Comparative Research on Rural Redevelopment planning in the Linpan Landscape: Case Study of Sandaoyan Town, Chengdu.

Liying zhu

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Abstract

Comparative Research on Rural Redevelopment planning In the Linpan Landscape: Case Study of Sandaoyan Town, Chengdu.

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The rapid urbanization of China has greatly affected farmers, rural villages and agriculture, and exacerbated the contradictions and trade-offs that always accompany change in complex ecosystems. Conflicts between economic development, local environmental protection, and cultural landscape stewardship have caught the attention of rural planners. In the extremely populous and agriculturally productive Western Sichuan Plain, *linpan* – small patches of farmsteads, forest and bamboo, and irrigation channels – are an unusually dispersed settlement form. This thesis studies the effects of housing concentration in classic instances of this landscape in Sandaoyan town, Pidu District, Chengdu, Sichuan. The study uses established indicators of spatial change in the *linpan* landscape and describes accompanying changes in accessibility to social services and household living conditions. Combining quantitative geo-spatial information with a data set of socio-economic variables at the household level, the study tested an approach to identify environmental indicators associated with housing concentration and loss of the *linpan* settlement form that may be significant to household income level. Implications for future research include suggestions on designing effective questionnaire surveys and other data collection and decision making. Findings from this study may help local planners make decisions with quantitative and geographic data support.

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This thesis work could not be fulfilled only by myself. I dedicate this thesis to my family– My dear Mom and Dad. Without their support, I cannot finish all tasks and look forward to a more professional career in Urban Planning.

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I am also thankful for the help from other people. Ph.D. student Shuang Wu and Master student Fengyi Xu, who worked with me for months on the spatial analysis of linpan as group work. Without their company, I cannot imagine how I can work out that period without their company and collaboration. Ph.D. student Feiyang Sun helped me a lot on how to organize the research and how to apply methods of other literature into my study, who always give me inspirations when I feel upset and confused. Ph.D. student Boyang Sa helped me to solve technical issues on ArcGIS which usually bothered me for a long time. Buster provided plenty of support on my English writing in the final stage and gave me valuable suggestions to express my thoughts precisely. Thanks to other students who used to participate in related research and field surveys. Ph.D. student Tianzhe Wang helped me a lot in the related coursework and statistic analysis as a great tutor and a warm-hearted friend.

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Chapter 1. Introduction

1.1 Problem statement

Rural planning problems

China is a nation with a long time farming culture. In traditional Chinese culture, from the ideology to the daily life, the population are profoundly infiltrating the imprint of rural culture (Chen, 2013). The development and growth of the Chinese society also have local cultural characteristics. According to the data from the sixth nationwide population census in 2010, the number of people living in rural areas is about 674 million, accounting for 50.32% of the total 1.34 billion population. It remains complicated and meaningful to address the rural development problem. Since the founding of New China, primarily since the Reform and Opening policy 30 years ago, the economy has significantly strengthened (Wang and Tan, 2018). At the same time, the gap between urban and rural areas in China has gradually become massive. The backward and effiencient agriculture, the deteriorating rural living environment, culture and landscape, and other problems relating to agricultural technique, built environment of countryside, and farming customs have hindered the rapid development of the economy and society (Fang, 2012)

The term “Three Rural Issues” (San nong) is used to describe the issues related to the urgent need for China to modernize its agriculture, improve farmers’ socioeconomic conditions, and build fundanmental infrastructure in rural areas (Li 2017; Giblin-Delvallet, Colin and Vermander 2013). Briefly, the three issues are agriculture, countryside, and farmers (nong ye, nong cun, nong min) (Li 2017). Without mediations, the “Three Rural Issues” could threaten economic growth, social stability, and even the Party’s hold on power (Giblin-Delvallet, Colin and Vermander 2013).

Table 1 Three rural issues (Adapted from Whyte 2010)

Three Rural Issues
Issue: Pay attention to economic development indicators and ignore natural ecological protection.
1. Excessive use of ecological resources, causing soil erosion, environmental damage, and environmental pollution.
2. Ground and groundwater pollution, plant soil pollution.
3. High energy consumption High-polluting enterprises are transferred to rural areas.
Issue: Pay attention to village construction and neglect industrial integration.
1. Push down the old village and fix the new town.
2. Forced peasants to build houses in a concentrated manner, blindly pushing farmers to go upstairs.
Issue: Pay attention to material inputs and neglect cultural construction.
1. The fragmentation of traditional settlements and the loss of folk cultural resources.
2. Cultural development is lagging behind.
Issue: Pay attention to top-down administration and neglect bottom-up village self-government.

Therefore, the goals of advancing the rural ecological, economical, social, and cultural environments guiding the construction of communities are more consistent with the new Chinese socialist culture. This obviously calls for comprehensive, in-depth research. The study of planning models and policy evaluations for rural areas are an essential part of the research which is prevalent in the urban planning disciplines seen recently in the Chinese literature.

Contradictions and trade-offs always accompany rural planning in the case of a complex ecosystem.The conflict between economic development and local environmental protection, and cultural heritage has caught the attention of rural planners. Combining with China's national conditions, rural planning has traditionally been conducted in a top-down approach. The existing rural policies have had an unavoidable and enormous impact on local culture and environment. On the one hand, China's population is relatively large, and it needs rural space to ease pressure on crowded cities. On the other hand, a part of the rural community has become dissatisfied with low-income agriculture and has gone to work in cities. Therefore, the population flow between cities and rural has brought complex cultural network into the mix of regional planning and construction. However, it is difficult for rural areas to preserve the most valuable or at least unique features in the process of urbanization.

This paper is based in part on rural planning and design for related topics in my undergraduate coursework projects. For example, I worked with group members for a long-term comprehensive

planning for Huashui Town (a village in Zhejiang province) which want to upgrade their industrials and expand the center area in the planning. I gained experience dealing with rural planning through these works.

In the UW ArcGIS related course, I was involved into a project with Prof. Dan Abramson and a Built Environments PhD student Shuang Wu.We participated in a series of studies on Linpan, which is a local characteristic of traditional rural settlements. As the figure 1 shows, Chengdu is located on the western plains of Sichuan and is considered to be one of the most meaningful topics in Chengdu rural planning (Figure 1).

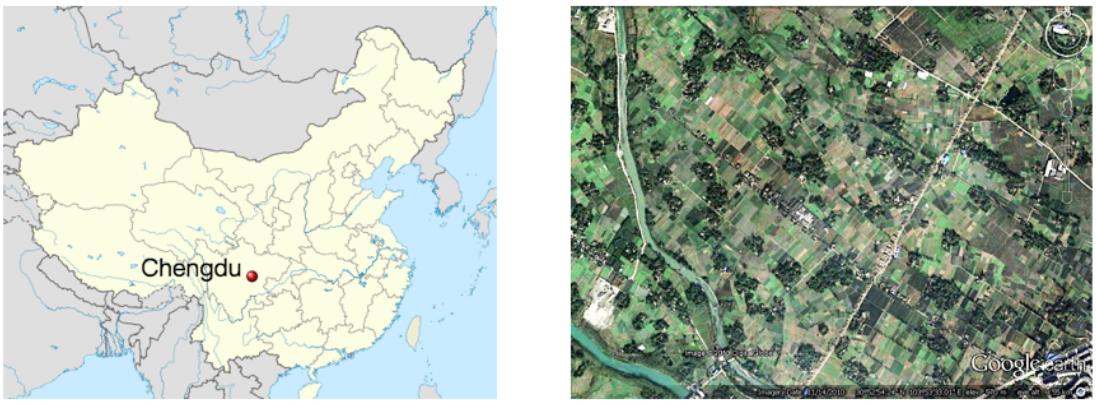

Figure 1 Location of Chengdu and Chengdu Plain Aerial (Source: Dan Abramson, APRU presentation)

Linpan is defined as the basic geographical unit of compound rural settlement system, Linpans are scattered throughout the Western Sichuan Plain (Figure 2), and are defined by rural housing settlements within forest environments that to some degree integrate living and production areas with the native ecology and landscape (Fang 2012).

Figure 2 Chengdu Plain Aerial (Source: "Linpan In Chengdu Plain" 2018)

The Western Sichuan Plain is one of the most fertile plains in China. Historically, as a result of the famous Dujiangyan irrigation project, millions of acres of farmland in the western Sichuan plain have been flooded by self-flowing irrigation. Its rich resources and fertile land can be compared with the pearl river estuarial delta and Yangtze River estuarial delta. However, few of the agricultural lands like Chengdu Plain in the world has remain its integrity along with highly productive agricultural activities.

Linpan development

In the wave of new rural construction, Chen and Gao (2011) has stated that concentrated communities can improve the efficiency of roads and other transportation facilities, and also increase the utilization of social infrastructure (Wang and Xue 2017). In other words, the scattered peasant settlement model is an inefficient use of land. The government believes it's more efficient and cheaper to maintain services and utilities in a compact pattern than a dispersed one based on the theory of New Urbanism and Smart growth movement which support a compact approach.

When this idea is applied to the western plain area of Chengdu, which is dominated by the traditional dispersed Linpan (rural settlement）, it gives rise to some problems. The survival of the traditional Linpan structure and function is threatened not only by the urbanization process but also by a redevelopment policy preference for concentrated settlement forms.

Need for next step

Pi County, located in Chengdu, applied for Globally Important Agricultural Heritage status in 2017, and the themes for the application are crop rotation and Linpan cultural heritage protection. As the core irrigation area in Dujiangyan, Pi district has a traditional mode of production that includes Paddy-upland rotation (Shuihan lunzuo). From ancient times to the present, Linpan, as a type a rural settlement in the west of Sichuan, is distinctive and resilient.

Linpan is a kind of culture that has stood the tests of history. Studying its residential, morphological transformation can provide a robust basis for future planning and continuous

study. From the 1990s to 2010s, there were several policy direction changes.The policy has evolved to semi-concentrated principles which are dominant in current plans (Figure 3). Before and after the transformation, people's production methods, social resource allocation, transportation, and accessibility of resources changed to some extent. It's worthwhile to explore the change, not only in morphology and spatial structure of Linpan system, but also the livelihood choice and living habits of villagers. In this instance, a methodology to study the features of Linpan system and local livelihoods based on these changes are needed to evaluate the redevelopment of semi-concentrated Linpan and traditional Linpan.

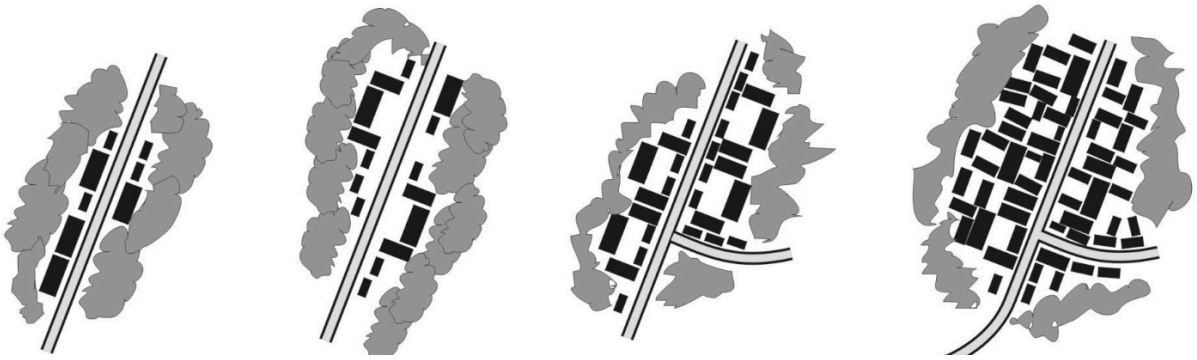

Figure 3 Settlement type of Panxi style (Source: Lin, 2011)

Aiming to help local rural planners evaluate and compare the choice for the redevelopment of the villagers with Linpan landscape, I want to conduct some comparative research on the villages led by different models, both on village level and household level. According to the media and news, the new mode of "Small-scale (xiaoguimo 小规模), Group-forming (zutuan 组团式), Micro-Ecological gardens (weiqihouhuayuan 微田园，生态化)" (the "semi-concentration model") has received lots of recent appraisals. However, there is little research to compare different models and landscape characteristics in the planning process which is done in a top-down fashion. Furthermore, the rural planning process usually lacks the support from spatial analysis (e.g., Table 6) and quantitative research on household data in section 4.4. Such study may help the local government think in-depth, and understand the impact of the different alternative model at the village level and household level, and carry out the design of various plans thoughtfully, and improve the support for the current rural landscape planning in combination with the new technology of geographic information.

There are some aspects in the Linpan study appealing to me. Firstly, it's meaningful to quantify the spatial structure of Linpan landscape in a time series to establish a baseline to be incorporated into future Linpan development planning. Based on the baseline and trend of Linpan landscape, the evaluation of different models would be more robust.

Inspired by the literature and projects, this thesis compares two different models of Linpan redevelopment both on village level and household level to understand the discrepancy and similarity by a set of indicators adopted by available data and appropriate approaches. On top of that, using socio-economic survey data, I tested a Multiple Regression Model as a method to correlate aspects of the semi-concentration model, and other built-environmental factors with rural income and livelihood choices. The methods tested in this thesis, when applied to a larger set of data, may provide some evidence about the performance of the semi-concentration model and traditional model in a quantitative way. The purpose of this approach is to interpret the significance of indicators for the difference of accessibility to services and facilities, and the variance of livelihood choice and lifestyle.

1.2 Research question

This research addresses the following questions:

- During the urbanization from 2002 to 2018, how has the distribution of Linpan spatial pattern in a specific sample area changed?
- How is the semi-concentration model and the traditional model of rural settlement different in terms of accessibility to social services and infrastructure, socio-demographic characteristics, and household economic conditions?
- How might a future survey best take account of the findings of this study?

