were finally ascertained. The survey had three goals: firstly, to collect the basic information about the physical construction and socio-economic context of each village; secondly, to gather the basic information of the villagers, including their household members, incomes, employment, opinions on HVs, expectations on new countryside construction; and thirdly, to obtain information of homestead land, including homestead land area per capita using a remote-sensor image with a resolution of 0.25 m × 0.25 m.

A total of 800 questionnaires were obtained, 401 of which were valid. Also, 4000 copies of information of the homestead land were collected.

4.2 Investigation results

4.2.1 Overview of hollow village

According to the questionnaire results, abandoned homestead lands, unused lands, threshing-floor lands were abundant. The survey of homestead land showed that some families usually had more than one homestead land; such families accounted for 40% of the total households. Most of the houses were brick houses built after 1980. The houses built before 1980 were mainly adobe houses, constituting approximately 15% of the total houses. Deserted houses included both adobe and brick houses. Most of the deserted adobe houses were distributed in the center of the village, and the deserted brick houses were distributed throughout the village. If all the inefficiently used land were used for farming, the farmland per capita would increase by 0.06 ha, or 35% of the current amount per capita.

4.2.2 Effects of urbanization on villagers

According to the questionnaire results, the net income per capita of farmers was approximately 500 USD. Non-agricultural income accounted for 53% of the total income for farmers. Agricultural labor, mostly composed of the elderly, comprised 57.3% of the total labor. In contrast, migrant workers accounted for 16.7%, mostly composed of young people. Farmers who had part-time non-agriculture jobs accounted for 17.2%, and farmers who had other jobs accounted for 8.8% of the total subjects surveyed. Approximately 33.4% of the total villagers lived year-round in cities, and their houses in the countryside were left unused. However, these villagers did not consider their homestead to be idle. The villagers born after 1980 have become accustomed to city life. However, incomplete urbanization makes it difficult for them to live in the city when they become old and lose their competiveness in urban labor market. Thus, they keep their houses in the village in the event that they return to their village in the future.

4.2.3 Villagers' perceptions towards HVs

The villagers who were interviewed identified five factors that have caused the increase of homestead land. First, the area of the original homestead land is too small to meet the needs of the farmer; thus, another plot of land has to be acquired. Second, young couples need a new house for marriage; thus, a new homestead land is needed. Third, the living conditions of old houses degenerate and they become unsuitable to live in. Fourth, the idea of *feng shui* remains still prevalent in rural areas in China. *Feng shui* dictates that the eaves of a new house cannot be higher than the surrounding old houses; otherwise, this would offend the neighbors. To avoid conflict, the farmers tend to obtain a new piece of land for housing on the periphery of the village instead of building it on the original land plot. Fifth, the villagers tend to have easy access to transport services. As a result, the new part of the village usually moves away from the village-heart, leading to the increase in the amount of homestead land.

According to the investigation, the emergence of HVs seems to be linked with the villagers themselves. However, the villagers do not lack knowledge about the law and regulations in land use, and most of them know the policy of ′one homestead for one family′. Thus, there are other driving forces behind the emergence of the HVs.

Key factors behind the emergence of HVs include opportunity and congestion costs. Opportunity cost comes from living in the village-heart. For example, some of the interviewed villagers considered that living on the periphery of their village makes it easier to go to towns or cites. Actually, this problem is mainly caused by poor road conditions in the village-heart, which makes it congested and inconvenient for living. The

congestion costs related to the conception of *feng shui* can be explained as follows: if people live in the periphery, they will not be affected by *feng shui* and have enough space to live in. However, if they do not, they will be congested and lose the benefit of living on the periphery because there is no public facilities and benefit of concentration in the village. If the benefit of concentration is larger than the cost, they will not choose to move out from the village.