1.3 Structure of this thesis

Chapter 2 provides the background and literature review for the development of Linpan. Firstly, it reviews the national and citywide rural redevelopment policy. It then introduces the concept of Linpan and its characteristics in a detailed look and further interprets the planning directions in the past and for the future.

Chapter3 introduces the history and development of village sites discussed in the study. Also, additional mapping of some preliminary graphics are shown in this chapter to illustrate the spatial pattern of the study area.

Chapter4 describe the process of how to acquire and collect the main data set. It then defines the method how to understand the change of Linpan landscape in a time series, and how to evaluate the redevelopment models in the household level.

Chapter5 shows the result of the comparative evaluation and regression model to further examine the spatial and social indicators based on survey data.

Chapter6 summarizes the statistical analysis result and discusses reflects on this result for a future study and field survey.

Chapter 2. Background

2.1 Chengdu and Pi county

During the period of land consolidation, Chengdu played an important role in the exploration of rural construction and resettlement. An increase and decrease linking policy (Zengjian guagou） has brought a significant change in rural settlements since 2008 (Zhou and Wang 2015).

In 2007, the National Development and Reform Commission of China approved the establishment of two pilot regions for further experimentation in executing reform packages under the CURD strategy: Chongqing and Chengdu (see Notice of the National Development

and Reform Commission on allowing (the establishment of) pilot region for comprehensive reforms of coordinated urban and rural development in Chongqing and Chengdu).

Notably, Chengdu was approved as the pioneer city by the National Development and Reform Commission of China as "experimental zone of comprehensive reforms of coordinated urban and rural development" in 2007 (Zhou and Wang 2015; Wang 2009; Li 2017). The main content of the comprehensive reforms of coordinated urban and rural development can be concluded in the principle of “Three Centralization” (Zhou and Wang 2015). The “Three Centralization” means the concentration of industries on industrial zone; rural farmers to concentrate on the urbanized fringe area and move to new housing compounds developed by the authority; and land development to be concentrated and intensified on designated areas (Li 2017). This not only transformed the context of rural area, but also encourage the integration of urban and rural areas. In the background of rural land reform, the morphology of the village and the Linpan, the lifestyle and production of farmers would change significantly in Western Sichuan Plain , located in Chengdu(Zhou and Wang 2015).

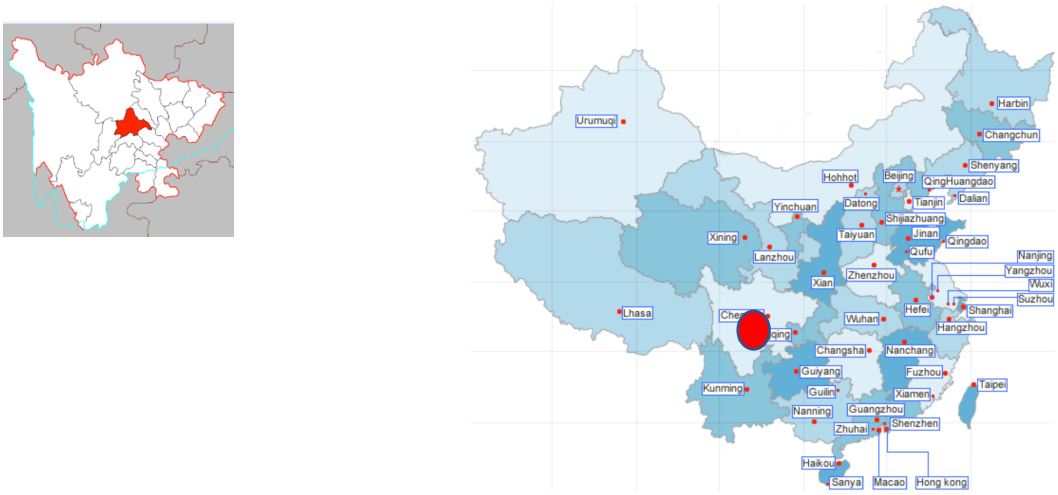

Figure 4. the Location of Chengdu city

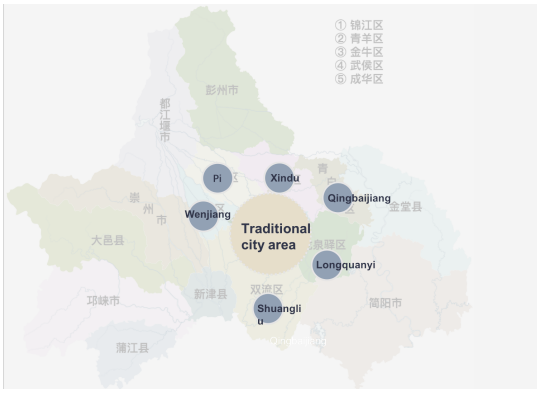

Figure 5 Structure of Chengdu city (source：created by the author)

As a fast-developing satellite county, Pi county is a widely selected study area for Linpan researchers which has both characteristics of traditional rural culture and rapid urbanization (Guo, Liu and Xu 2017; Fan 2009) Particularly, Pi county has advantages for the large numbers of Linpan and well-preserved Linpan（Fan 2009）. Therefore, the protective planning of Linpan landscape is the critical approach to build the ecological town which is the development goal of Pi county.

The rural land reform area includes our study area, Pi county, since it is close to the city center and is included into the planning boundary of Chengdu according to the comprehensive plan of 2011-2020. The main task of Pi county's rural land reform is the demolition and reclamation of scattered rural residential areas to increase the area of cultivated land ("Linpan Protection And Utilization In Western Sichuan" 2014). However, if a Linpan is defined as “Protected Linpan”, it would not be included in the scope of land consolidation. The quantitative goals of the reform policy are based on a sample survey result which indicates that 25% people who are not willing to move in the county level ("Land Use Planning of Pi County 2006-2020" 2006). In this case, 64 centralized settlements (708 ha) are planned to provide houses for farmers in the town, aiming to settle 118000 people ("Land Use Planning of Pi County 2006-2020" 2006).

2.2 Linpan development

Linpan is a social ecosystem with cultural and ecological significance that persists for centuries or even thousands of years. Linpan landscapes are characterized by decentralized living patterns and the interaction of necessary land use factors including fields, irrigation channels, and

dwellings within forest lands or forest patches. Fang (2012) summarized the structure and rules of development of Linpan culture from the perspective of living, production, ecology, and landscape metrics, aiming to discuss and explore the protection and utilization of Linpan in modern society. It's a comprehensive study which not only refers to the summative description of Linpan landscape from past to the present but also discusses different redevelopment models of Linpan based on both strategies and evaluation indexes (Fang 2012).

The mode of "Small-scale, Group-forming, Micro-Ecological garden" is unique in the process of balancing urban and rural development of Chengdu. It collaborated with propulsion of "Industrial development, new village construction, infrastructure and public service support and grass-roots governance" (Shurong and Ao 2018). For future planning development, Qinggangshu village was selected by local government as a typical case. These innovative settlements are a group of Linpan and rural complexes, which are advertised as a typical successful case in the new countryside construction regarding the landscape of Western Sichuan Plain. The word, "Semi-concentrated model" (figure 6)is used in the following chapters of this thesis to represent this mode of "Small-scale, Group-forming, Micro-Ecological garden".

In the process of village development, there are three spatial patterns established by the different planning policies (Tippins 2014).

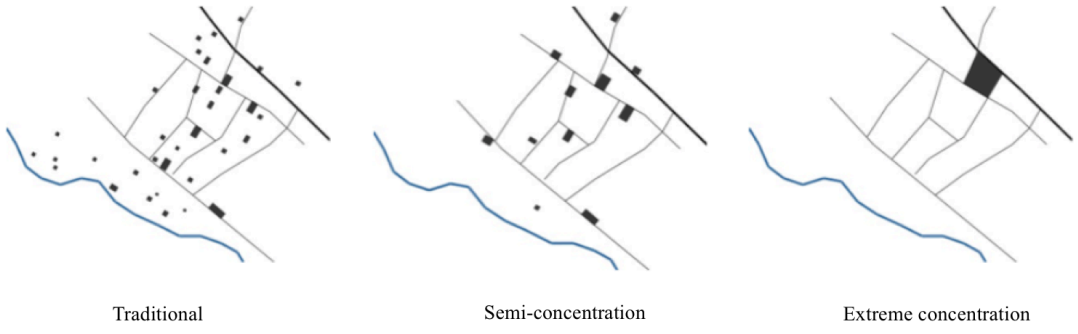

Figure 6. Examples of different spatial patterns of villages
(Source: adapted from Tippins 2014 and created by Wang Yue)

With a view of the contradiction between short-term planning objectives that focus on efficient land use and long-term goals that support resilience and sustainable development, Tippins (2014) applied a resilience framework to evaluate redevelopment model choices and to conduct spatial analysis on landscape pattern using a group of indicators and measures in three main categories (landscape heterogeneity, appropriate scale, and biodiversity). The study area includes Zhanqi and Anlong and Jiangan village which located in Pi County (Pi Xian) because each of these three villages executing different redevelopment parttern. Through interviews with different groups of local people and in-depth understanding of Linpan, Tippins (2014) establish a baseline typology in 2014 and then do comparative analysis on alternatives including traditional model, semi-concentration model, eco-village model and extreme concentration model (Tippins 2014). However, she also indicated several future directions on the related topic. One is to find a fully developed semi-concentrated village since it was too early to assess the changes and redevelopment in the semi-concentrated model in Anlong village, which only began redevelopment in 2012, within a year of her survey. Besides, selected social indicators adapted for local communities , like the data form household surveys which was the first used by Lei (2014), are helpful to do further analysis on comparative study.

Additionally,Liu and his partners summarized and analyzed the research progress of the connotation, evolution rule, value characteristic, protection and development of Linpan. They pointed out the future research direction: (1) quantitative appraisal and synthetic tradeoff analysis of Linpan ecosystem services; (2) research on theory and technology for the protection and transformation of Linpan in Chengdu Plain; (3) explore and analyze the theory and technology of the utilization and renewal of destroyed Linpan. (Liu et al. 2017)

Additionally, Wang (2015) states Lin Pan landscape might be a kind of new planning model for Chengdu which has high population density, this model can increase the accessibility between village and external without any increase in building density. Also, she analyzed and evaluated the differences commuting behavior of four different villages of pi county through three factors — commuting characteristics, population density and accessibility (Wang 2015). Similarly, to protect Linpan traditional landscape, Xiao (2015) extends previous research and explore the agricultural ecosystem resilience index based on landscape morphology, and she finds that

compare with diverse agricultural ecological system and decentralized network of marketing and social relationship, the Linpan landscape pattern might be more geographically adaptable and bring vitality to rural households (Xiao 2015).

Chapter 3. Study Area

The study area, Sandaoyan town, is in Pidu District (It transferred from county to district in 2016). This area is located in the heart of the Chengdu Plain and Dujiangyan Irrigation District where the rural area maintains the typical characteristics of traditional Linpan settlements. Dujiangyan is an ancient irrigation system constructed around 256 BC as an irrigation and flood control project which is still in use now ("Dujiangyan", 2018). Looking at the important form of regional spatial structure, Pidu district stretches across the first, second, and third ring of Chengdu city(figure 7), which can represent the gradient distribution from Chengdu's downtown area to the urban-rural fringe area to the rural area.

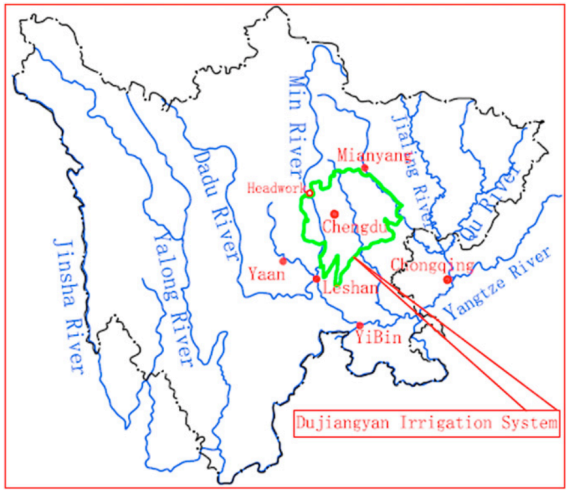

Figure 7 Location of Dujianyan Irrigation System (DIS) in Sichuan Provice （Source: (Cao, Liu and Er 2010)）

Sandaoyan Town is located in the northeast of Pi District and the town is just 6 kilometers from the county seat of Pi County and 19 kilometers from the central district of Chengdu. The township covers the total area of 18.26 square kilometers, a built-up area of 2.5 square kilometers, and a cultivated area of 16,505 mu ("Yearbook of Pi District" 2016). Sandaoyan Town is rich in water resources, and two of the five major branches of the Min River that flow through Dujiangyan - the Baitiao River and the Xuyan River -- run through the whole territory of the town.

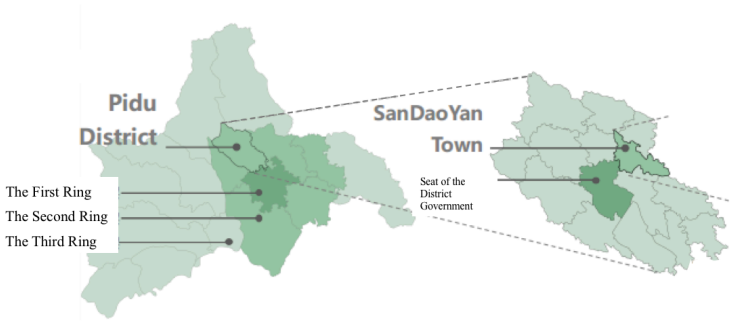

Figure 8 Location of Sandaoyan town (source: adapted from Wang & Xue, 2017)

Sandaoyan town plays a critical role in the development of Pidu district. Chengdu government noted Sandaoyan town as Pilot Town of Sichuan Small Town Construction in 1996 and as the important town of Sichuan Small Town Construction in 2002. In January 2007, it was listed by the Chengdu Municipal Government as one of "the city's 60 priority new towns for the future development", "a unique new village in a Water-town leisure tourism destination". Until 2011, it was nominated by the county government as one of the demonstration towns for "Ecological gardening in the world".

In the yearbook of Pi (2016), it showed that the basic protective farming land is 1187.21 ha with 609.63 ha constructive land and 15.11 ecological control area. In fact, the development and urbanization of Sandaoyan have been in fast-paced growth in the past 20 years with newly improvement and construction of base infrastructure such as road system and sewage treatment. From the aspect of transportation, the government had much investment in the road systems which aim to support significant additions to local demand. It also shows that the average income of farmer is 18600 yuan, an increase of 12%. Generally, the Sandaoyan Town completed a tax revenue of 52 million yuan throughout the year, an increase of 12% yearly, an investment in fixed assets of 920 million yuan, and a target of 112%; the industrial output value above designated size was 410 million yuan, an increase of 10%.

With the water source resources, there is a relatively strict protection policy in local development especially in a specific area within a buffer of the river and riverbank. Additionally, the new

second ring motorway of Chengdu passes through the Sandaoyan Township which adds more restrictive at both sides of the buffer zone (Figure 9).

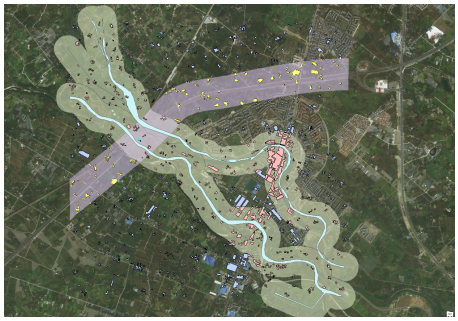

Figure 9 illustration of the buffer zone (source: created by the author in coursework)

In July 2017, a group led by Prof. Daniel Abramson that included students and faculty from Sichuan University, Tsinghua University, Harbin Institute of Technology, Taiwan National Cheng Kung University, and the University of Washington conducted a field survey, with householder questionnaires and face-to-face interviews with village leaders in three villages of Sandaoyan town. The questionnaires were developed based on a previous 2014 survey in four other villages elsewhere in Pi County, aimed at understanding and exploring the socio-cultural issues of the linpan villagers in Sandaoyan. The Sandaoyan survey was conducted in Qinggangshu village, Qingta village, and Paotong village. Qinggangshu village was fully transformed into a new type of village, with flourishing rural tourism in semi-concentrated linpan settlements. The Qingta village and Paotong village keep the traditional dispersed linpan pattern to a large extent. Indeed, Qingta village just began to follow similar development process of Qinggangshu village at the point of the questionnaire. However, it is still identified as the village with the traditional pattern of linpan. As for Paotong, a large part of the land for construction is located in the buffer zones along the river and highway. Therefore, the landscape is well-preserved in Paotong village all the time. The conventional cultivation of rice and vegetables such as chives is still the primary source of household income for Paotong villagers. However, residents are forbidden to undertake any construction or infrastructure improvement within the buffer zone, imposing a significant hardship. Due to different development pattern of the land reform and linpan, the three villages represent two models as the village with Semi-concentrated model and the village with the traditional dispersed model. It's worthwhile to explore and present the features of these two types both on the survey data and spatial and landscape analysis.

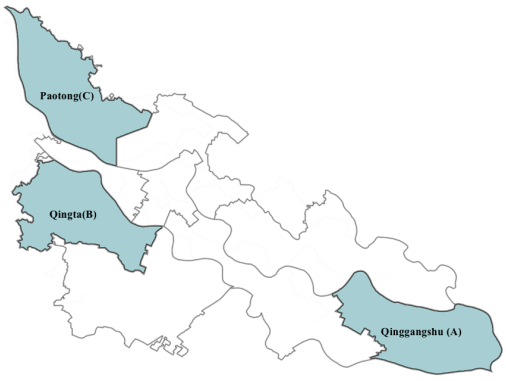

Figure 10. The location of the three villages (source: created by the author)

Table 2 An overall statistic of the three villages （Source: Wang & Xue 2017)

		Qinggangshu	Qingta	Paotong
Household/Population		932/2251	690/2300	720/2332
Village Area (km^2)		2.40	2.32	1.87
Rural Land Reform Contents	Rural planning	√	√	√
	Land registration	√	√	√
	Farmland transfer	√	√	
	Construction land transfer	√		
	Land consolidation	√		
	New settlements construction	√		
Number of interviewed households		47	38	32

Until the survey conducted, because the redeveloping of Qinggangshu village has greatly increased the income of farmers, so it has been developed in semi-concentration model for four years as a typical and successful case in Linpan protection. The project of centralized construction of farmers in Qinggangshu Village was approved in 2010. Farmers' net income was 11,953 yuan in 2012 which mainly from farmers grow grain and vegetables, other from migrant workers. (Cheng and Zhao 2016).

The project plan is to build nine resettlement sites, a total of 98,000 square meters of resettlement houses, and 487 households and 1668 people will be resettled. It is expected that the rural construction land use index can be saved 305 mu. After two years, the Qinggangshu farmers autonomously established the "Qinggangshu Village Asset Management Company" and initiated land consolidation and resettlement housing construction through financing to the Chengdu

Rural Commercial Bank (compared with the expenditure of public funds from fiscal funds). It took three years to complete the construction of nine resettlement sites with infrastructure construction and community public service centers. As a result, 2041 villagers (in anticipation of resettlement of 1668 persons) were assigned to check-in accommodations in 2013 (Table 2). It won lots of titles in 2015 such as “National Livable Town” and “China's Top Ten Most Beautiful Villages". Since the completion of the construction of the beautiful village in 2013, Qinggangshu village has received more than 3,000 tourists every day (Micro Chengdu 2017).

For Qingta and Paotong village, which large part of the land is located in the protection area of drinking water in Chengdu city, the eco-agriculture base is the key to form a water conservation harmonious communion. Comparing them to Qinggangshu village, they have entirely different development pattern and spatial form until 2017.

Chapter 4. Data and Methodology

The purpose of this chapter is to describe the data collection process and the methods used in this research. In order to collect data about geographic accessibility and household living condition, questionnaires have been used and the result would be more available.

4.2 Data collection

The research questions focus on the comparison of geographic accessibility to social service and facilities and household living condition between traditional Linpan and semi-concentrated Linpan.

Briefly, there are three main sources of data as discussed below.

1) The spatial distribution layer of Linpan, including:
   - Linpan patches in the study area with spatial information
   - Roads layer in the study area with spatial information
2) The socioeconomic data and geo spatial data of services and facilities of Linpan study area, including:
   - Spatial and Geographic database of social service and facilities
   - Socio-economic data of the town and selected villages
3) The household data
   - Questionnaires result
   - Geographic location of sample population

Understanding the transformation of Linpan settlement system in a time series, there are two sets of data collected from different sources, a historical vector map and google earth image. For Linpan itself, the transformed data needed in this study are the wood area patch and the road layer.

The first dataset came from my coursework of geospatial class, where our group conducted a project to explore and quantify the changes of the Linpan landscape. The base map is a set of valuable 1990's maps of Sichuan, and the study area was within Sandaoyan town. Without a raster format, the measure of the change cannot be smooth in the ArcGIS if there is only a vector image. The way used to transfer the vector to raster relied on the AutoCAD and GIS software because of two reasons. One reason is that there was no available technique to get a satisfying result automatically and correctly. The main reason is that the concept of Linpan cannot be recognized rightly in image recognition.

The final method was to use tracing in AutoCAD and then import into ArcGIS. Additionally, the tracing work with the same procedure continued for the 2002–2018 image of the sample area in Sandaoyan (google earth image). The local planning document provided the original planning maps, which provide some local information about that year, such as the planning boundary. Finally, a time series graph of the Linpan form and main road in 2002, 2010, 2014, 2015, 2017 and 2018 of the eastern area of Sandaoyan town were finished. There were two fundamental parts, including the Linpan patch as polygon and the road system as the polyline.

For measuring the spatial accessibility of services and facilities for the rural Linpan settlements, the Point of Interest (POI) data of Sandaoyan town was collected from the AMAP (A Chinese map company) as the destination information. A POI is a specific point location, a landmark and scenic spot on the electronic map to mark the activity places, such as government agencies and commercial organizations (gas stations, department stores, supermarkets, restaurants, hotels, convenience stores, hospitals, and so on), represented by the area ("Points of Interest" 2018). Through python to get the required range of rectangle data on Gaode API interface, then filter them to get available POI.

To some extent, POI can reflect the spatial distribution of local activities, service, and facilities.

It would include tourist attractions (parks, public toilets, and so on), historical landmarks, transportation facilities (various stations and parking), and the like. The requisite is that the points of interest should include names, categories, longitudes, latitudes, altitudes, and so on, to enable to be presented on the electronic map ("Points of Interest" 2018). To some extent, it can reflect the spatial distribution of local activities, services, and facilities.

In the following chapter, the spatial accessibility of Paotong, Qingta and Qinggangshu is quantified in ArcGIS to different types, according to the kind of facility or service. The classification comes from the AMAP standards and has been simplified for this study, as shown in Table 3.

Table 3 Standard of Classification for POI adapted from AMAP standard of classification

Classifiation	Sub-subject
Car service	/
Catering service	/
Shopping service and markets	/
Life service	/
Sports leisure	/
Healthcare	/
Accommodation service	/
Scenic spots	/
Business residence	/
Government agencies	/
Technological and cultural venues	Kindergarten / Elementary School / Senior School / High school
Transportation facilities	Parking lot / Bus stop / Intersections
Financial insurance service	/
Companies	Primary industry (farming, forestry, animal husbandry and fishery) / Factory
Village name	/
Public utilities	/

For the third part, the household information was derived from a face-to-face survey conducted in 2017. A group of college students from Sichuan University, Tsinghua University, Harbin Technology University, Taiwan National Cheng Kung University, and the University of Washington accomplished a summer workshop in Chengdu city. The workshop contained field surveys and face-to-face interviews in three villages of Sandaoyan town, including Qinggangshu village. The questionnaires were in Chinese and developed based on previous years' workshop experience, aimed at understanding and exploring the socio-cultural issues of the Linpan villagers in Sandaoyan Township, Pi District of Chengdu Metropolitan. There are four principal sections to organize this questionnaire, as shown in Table 5. The questionnaire and survey results come from the collection of Prof. Dan Abramson.

Table 4 Main Categories of the Questionnaires

Category
1) Individual and family basic information
2) Land usage and occupation information
3) Household consumption and income
4) Daily activities and social network

As a consequence, person-to-person interviews involved a sum of 117 households with geospatial information as the sample, for the comparison and evaluation of the evolved Linpan and traditional Linpan – 47 from modern Linpan and 70 from traditional Linpan. It includes Qinggangshu village (village A / semi-concentrated pattern), Qingta village (village B / traditional pattern), and Paotong village (village C / traditional pattern). Thus, we can adequately portray, analyze, and compare the reconstruction and transformation of the spatial and socio-economic patterns of the rural settlements, driven by the mode of "Small-scale, Group-forming, Micro-Ecological garden," which is titled as semi-concentration model here, as a typical case.

4.2 Change of Landscape trends

As a cultural landscape or agricultural heritage (Figure 11), the critical element that keeps rural landscapes of Western Sichuan Plain with its unique enchantment is the unique settlement "Linpan." Forests, irrigation channels, and house yards compose a Linpan unit physically (Qingjuan, Bei and Kui 2011). With geographically dispersed location, this unit is the most fundamental of a settlement. It has been used not only as the residential cluster but also a complex agricultural ecosystem by the local people for hundreds or even thousands of years ("Chengdu Planning: Protect Linpan Landscape in Western Sichuan" 2007).

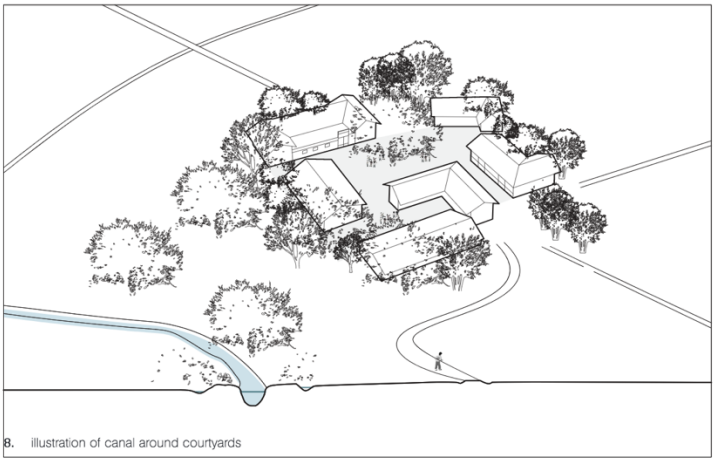

Figure 11. Linpan Landscape Illustration. (Source: Fei Hong, MIT Thesis, 2015)

On the purpose of understanding the change over time, historical data and appropriate attributes are needed to describe and analyze the trends. I counted a patch defined as Linpan as a geospatial point and calculated Euclidean distance from a point to point. The tool used in ArcGIS here is Proximity Analysis, the Near tool. The indicator to quantify the transformation of Linpan form are shown in the table 5 which clearly classify the approach to measure accessibility.