4.2.4 Villagers' willingness toward rural restructuring

Approximately 27.1% of the villagers hoped to get help from the government to restructure their villages and to increase the provision of public facilities. Approximately 60% of the villagers also hoped for the restructuring of their villages, but with appropriate compensations offered by the government. Approximately 5.9% of the villagers believed it made no difference to restructure village or not. Another matter of concern is the farming radius. Village restructuring was considered by many villagers to be synonymous to village regrouping. They believed that a bigger farming radius would mean more trouble. Approximately 89.1% of the villagers considered that they needed village planning when they were asked how to restructure their villages.

4.3 A case study of rural restructuring

Lunzhen Town, with a population of 37 500, is located in the southeast of Yucheng City. It has 96 administrative villages, with an average population of 400 in each village. Providing necessary public facilities for every village is difficult because of the small population size of each village. Thus, rural reorganization and restructuring need to be carried out.

The villages considered for regrouping are Zhaozhuang, Wanzhuang, Yuzhuang, and Paizi, which encroach upon one another in the town of Lunzhen. With an average population of about 500 in each village, the total population of the four villages is 1948. Due to incomplete urbanization and shortage of public facilities, all of the four villages are typical HVs (Fig. 5).

4.3.1 Source of funds

The east part of Shandong Province is well developed, whereas the west part is backward. Thus, the government of Shandong Province should carry out a policy that the east provides funds to the west for rural restructuring, while the west provides construction land quotas to the east (new land can be obtained from land restoration through rural restructuring). Lunzhen, can receive funds from the east if its agricultural land is increased by rural restructuring. Land prices in the east are very high due to land supply shortage. By adopting such a policy, the total amount of farmland can be maintained, while the east part can obtain the necessary land resources for industrialization and urbanization, and the west part can get funds for rural development.

4.3.2 Rural restructuring and optimal population scale for new village

Table 1 shows the largest farming radius that the villagers can accept. The farming radius that the villagers can accept is larger than the present radius. As to the service radius, most villages considered that the present radius

Fig. 5 Landscape of four old villages in Lunzen Town, Yucheng City

of primary school is too large and inconvenient. The largest radius they accepted was two kilometers. Another key concern of the villagers was the radius of public water supply. Currently, due to the small size of villages, a water pump is usually shared by several villages; this causes enormous losses in the process of laying pipes. The interviewed villagers believed that, in order to economize the cost of public water supply, the population should not be less than 2000.

Table 1 Survey of largest farming radius in four old villages

Farming radius (km)	Present situation (%)	Willing (%)
$r \leq 0.5$	46	25
$0.5 \leq r \leq 1$	35	32
$1 \leq r \leq 1.5$	14	18
$r \geq 1.5$	4	24

Considering the willingness of the farmers, the optimal village radius was set at 1.5 km, and Lunzhen Town was delineated in a square grid with a 3-kilometer side length, whereas the center of the square grid was chosen as the location of the central village. When the location is geographically limited or far away from the key highways, a fine adjustment should be made. The locations of the central villages and a new spatial structure of Lunzhen Town are illustrated in Fig. 6. After the reorganization, most of the central villages were near the main highways. For a few of central villages that are not currently near the main highway, new highways should be built to connect the villages with the higher-class central places.

After the reorganization, the number of administrative villages dropped from 96 to 13. Supposing the urbanization rate is 1%, the total population of Lunzhen Town will be 35 000 in 2020. Assuming the population of the township is 8000, the total population of all the villages will be 27 000, and each village will have an average of 2000 residents in 2020.

4.3.3 Rural plan for New Keyuxincun

By the method of rural restructuring above, the four villages, namely, Zhaozhuang, Wangzhuang, Yuzhuang, and Paizi (Fig. 5), were reorganized into a new village. The new village is named Keyuxincun, with a projected population of 1800. Due to inefficient land use at present, 125 ha of farmland were restored after the completion of the project. If the government gives the land quota to some east cities for construction use, new Keyuxincun village will receive funds of 2×10^7 USD. In addition, because of sufficient public facilities and clear boundary in the new village, villagers will receive much of the benefits of centralization, which will prevent them from moving out. Meanwhile, the reorganization makes