Table 5 Indicators to quantify the Linpan landscape

Approach	**Accessibility measures**
Immediate proximity	The distance between a position and the closest facility
Availability within one area unit	The number of facilities contained within an accustomed unit
Number of facilities contained within an accustomed unit	The number of facilities contained within an accustomed unit
Average cost from a location to all destinations	The average distance between a position and all facilities
Average cost to reach diversity	The average distance between a place and facilities

4.3 Evaluation of accessibility

In order to explore the spatial connection between Linpan and facilities, the accessibility are measured in this study. Accessibility is a concept referring to the origin and the destination two main component in individual trips including someone's home, places of work, or shopping malls. ("Multi-modal Accessibility Methodology and Application" 2016).

Rural accessibility is different with accessibility in urban area. In rural areas, accessibility to the center of each administrative division (City/County/town/village) and to the local markets has a strong influence on the livelihood choices and welfare of the villagers (Olsson 2009). The critical function of transport is to facilitate the access people have to goods, services, and information. However, the transport patterns and lifestyles differ substantially between urban areas and rural areas (Donnges 2001). Donnges published a framework based on IRAP (Integrated Rural Accessibility Planning) approach in the Transport and Communications Bulletin for Asia and the Pacific journal.

Additionally, rural-to-urban transportation options affect the opportunities for education and healthcare. In other words, the welfare of residents relates closely to accessibility to all kinds of facilities and public services, as same as job opportunities. There is abundant literature referring to the accessibility of public health or educational facilities in the rural areas.

Health service is the most popular topic to explore the accessibility in rural area. The two-step floating catchment area method (2SFCA) is a methodology to measure the accessibility of public health services, using a gravity model of spatial interaction (Luo and Wang 2003). McGrail and Humphreys (2009) introduced an improved 2SFCA method in quantifying the index of rural access that measures the primary care access, which is a advanced two-step floating catchment area method. The three main access elements in their framework are availability, health needs, and mobility, which are based on cumulative zoning data.

Commonly, quantifying the accessibility score is based on zone scales, which is not applicable to this study. The significant reason is that the data needed at village level and rural areas is

difficult to acquire in the Chinese environment. It is not readily available in public online platforms right now. In this case, the distance from a point to another point is the central concept applied in assessing the accessibility. Initially, the Euclidean distance between the origin and the destination is the most traditional and straightforward method, though it has been critiqued (Ingram 1971). Aiming to describe and understand the spatial patterns of accessibility in the study area, the approaches summarized in Aparicio's article are the leading methodology for this study, which is Distance Accessibility.

Apparicio et al. (2008) compared the alternative approaches to measuring the geographical accessibility of urban health services, including distance types and aggregation-error issues. This methodology can be used to measure other accessibility, such as accessibility to jobs and other public services, as shown in Table 6.

The data source is varied because of the lack of transparency of the geographic and demographic data. Due to the data limitation especially for the household and zonal data, Apparicio would be the main methodology in measuring the accessibility and availability of social service and facilities.

Table 6 Factors for measuring the spatial accessibility of services and facilities for residential areas (Source: created by the author based on Apparicio et al. 2008)

Genre	Services and facilities	Indicator
Basic Infrastructure	Highway	Distance to the highway
	Transit	Number of bus stops
	Public toilet	Number of public toilets
Education Accessibility	Elementary school	Number of elementary schools
	Senior school	Number of senior schools
	High school	Number of high schools
		Average distance to schools
Transportation Facilities	Main road	Distance to the main road
		Total road length
Medical Service	Hospital/Medicine service	Distance to the medical service
Tourist Accessibility	Tourism spot	Distance to the tourism spot
Financial Facilities	Financial companies / Bank / Insurance companies	Distance to the financial facilities
Job Opportunity	All POI with potential jobs	Number of job opportunities within 15 min circle (1000 m)
Natural System	Linpan size	The average size of Linpan
	Linpan density	Linpan density per kilometers

When people want to reach some activities, the time and money they must devote to transportation, especially in Linpan landscape where people live in scattered settlements. Lots of factors can affect accessibility in different ways. In order to evaluate the performance of the village oriented by the different development model on the accessibility of the service and facilities, I established a framework of the evaluation factors for the village level (table7). However, the result need to be based on the accessible data, which are designed to be practical.

The central question here is that whether semi-concentrated Linpan performed better than traditional dispersed Linpan after several years' development at the level of various facilities and public service in a spatial analysis as the policy indicated.

Table 7 Indicators of accessibility

Genre	Service and facilities	Indicator
Basic Infrastructure	Highway	Distance to the highway
	Transit	Numbers of bus stops
	Public toilet	Number of public toilets
Education Accessibility	Elementary school	Numbers of elementary school
	Senior school	Numbers of senior school
	High school	Numbers of high school
		Average distance to schools
Transportation Facilities	Main road	Distance to the main road
		Total road length
Medical Service	Hospital/Medicine service	Distance to the medical service
Tourist Accessibility	Tourism spot	Distance to the tourism spot
Financial Facilities	Financial companies/ Bank/ Insurance	Distance to the financial facilities
Job opportunity	All POI with potential jobs	Number of job opportunities within 15min Circle(1000m)
Travel time to the town center	Jobs and markets	
Travel time to the county center	Jobs and markets	
Travel time to the city center	Jobs and markets	
Natural system	Linpan size	The average size of Linpan
	Linpan density	The Linpan density per kilometers

According to Wang (2015), the Baidu map is a solution to measure the commuting time for each village's people to get to different levels of communities in their activity area. The Baidu map is a corresponding Chinese version of the Google map, which can automatically calculate the time spent on the trip between two locations by different travel modes. For the public transit, the setting departing time in the Baidu map

is 10:00 in the morning. In this way, the result could reveal the difference influence of mobility of different villages and the Linpan spatial pattern. The travel modes here include walking, bike, bus and car, aiming to analyze the various transportation options and mobility.

4.4 Evaluation of Livelihoods and Lifestyle

Overall, the face-to-face survey data is the primary data source for the household study of Linpan villagers. Descriptive analysis, including frequency counts and the proportional valve, was applied to explain the socio-economic features of the different respondents. The impact on the individual is identified by comparing the descriptive data of the survey result, comparing the semi-concentrated Linpan with the traditional, dispersed Linpan.

Furthermore, in analyzing the determinants of rural Linpan households in the study area, the multiple regression model was accepted to investigate the significance of different indicators. The sampling technique here is to pick out the effective questionnaire that answered all the questions related to the independent variables. After cleaning the data, there are 68 out of 117 left (32 villagers living in semi-concentrated Linpan and 36 villagers living in traditional, dispersed Linpan). The regression builds on the primary data, which was obtained by the well-structured survey and interview.

A study was carried by Fadipe, using census data(sample size: 90) in 2014 to evaluate the determinants of income of the rural households in Kwara State, where the farm income still makes up 57.9% of the source of income for rural household. Levels of educational of household head, farm size and access to electricity and gender of the household head were identified as significant indicators to the household income in that area (Fadipe, Adenuga & Lawal, 2014).

Another study identifies determinants of livelihood choices including a set of socio-economic variables at the household level and the state of rural infrastructure in Bangladesh (sample size: 4,195 ; sample area: 139 villages) by applying a multinomial logit model of livelihood choice and a multivariate Tobit model which allows for jointness in decision making (Rahman & Akter, 2014). Typically, the resource-rich and educated households engage in diversified livelihoods

and rural infrastructure promotes such divesification. Another find is that that female-head households fail to compete in livelihood choice and tend to get lower income consequently(Rahman & Akter, 2014).

The regression model is specified as follows:

$Y = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \beta6X6 + \beta7X7 + 8X8 + e$

Where,Y=Household income (logarithm)

X1=Linpan Development pattern (Dummy variable by Semi-concentrated Linpan=1, Traditional dispersed Linpan=0)

X2= Schooling years of household head (Start from primary school)

X3= Vehicles

X4= Age of household head

X5=Farm size

X6=Household Asset numbers

X7=Household Size

X8= Female-headed household (Dummy variable by female household head=1, male household head=0)

$\beta0$ =the intercept; $\beta1 \sim \beta7$ = estimation parameters; e = the error term

Table 8 Summary of Variables for income level

Variable	Name	Measurement
Dependent variable		
Household income	h_income	Logarithm of annual household income
Independent variable		
Development model	d_model	Dummy (1 if Semi-concentrated Linpan=1, 0 if Traditional dispersed Linpan)
Female-headed household	f_head	Dummy (1 if female household head, 0 if otherwise)
Vehicles	h_vehicle	The number of cars owned by household
Schooling years of household head	h_school	The length of Schooling years starting from primary school
Age of household head	h_age	The age of household head
Farm size	h_farm	The total size farming land of household (unit: mu)
Household size	h_size	The total numbers of family members
Household Asset	h_asset	The total numbers of real estate assets
Job availability	Job count	The catchment of job opportunities within 1000 life circle

Chapter 5 Results

5.1 Linpan spatial transformation

5.1.1 Linpan Size and Density

In order to further understand the detailed spatial location relationship of the typical Linpan settlement of the study area, it is necessary to select the sample site of the Linpan settlement, which is similar to the the study area, and carry out the spatial analysis and information extraction of the landscape elements. There're some existing literature applying the geographic technology to the Linpan landscape these years. Another case study of Sanba village (a village of Chengdu) did a Linpan rural landscape elements analysis in the sample site, shown in Figure 12 (Xue, Dang, Zhu & Yang, 2016) which indicated the ratio is 1 : 2.6 of wood to building area in a Linpan.

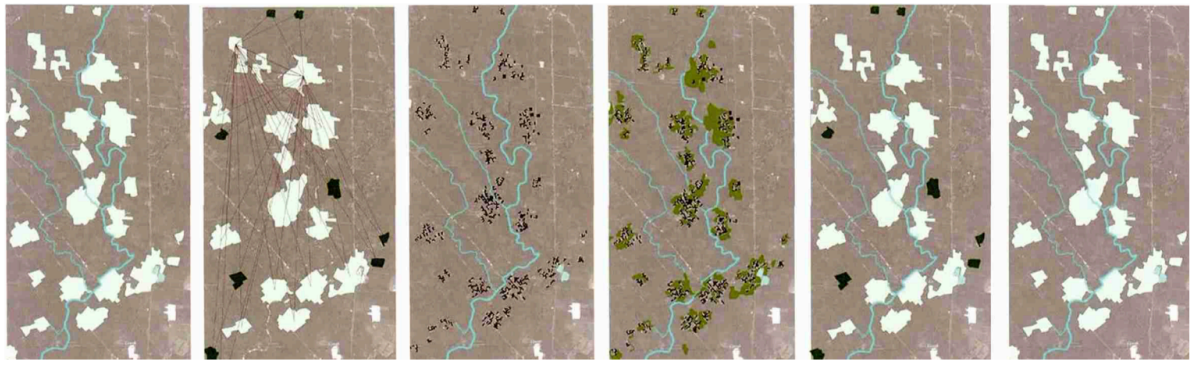

Figure 12 Landscape elements analysis（source: adapted from Xue, Dang, Zhu & Yang, 2016 ）

Guo, Liu & Xu examined the spatial pattern and distribution characteristics of Linpan based on the interpretation of remote sensing image of 2015. They found that the total number of Linpan in Pidu district was 6239 and there were 14.64 Linpan per square kilometer (Guo, Liu & Xu, 2017). Linpan density is dense in north and sparse in south in Pidu district, at the same time, the small scale of Linpan tends to be more tensive than the Linpan of large size (Guo, Liu & Xu, 2017).

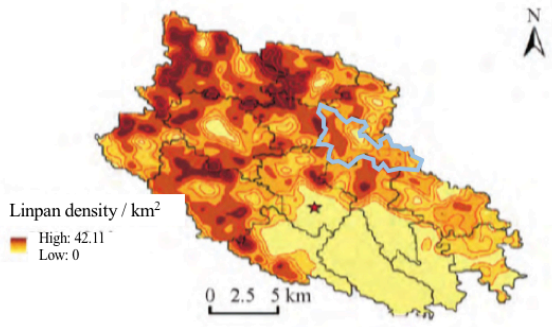

Figure 13 Linpan density of Pidu district

Wang and Xue (2017) explored the three villages based on the same survey of this study. They found that the average area of each Linpan increased which indicates that less fragmented in Village A,B and C, especially for Village A. It's because the reform of the rural land property rights in Village A since 2010. Overall, from 2002 -2017, the change of Cohesion index showed the increasing spatial agglomeration level, which means a more intensive development pattern (Figrue 14).

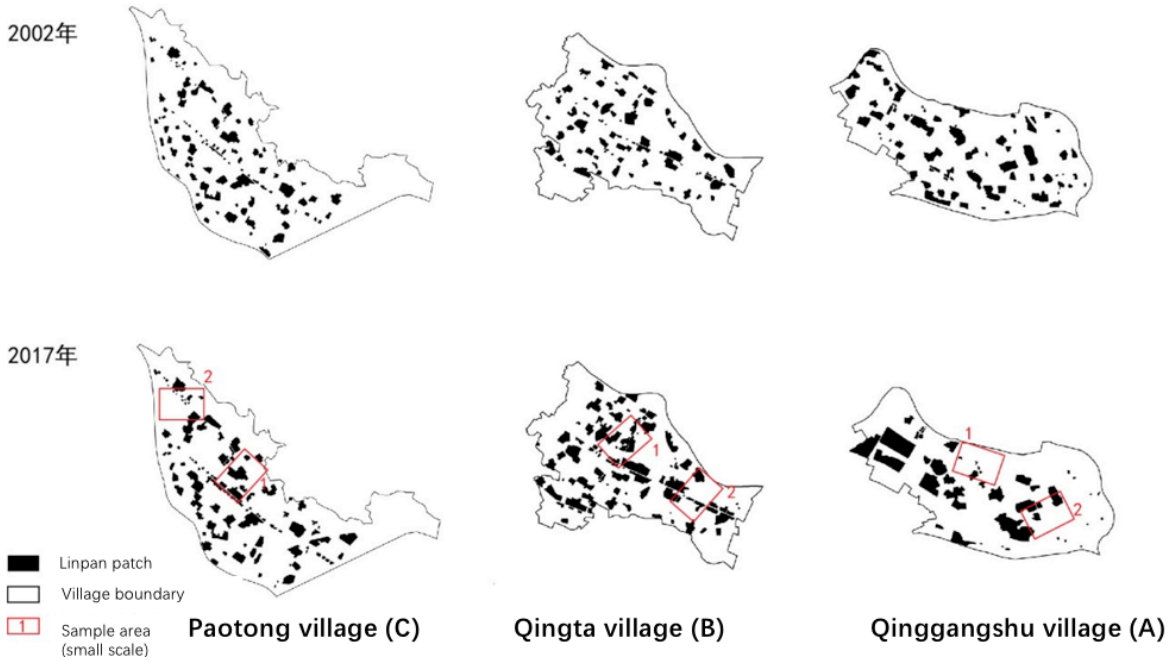

Figure 14 The change of Linpan from 2002 to 2017 in three villages (Source: Wang and Xue 2017)

The sample area of this study is located in eastern and southern part of Sandaoyan township which includes Qinggangshu (Village A and the town center area (Figure 15). According to the map traced from Google earth image, there is a significant downward trend of the amount of Linpan that appears to be heading in the period from 2002 to 2018. Based on the count numbers, it seems that 2002-2010 and 2014-2018 are two different periods for Linpan development.

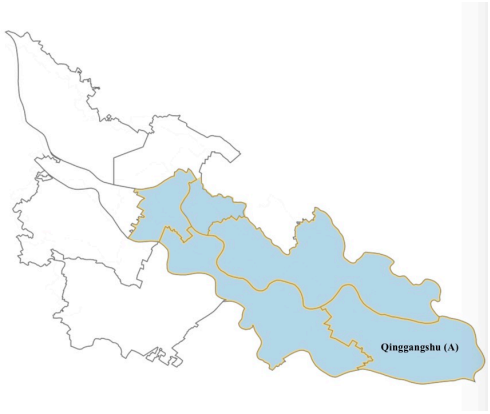

Figure 15 Sample area for Linpan evolving rule study

Year	Number
2002	202
2010	142
2014	66
2018	64

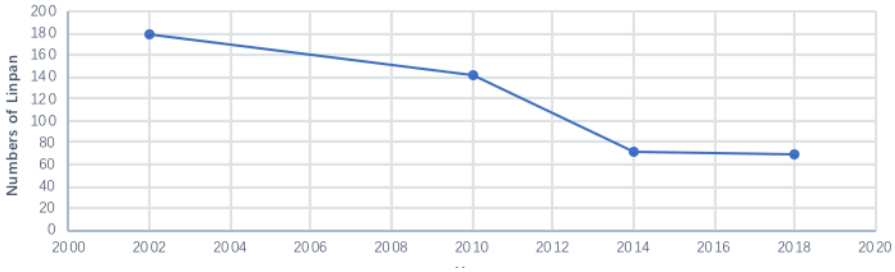

Figure 16 The trends of the count of Linpan

According to the official statistics before 2012, the Linpan settlement per 0.04 km^2 land in the flat area is 25 Linpan per km^2; meanwhile, the average cultivating radius is 113 meters and the average Linpan distance (distance to center of nearest Linpan) is 226 meters (Fang 2012). Comparatively, for the whole city area, the Linpan density is 15 per km^2, with the average cultivating radius 146 meters and the average Linpan interval 292 meters. Looking at the medium and large size Linpan, the average Linpan interval is 1082 meters, and the patch density is 1.09 per km^2 (Fang 2012). In a case study of Pi county, based on 2015 data, the Linpan is counted as 6239, and the patch density is 14.64 per km^2 (Guo, Liu and Wang 2017).

In our sample area, the density dropped because of the decreasing total numbers, as shown in Table 9. Located in plain area, the density is relatively lower than the average level. The reason might be interpreted from Guo's study (2016) that the sample area is near town center and Chengdu city, shown in Figure 11.

Table 9 Linpan density chart (source: Guo, Liu and Wang 2017; Fang 2012)

	Patch density/ km^2	Source Year
Chengdu Plain	25	2012
Chengdu city	15	2012
Pi county	14.64	2015

Table 10 Summary statistic of Linpan in sample area

	2002	2010	2014	2018
Counts	202	173	75	73
Small Size	142	127	44	52
Medium Size	32	27	13	12
Large size	11	11	7	5
Average Size	7668	7753	9529	9780
Linpan radius	49.42	49.69	55.09	52.27
Linpan Density	19.70	16.88	7.31	7.12
Min area/m2	651	938	1179	1179
Max area/m2	41180	39213	39213	35075
Study Area/km2	10.25	10.25	10.25	10.25

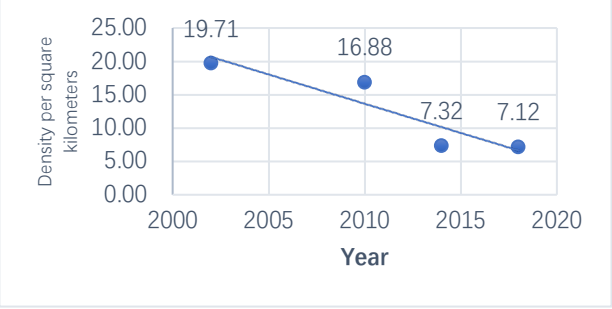

Figure 17 Linpan Patch Density Trends

Generally, the Linpan are divided into three types based on their size including small size, medium size, and large size. There are no universal standards of that right now. In Xue's geo study (2016), he defined small size Linpan as 0-500 m2 with less than 5 households, medium size as 500-3000m2 with 5-10 households, and large size as 3000-30000m2 with more than 10 households. However, the figures in Xue's study might represent only built area (building footprints) which does not include forest because they identified the Linpan by the area of construction land from 200 to 30000 square meters. Fang (2012) also investigated a suburban area in Qionglai county, Chengdu, and summarized as a table, which is shown in Table 11.

Table 11 The investigate chart of the Linpan classification（source: Fang 2012）

Type	**Small Size**	**Medium Size**	**Large Size**
Households	1~9	10~40	>40
Radius	<50	50≤ r ≤100	r ≥100
Percentage (%)	79	17	4
Location	Scattered in the field or close to channels	Mainly close to the main road and river	Close to the main road or river.

In the investigation of this study, the obvious change is that the main drop in the count of Linpan owe to the small size Linpan (Figure18). Guo, Liu and Wang conclude that the center area of Linpan distribution is in northwest of Pi county and the northern area has higher patch density than southern part of Pi county (2017). Due to the data limitation, using the Manual Interval as the data classification method in ArcGIS for 2002 as the baseline, the study sets the percentage as small size (70%), medium size (25%) and large size (5%), based on the investigation of Fang (2012). Since the small size Linpan accounts for a large proportion, the planning might need to consider more how to protect these small patches and to connect them in the rural landscape.

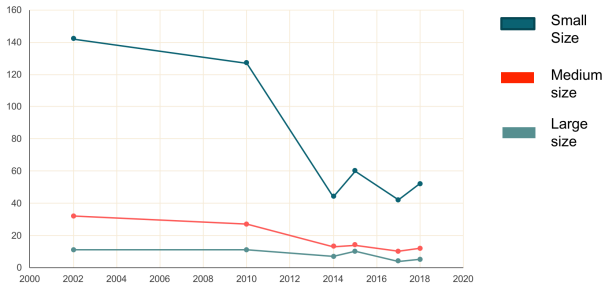

Figure 18 The change of number of Linpan on different size（source: created by the author）

5.1.2 Spatial Pattern

Calculating the relative distance among Linpan centers, I founded that not only the average distance increased but also the range of the nearest distance to the other Linpan enlarged in the sample area (Figure 19). Generally, they are in the walking distance to each other all the time which remains a sense of community though from 2002 to 2010 people lived closer to each other than 2014-2018. In 2002, the average length was 144 meters, while it is 179 meters in 2018. Comparing to the 233 meters of Sanba village (flat plain) in Chengdu city, they are all around 200 meters (Xue et al. 2016). From the trend, the average distance would continue to grow gradually and slightly which also indicates that the distance, about 200 meters, is a reference to the future Linpan planning (There are satellite image and interpretation errors in the measurements).

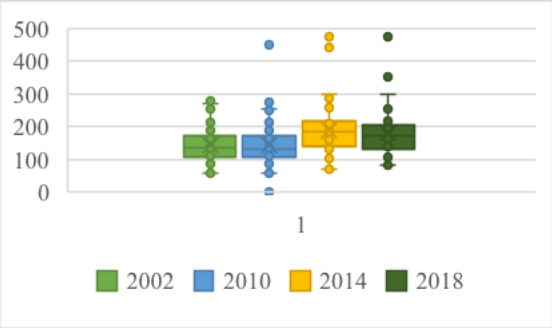

Figure 19 The investigation of Linpan interval

It can also be observed from the distribution map of Linpan (Figure 20-23) that the distribution of Linpan still keeps a structure to follow the river and the main road. However, part of the land is transferred to concentrated residences. Middle-large size Linpan are more likely to locate near the built-up area and central area, while the small-size Linpan is more likely to remain scattered.

Figure 20 The distribution of Linpan in 2002

Figure 21 The distribution of Linpan in 2010

Figure 22 The distribution of Linpan in 2014

Figure 23 The distribution of Linpan in 2018

5.2 Comparative results

5.2.1 Household characteristic

On the whole, the majority of the population are middle-aged people, aged 40–60. There are more young people in the village A with semi-concentrated Linpan pattern than in the villages B and C with the traditional, dispersed pattern, and the proportions of people below 50 years are 69% and 50%. Additionally, primary school is the most frequent educational background in both the study sample groups, and both groups' percentage of university background equals to zero (Figure 24 & Figure 25). Academic background of village residents at village A has 40% primary school and 49% junior high school. Villages B and C have less percentage of high school and junior college, but a little higher of high school and kindergarten.

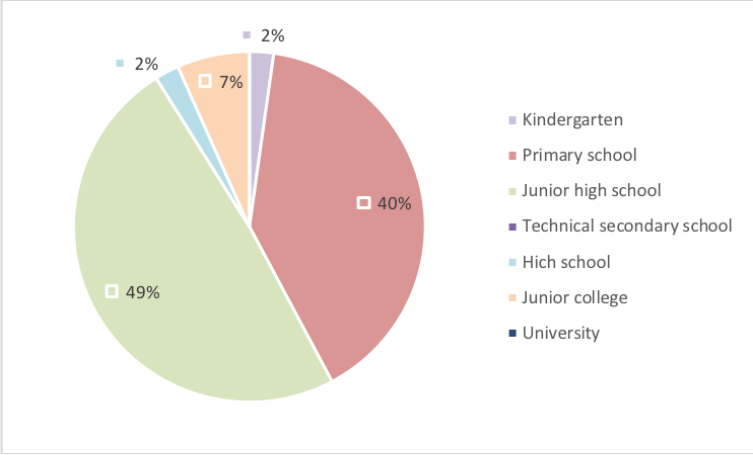

Figure 24 Educational Background of household population in semi-concentration model village

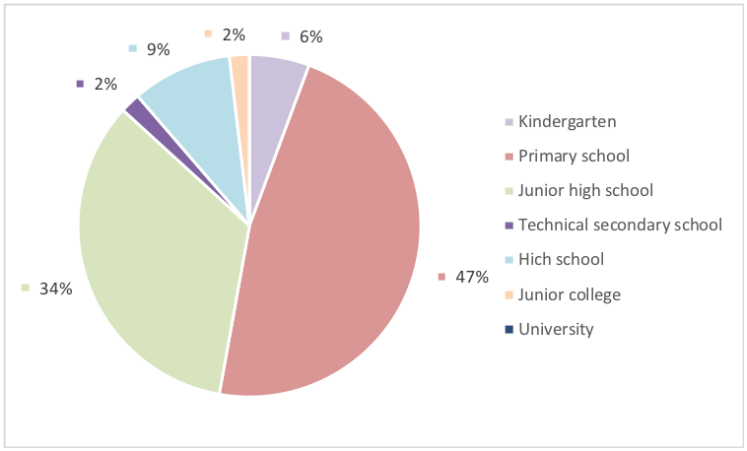

Figure 25 Educational Background of household population in traditional model village

What is the reason behind the difference in educational background and age? The study found that the residents living in the semi-concentrated village(A) are more likely to work in other counties – 14% compared to 7% of traditional villagers. The development of the new housing and tourism industry has led to the construction of roads. It has also allowed more people to work and study outside the county. However, if they lost their farmland and there are not enough opportunities for other kinds of jobs (tourism, etc.) locally, they might be forced to travel farther to work.

At the same time, it may be because, in the traditional model, most of the households left behind consist of older, traditional people who are more closely connected to agriculture, while the tourism and local markets provide young people with more job opportunities in the semi-concentrated village. To some extent, this age group reflects the rural construction and industrial development driven by the transfer of land in the process of evolving Linpan from the traditional, dispersed mode to the semi-concentrated mode in the village of Qinggangshu (A), attracting more young people to return for tourism, business, and other opportunities.