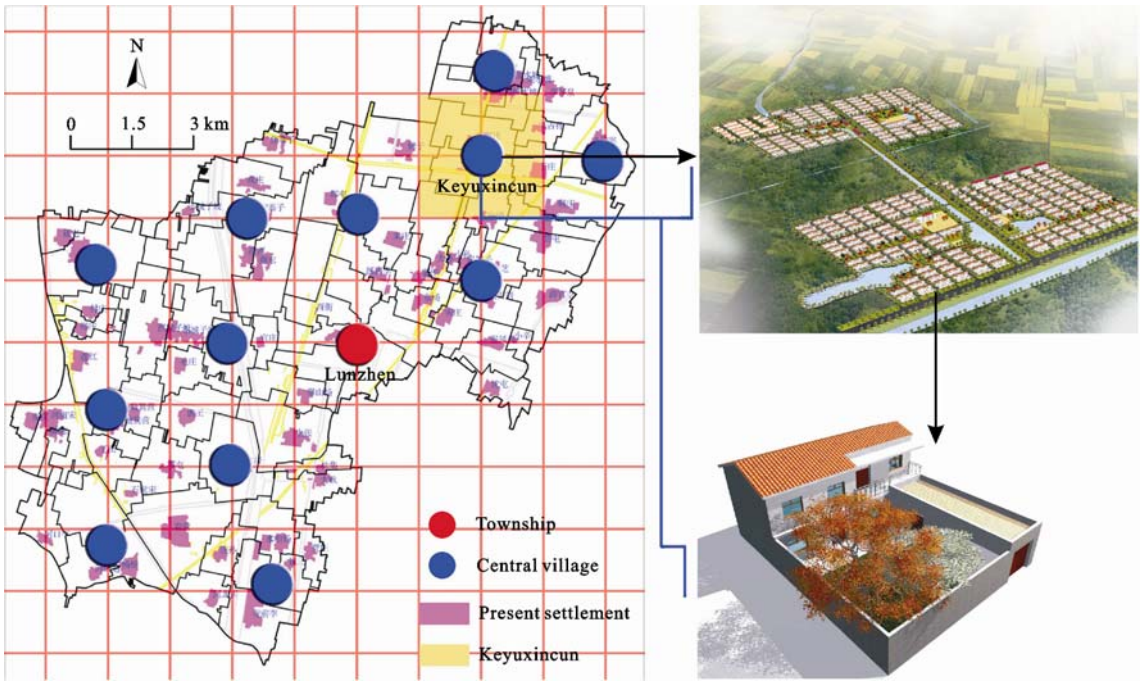

Fig. 6 Location and landscape of New Keyuxincun Village in Lunzen Town, Yucheng City

it easier for the government to manage the land use.

5 Conclusions

This paper examines the mechanism of HVs creation and the method of rural restructuring. Incomplete urbanization and shortage of public facilities were identified as the cause of the emergence of HVs. Thus we suggest that more facilities to rural areas and more job opportunities and social security to rural people living in cities (especially migrant workers) should be provided by the government. To support the work, the central place theory can be applied to villages for regroup them; meanwhile, a new mechanism in the provision of compensation funds by developed regions to the villages in less-developed regions must be established.

Using the emergence theory of hollow village and the rural restructuring theory, we developed a village plan for building New Keyuxincun Village. Based on calculation, we found 125 ha of farmland could be restored after restructuring the four old villages, and New Keyuxincun Village could receive enough funds for building the new village by selling this quota to some developed regions.

This paper has shown a way to solve the problems of HVs in the traditional agriculture areas; however, in the future, we should consider the following aspects. 1) The amount of additional agricultural land that can be restored through the rural restructuring in China should be assured. If the total number is obtained, whether there is sufficient construction land for urbanization will be known. 2) In order to deepen the reform of rural land property right system and reconstructing rural communities, the house and land mortgage system should be studied. 3) How to establish proper monitoring system in the progress should be studied, for village restructuring does relate to the rights and interests of farmers.

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