On the other hand, the proportion of people staying in the villages is roughly the same, while the number of people who work and study in foreign counties is higher than that of the villages B and C with traditional model. In addition, by examining the work and study locations of spouses and household heads, we found that 79.60% of the villagers in village A live in the same place, and the traditional villages (B and C) also had 79.31%. In the land reform process, the family relationships keep relatively stable.

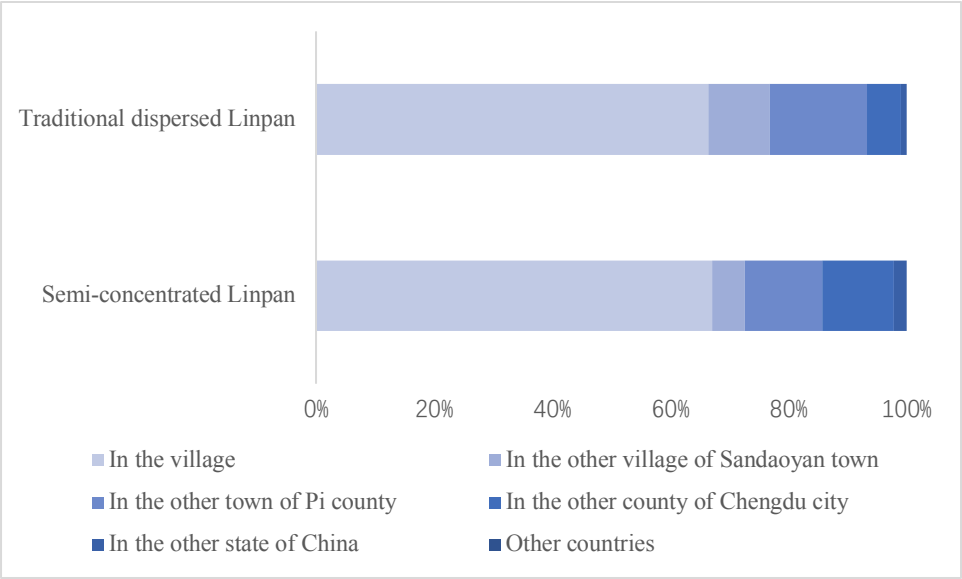

Figure 27 The investigation of the place to work or study

5.2.2 Livelihoods choice and Income

For real estate, people own 1.34 house property unit per household in average in the traditional villages compared to 1.51 per household in the semi-concentrated village. Furthermore, most households still keep their own homes in their original village. It could be found that A villagers are more likely to own real estate assets outside of the village. They might have ideas to invest or move to the town, county seat, and the city center or other places. They also might have received a relatively large amount compensation money for loss of their farmland, and they would have idea to make investment or move to the town, county seat, and the city center of other places.

Table 12 Investigation of Household Real Estate Assets

	In the home village	In the town	In the countyseat	In the city	Other places
Village A	46	19	17	8	12
(size:47)	98%	41%	36%	17%	26%
B&C Village	67	10	9	5	6
(size:68)	97%	14%	13%	7%	8%

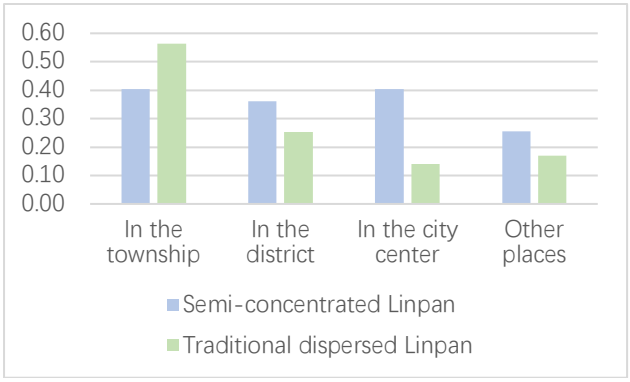

Figure 28 Average number of Assets per household in different locations

In fact, income is a sensitive issue in China's environment. Compared to other issues, effective answers have been greatly reduced. In spite of this, we can find the relative features of the economic income of the residents in the two forms of the redevelopment model.

Statistically, Sandaoyan town completed a tax revenue of 52 million yuan throughout the year 2015, an increase of 12% over the same period; an investment in fixed assets of 920 million yuan, 112% of the target mission; the industrial output value above the designated size was 410 million yuan, an increase of 10%; the net income per capita of farmers was 18600 yuan, an increase of 12%; and the per capita disposable income of the urban residents was 34,280 yuan, an increase of 8.2% (Yearbook of Pi 2016).

It is unexpected that the average household income in the survey does not differ greatly between the two kinds of development models based on the Survey in these three villages. Also, the household income of traditional Linpan is slightly higher than the other one. However, when looking at all the data acquired, it can be found that the income range in the income level is greater in A village with the semi-concentration model.

Table 13. Household income statistic table

	Semi-concentrated Linpan	*Traditional Linpan*
Mean	27645	27886
Range	90000	62000
Min	10000	4000
Max	100000	66000
Observation	33	44

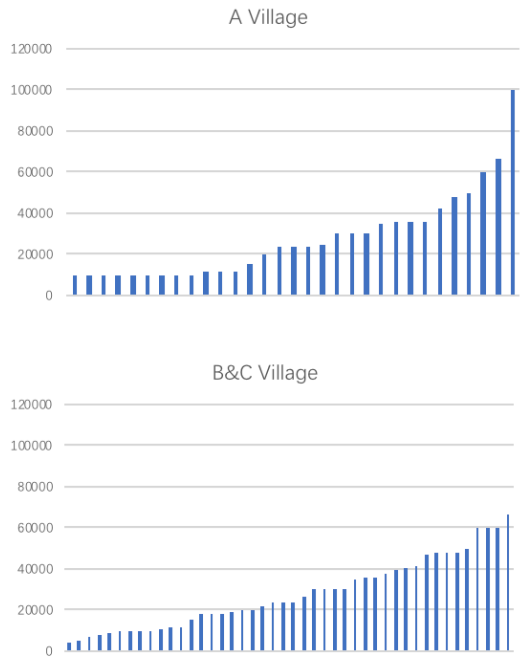

Figure 29 Household income survey result

According to the survey, respondents of A village has stop farming and transferred to other works. It means that most of them don't get income from agriculture work. The average income of farming of traditional Linpan is 18564 yuan in 2017 which is a little lower than net average income of farmer households in average town level (Figure 29).

Table 14 Investigation of Income source chart

	Semi-concentrated Linpan	**Traditional Linpan**
Some income from Agriculture	4%	66%
No income from agriculture	96%	34%
	47	68

It is remarkable that the village with traditional, dispersed model includes a much higher proportion of people who still have income from agriculture. In A village, 96% of villagers no longer work on agriculture, compared to the 34% in the traditional villages B and C. Following are the potential reasons to explain this phenomenon: The semi-concentration redevelopment process eliminated most of the agricultural land in Qinggangshu, and corporatized what was left. The villagers had no land left to farm even if they are willing to.

The agricultural food crops in the traditional village are dominated by rice (wheat, leeks, and corn). Of the 70 effective questionnaires in the traditional farming, 38 samples filled in the scale of crops —— average of 1.87 mu. 31 individuals filled in the income from sale of crops —— average of 442 yuan/mu, and 20 people filled in the yield ——average rice yield was 890 pounds per mu, which was lower than the average level of Sichuan Province of 1,000 pounds per mu. Mu, a unit of area (=0.0667 hectares).

Regarding the types of vegetables, the villagers mainly mentioned leeks and rapeseeds, and some mentioned loofahs. The averag scale of cucumbers, corn, and green beans is 2.46 mu, which is 32% higher than the grain size. Taking the example of leeks, Only 10 villagers filled out detailed data, which is not representative to some extent. However, the livestock might be important in a rural study. It would be enhanced with future survey. The principal way to sell vegetables is to go to the market for selling, and a few of them sell for company acquisitions. At the same time, a certain percentage of villagers say that some customers will go to their home to buy agriculture products directly. Livestock and poultry are mainly chickens and ducks, which are not in captivity, as self-supported for their own.

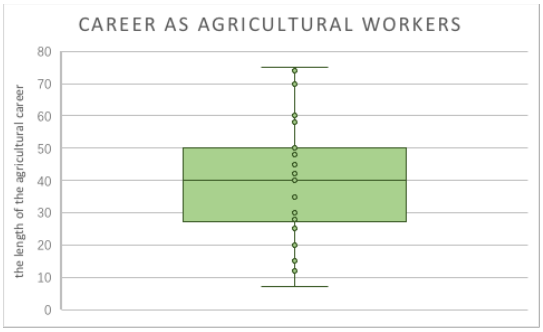

Figure 30 Career time as a farmer

Notably, the average years that these individuals in traditional village engaged in agricultural reached 40 years or more, ranging from 7–75 (Figure 30). Only 13% of people have been in agriculture below 20 years, which shows the degree of adherence of agricultural practitioners to this livelihood choice, especially for people in traditional villages. There is no denying that agricultural livelihoods work with more flexible time during the slack season and busy season. When asked how to decide on future crops, most respondents said that they decided on the basis of market prices and income. When planning for the next five years, the government's policy guidance also plays an important role. People who are in traditional Linpan, 18% workers, decided to go back to agriculture in five years, according to the effective questionnaire, while there is no data on the village A.

5.2.3 Accessibility and means of transportation

In terms of the travel mode choice and mobility, accessibility to the nearby cities and towns can be analyzed by the total time cost calculated in the Baidu map, as shown in Tables 15, 16 and 17. Though the spatial distance from A village to the town center is the langest （Figure 31）, the transportation facilities make up for that.

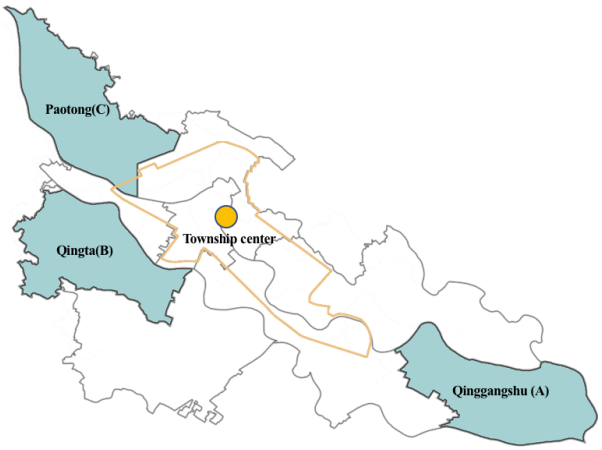

Figure 31 The location of township center

Table 15 Transportation choice and mobility table for village A

Village A	walk	bike	bus	Car
Town center	58	23	30	7
Pi county center	134	55	80	18
Chengdu	380	142	103	50

Table 16 Transportation choice and mobility table for village B

Village B	walk	bike	bus	Car
Town center	35	13	33	4
Pi county center	130	46	80	20
Chengdu	450	170	140	90

Table 17 Transportation choice and mobility table for village C

village C	walk	bike	bus	Car
Town center	45	19	45	10
Pi county center	170	61	93	33
Chengdu	470	180	210	90

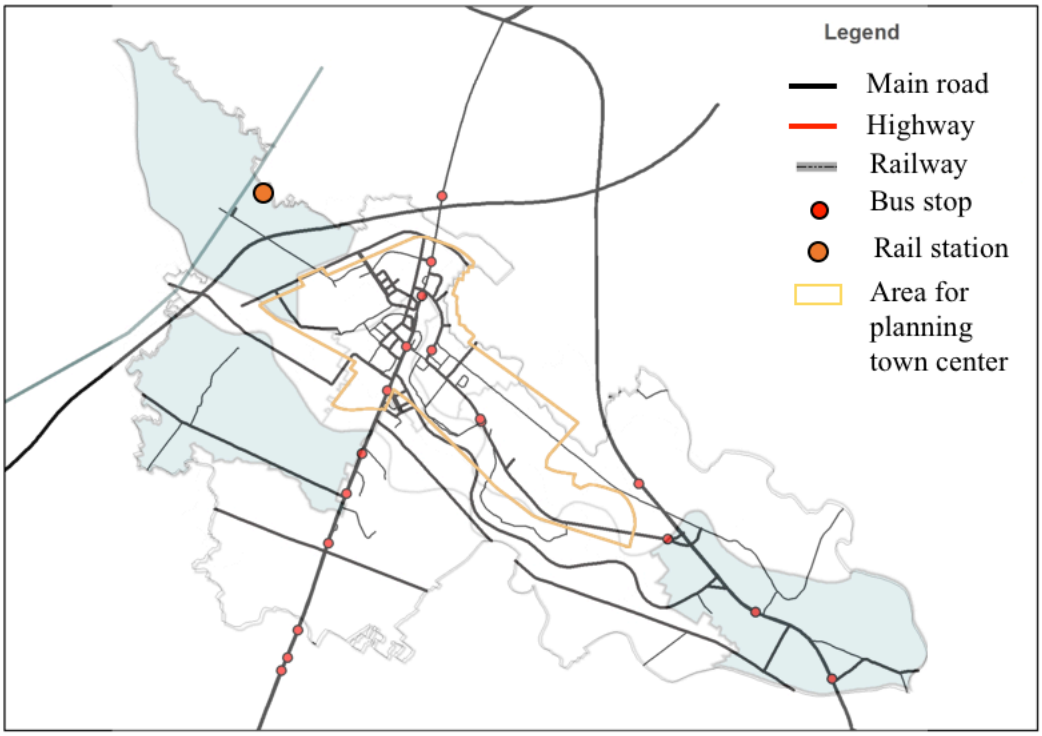

Figure 32 Road strcuture and transport facilities map of Sandaoyan town

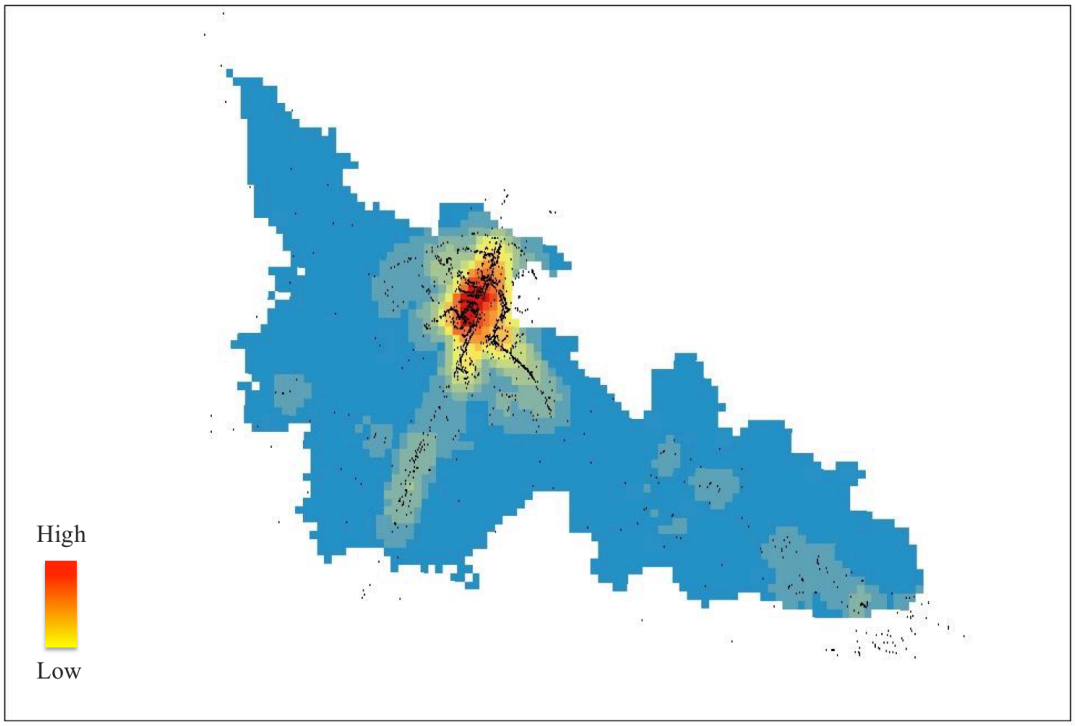

Figure 33 Heat map of POI data of Sandaoyan town

The difference in the level of diversification of transportation means is not very notable, and the mode of the number of means of transportation is 2. However, cases in the specific types are very different. The most popular modes in the village A is the Ebike, followed by bicycles, cars, and motorcycles. Tricycles have gradually been eliminated since only 4.36% of households in the survey have tricycles. In traditional, dispersed Linpan, the choice of means of transport is relatively even, with the highest rate 31.34% of bicycle penetration, followed by motorcycles and electric vehicles around 28%, followed by cars 25.37%, and at least 13.43% for tricycles. Apparently, the penetration rate of vehicles is higher in village A, and the vehicles available are more diversified on average, while the traditional Linpan villagers have a larger range at this point. The average is 1.87 for village A compared to 1.72 for the traditional villages B and C.

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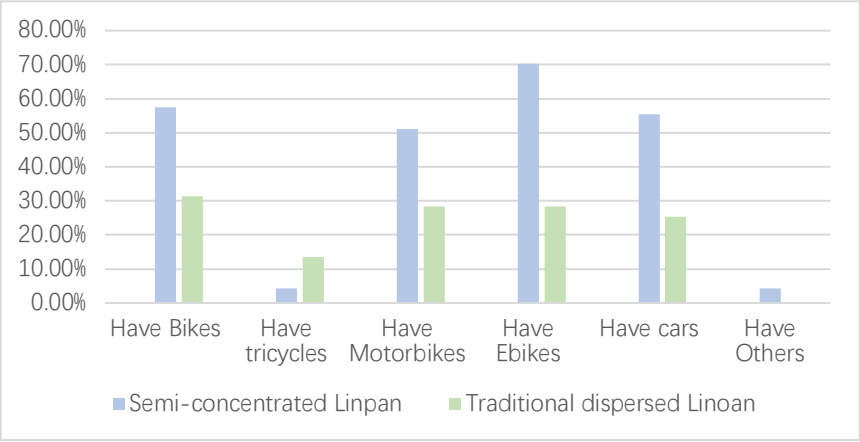

Figure 34. Percentage of population own different vehicles

After understanding the type and number of vehicles that the villagers possess, I divided different usages by their destination, mainly focusing on local markets and work places. From the chart below, we can see that Electro mobile is the preferred method during the rush and for shopping activities, as shown in Figures 35-37. Secondly, bicycles and electric vehicles are the small and flexible means of transportation. But in terms of commuting, as shown in Figure 30, cars become one of the main means of transportation for all the sample villagers. The dominant limitation here is that the questionnaire put the means of transportation under the vehicles section and thus ignored walking.

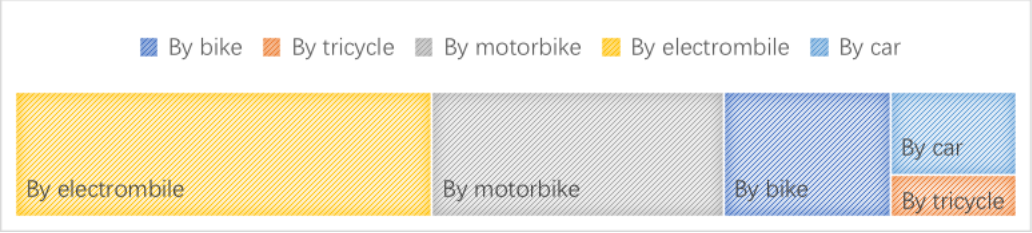

Figure 35. Vehicle choice of semi-concentrated Linpan villagers (A) for Markets

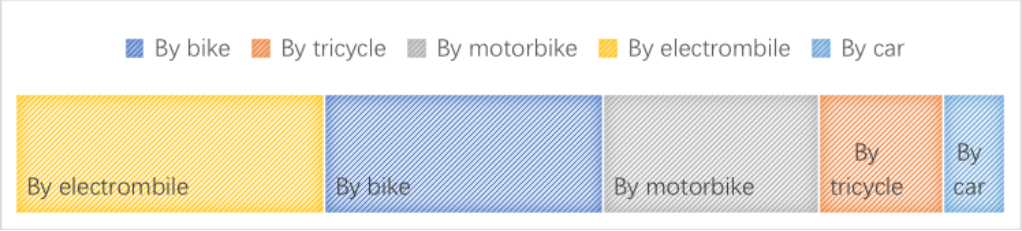

Figure 36. Vehicle choice of semi-concentrated Linpan villagers (B and C) for Markets

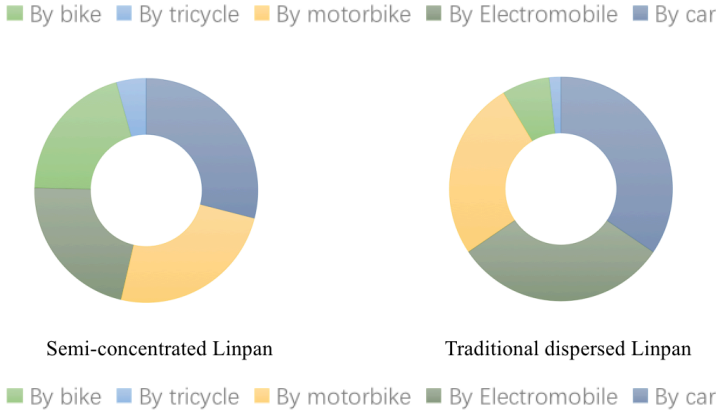

Figure 37 Vehicle choice for work places

Table 18 Vehicle Choice for Markets and Commuting

	Semi-concentrated Linpan		Traditional dispersed Linpan	
Mode	Market	Commuting	Market	Commuting
By bike	17%	7%	28%	20%
By tricycle	4%	2%	17%	4%
By motorbike	29%	26%	29%	25%
By Electromobile	42%	31%	42%	22%
By car	8%	34%	8%	29%

Based on the POI (Point of Interest) data I acquired from the online map software (Baidu), the Euclidean distance is calculated in the ArcGIS by the proximality toolset, including the buffer, near and point distance. Summarizing, the average distance from home to the bus stop of the survey samples is 1102 meters, which is equal to 13 minutes' walk. However, there is a large gap between the average distance from home to bus stop for the semi-concentrated Linpan compared to the other. For respondents in B and C villages (traditional, dispersed pattern), the distance is more than 4 times than that of respondents in A village (semi-concentrated pattern), as shown in Figure 38.

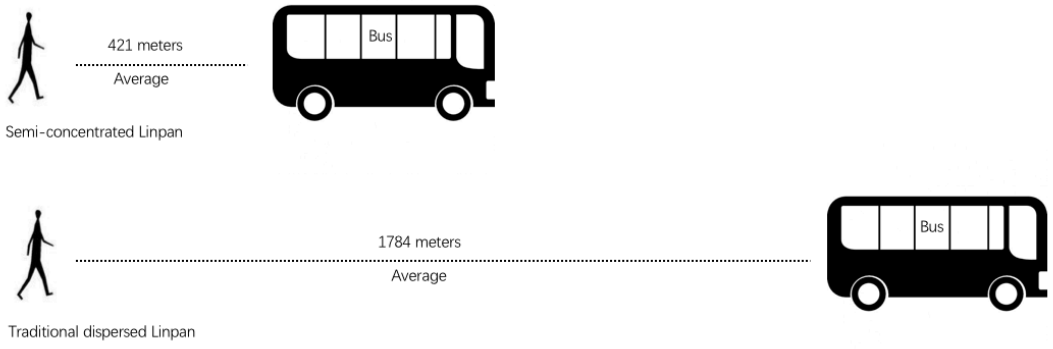

Figure 38. Illustration of Comparison of Average Distance from Home to Bus Service

Table 19 Summary table of distance from home to bus stop

	Semi-concentrated Linpan in A village	Traditional dispersed Linpan in B&C village
Mean distance(meters)	421	1784
Mode(meters)	351	1753
Range(meters)	598	1881
Minimum(meters)	179	796
Maximum(meters)	778	2677

Card room and tea house are two dominant ways to find entertainment in the rural environment. According to the answers to the questionnaires, tea house is more popular than card room. Unexpectedly, it turned out that the respondents in traditional, residents of villages B and C with dispersed Linpan pattern went out more than those who are living in the village A with semi-concentrated pattern. The new development is expected to increase the accessibility of these central places and thus more people would be there.

One potential reason is that people in B and C villages with traditional, dispersed pattern don't have a satisfying local market and need more supplies for daily life from other places. In other words, the semi-concentrated pattern with higher population density would attract more resources and facilities to some extent. Besides, people engaged in farming might be able to set their hours, which would enable them to have more opportunity to explore the outside world. Admittedly, the quality and sample size of this questionnaire might affect the final result relatively, and this outcome needs further support. As the figure 39 shows, semi-concentrated Linpan seems the needs of the villagers' public activities are better met than traditional dispersed Lipan. For instance, the number of villagers live in semi-concentrated who have been to the town center, county town and other state is generally less than number of villagers live in traditional dispersed Linpan. It may indicate that semi-concentrated Linpan has more attractive and dynamic.

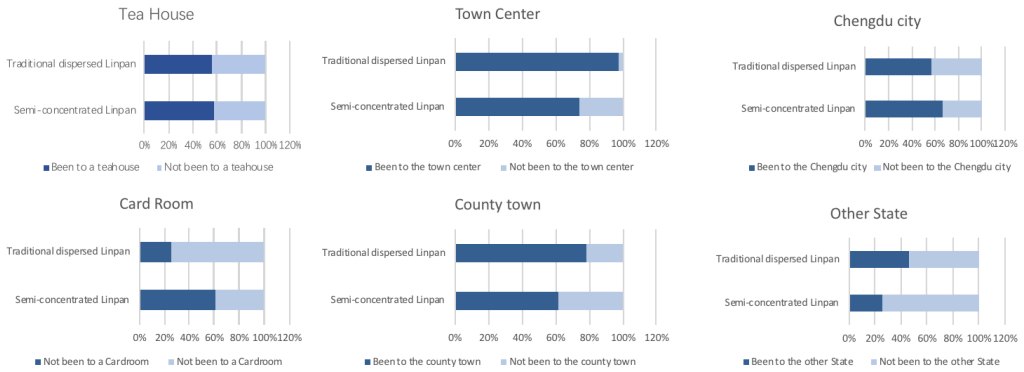

Figure 39. Percentage of people having been to certain place

For livelihood choice, the accessibility to non-agricultural job opportunities is distinguished as a significant indicator. Significant discrepancy exists between the situations of the semi-concentrated village and the traditional, dispersed villages in the survey. The points of interests include all kinds of categories, which might provide more job opportunity. It defined as the types of POI data including automobile service, shopping service and markets, living service, sports leisure, health care, accommodation service, scenic sports, business residence, technological and cultural venues, financial insurance facilities and companies.

Generally, the average points cached are 28 by the 1000 meters unit of a household. As the Figure 40 and Table 20 shows,there are fourfold job opportunities cached in a 1000 meters unit, comparing A village to B and C. In the traditional pattern, the lowest figure shows no point of interest related to jobs pinned in the household life circle (1000 meters), while respondents in A village with semi-concentrated pattern got 31 at least – unexpectedly, by the record of the nearest classification of POI, the distance between home and job point of the Semi-concentrated village is generally far lower than the traditional one, and the catchment of job opportunity within 1000 meters unit is higher than the traditional one.

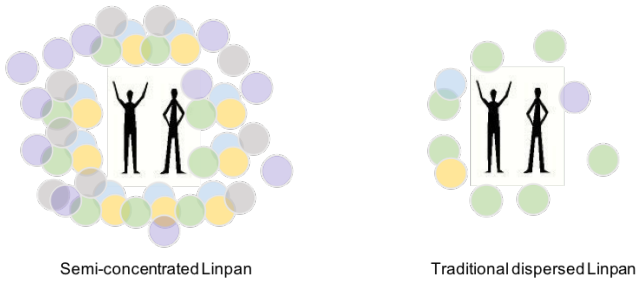

Figure 40. Job opportunities at different development mode of Linpan

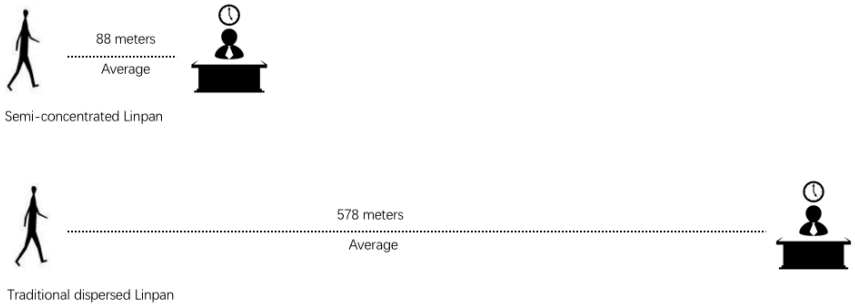

Figure 41. Distance to the Nearest Job Opportunity

Table 20. Catches of job opportunity within 1000 meters unit

Catchment of job opportunity within 1000 meters unit	Semi-concentrated Linpan	Traditional Linpan
Average	48	9
Median	50	6
Mode	63	1
Range	32	57
Minimum	31	0
Maximum	63	57

Table 21. Distance from home to the job point(meters)

Distance from home to the job point(meters)	Semi-concentrated Linpan	Traditional dispersed Linpan
Average	88	578
Median	89	490
Mode	84	456
Standard deviation	52	347
Range	178	1744
Minimum	2	59
Maximum	180	1803

Primary works still play a fundamental job in rural living broadly. Based on the questionnaire answers, it can be concluded that the accessibility level of agriculture declined at the average cost from a location to their fields. The time cost to walk from the home to the farming in semi-concentrated Linpan settlements land was 11.3 minutes, double that in traditional dispersed Linpan (5.4 minutes). For this topic, an average speed, 4.5ft per second, is selected to calculate the distance from the Linpan to the farming land which equals to 1.3765 meters per second (Carey 2005).

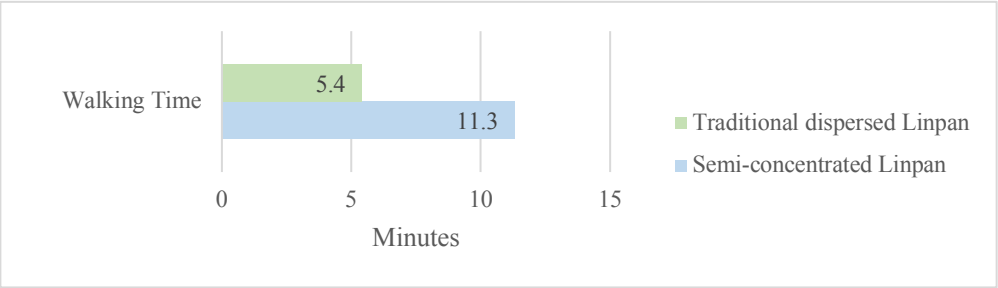

Figure 42. Mean walking time from the home to farming land

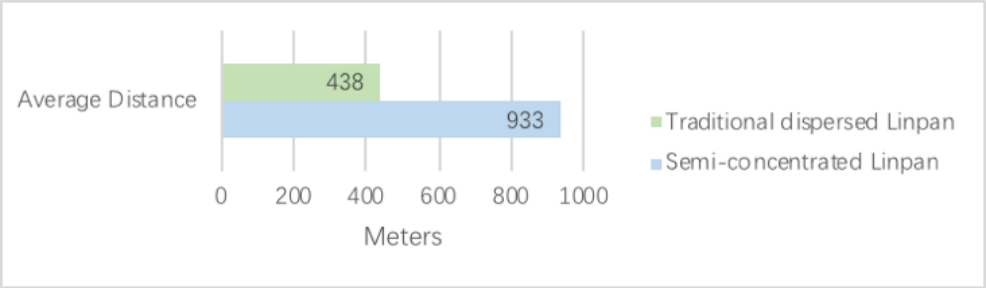

Figure 43. Mean Distance from the home to farming land

Table 22. Summary statistic of the average cost to reach own fields

Type	Semi-concentrated Linpan	Traditional dispersed Linpan	
Village	Qinggangshu	Qingta	Paotong
Average Walking time to reach own field per household(minutes)	11.30	3.94	5.64
Average Distance(meters)	933	325	466
Mode cost of time(minutes)	10	5	
Maximum cost of time(minutes)	90	15	
Average Distance (meters)	933	438	

In daily life, co-ordination and mutual help among the villagers has become the order of the day if there are difficulties, such as shortage of money, looking after children, or getting sick. The problems are determined by the social status and spatial activity scope of the villagers to some

extent, which is also a good way to analyze the current state of social communication. As shown in Figure 37, most of the social areas of respondents are limited to families and neighbors – very few contacts with other production teams in the village, towns, and counties. In addition, during the face-to-face interview, some description has been obtained about the competition among the villagers who run tourism business in the same neighborhood, which might cause some tension in the relationship, as shown in Figure 44.

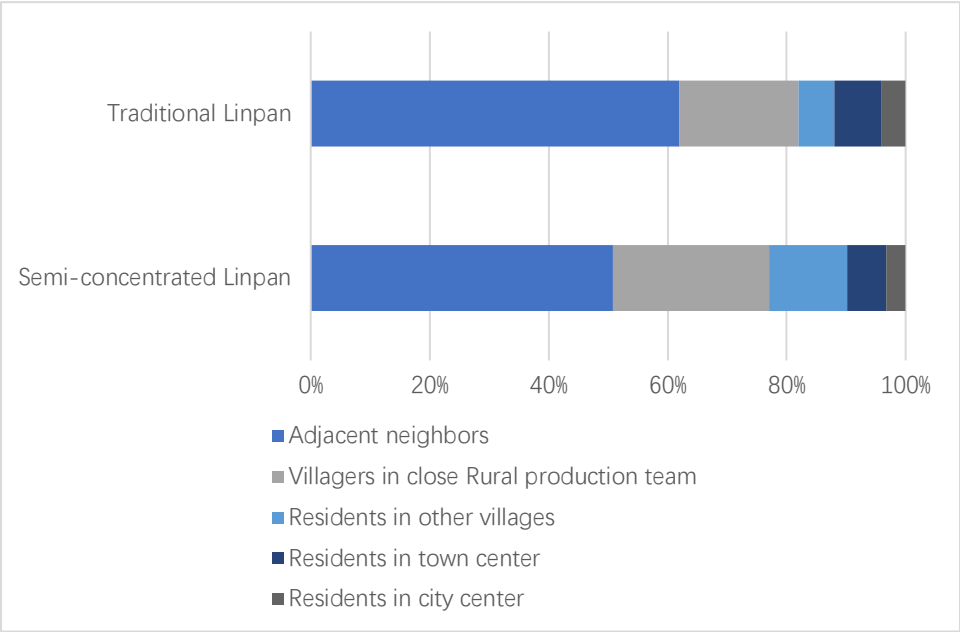

Figure 44 Social relationship allocation

5.3 Linear Regression

The indicators influencing income level of the household was investigated in this evaluation test. The sample size is 63 after selection which is not enough for a solid regression. However, it is a test to pick out the important factors related to the Linpan development topic, thus the future study and survey could expand the result based on more data. It can be observed that development model(dummy variable), schooling year of household head (dummy variable), vehicles, age of household head, Farm size, Household Asset, Household size, Female-headed household as independent variables, and using Household income level as a dependent variable for linear regression analysis, which can be seen in the section 4.4.

The dependent variable is the real income (logarithm) of the rural household. Before performing the regression analysis, regression diagnostics were done on the data sets. The regression diagnostics are done to ensure that the data being used meets the assumptions underlying linear regressions. Results from the regression may be misleading if the data does not meet these assumptions. The following assumptions were tested with the regression, which are included in the Appendix A. On the whole, the model R-squared value is 0.275, which means that these variables can explain 27.5% change causes of Income level. When the model was tested by F-test, the model passed the F-test (F=2.239, P<0.05). There are more test in the Appendix A.

Table 23 Summary Statistics of the Variables

	Unstandardized Coefficients		**Standardized Coefficients (Beta)**	**t**	**p**	**VIF**	**R^2**	**Adjust-R^2**	**F**
	B	Std. Error	Beta						
Constant	5.085	0.321	-	15.85	0.000**	-			
d_model	-0.214	0.108	-0.359	-1.978	0.053	2.404			
h_school	0.007	0.016	0.06	0.405	0.687	1.613			
h_age	-0.01	0.004	-0.373	-2.531	0.014*	1.59			
h_farm	-0.026	0.024	-0.158	-1.083	0.284	1.564			
h_asset	0.079	0.052	0.199	1.502	0.139	1.282	0.275	0.152	2.239*
h_size	-0.026	0.036	-0.099	-0.724	0.472	1.37			
f_head	-0.182	0.196	-0.131	-0.929	0.357	1.451			
h_vehicle	-0.069	0.076	-0.122	-0.905	0.369	1.322			
job count	0	0.003	0.013	0.065	0.949	2.888			

Dependent variable：h_income

* p<0.05 ** p<0.01

The age factor goes with negative effects significantly with a P value of 0.003, while the schooling year of household head has a regression coefficient of 0.014, and the P value of 0.358, which is greater than 0.05, means that the development model (dummy variable) does not affect the income level significantly. The approach here only found one significant negative indicator as the age of household head. The potential influence of other variables is still unclear. It need more effective data for future investigation in comparative study.

As a conclusion, we can see that household head age have a significant negative effect on the income level. However, schooling year of household head, Farm size, Real estate, Household size, female household head, development model, and vehicles type does not affect the income level

Intially, the model aimed to reveal a number of socio-economic factors significant to the household income and household livelihood choice. However, with the available survey data, only one significant indicator is identified which is less than other similar literature (section 4.4). Importantly, the livelihood choice question in this survey is not clear to summarize and be used for statistical analysis which left the problem to the future researcher.

Chapter 6 Reflection

6.1 Summary Result

By comparing the survey result of two different Linpan patterns, we can explore the influence that the semi-concentrated pattern brought to the villagers' lifestyle and livelihoods choices.

It is found that the semi-concentration model attracts more young people. Based on the survey sample, more young people live in semi-concentrated villages, which might be due to more job opportunities and entertainment places available to them in a walkable community. The educational background of household populations didn't change much, while the semi-concentrated village population did reach a greater academic level. The percentage for a semi-concentrated village to work and study in foreign Chinese counties is higher than for the traditional one. It might indicate that because the semi-concentration model provides more

non-agriculture job opportunities, such as tourism, commercial and service industry. So young people have a tendency to return gradually than traditional model. The semi-concentration model brings diversified job opportunity rather than only agriculture, thus the semi-concentration model might attract more younger and bring a more vibrant life and dynamic development.

The most significant change from traditional development model to semi-concentrated development model is the livelihood choice. Most people stopped farming the land when they move into a new semi-concentrated Linpan settlement. Nonetheless, there are still more than 60% percentage of the population that derive income from agriculture in the traditional village B and C. With more development and job opportunities, the income differential of household income of village A became greater than traditional village B and C according to the survey result, which might bring some social justice issues to rural lives. In fact, through the face-to-face survey, some villagers reported that part of resident in village A had difficulty in finding a non-agriculture job. The compensation provided by the government might be obtained by paying farmers more for their produce, but not by having them seek other jobs.

In the survey, the semi-concentrated development model brought more real estate investment to the villagers. People are more likely to invest in or own assets outside the village when they already have their own house in the home village. However, the traditional model tends to be more introverted in terms of the outside properties.

Considering the travel modes, this survey found that people in the semi-concentration development model have a better chance to own a car or other electric vehicles. At the same time, one apparent pattern is that some vehicles like tractor and tricycle show up less in their daily life in semi-concentrated village.

With the gain of non-agriculture job opportunities, the semi-concentration model might reduce accessibility to agricultural work and discourage a resilient, self-sufficient lifestyle including agricultural economy and small family business. The housing style of semi-concentrated village doesn’t fit for Chinese courtyard economy anymore. Combined with geoscience data, the study explores the accessibility of social service and facilities to the Linpan settlements. The measure

is based on the immediate proximity, availability within an accustomed unit, the average cost to reach all facilities. Spatially, accessibility is fundamental to the opportunities open to the rural population. According to the measure in ArcGIS, the job opportunities availability of semi-concentrated model is much better than traditional villages. As the accessibility to non-agricultural job opportunities increases, the distance and the cost to go to their field significantly rises which reduces the accessibility to the non-agricultural work places.

Overall, the transportation facilities are much closer to the village with semi-concentration model than the village of traditional model. For the distance from home to the bus stop, the semi-concentrated model performed well to get an average distance below 500 meters (421 meters), while traditional village still stays far from the Bus stop with an average distance around 1800 meters. To some extent, it is because that the government focuses on the development of these cluster settlements. It is true that the level of the life opportunities and household experience are constrained by relevant government policymaking.

Through the regression analysis of the survey data, it shows that household head age has a negative effect on the household income level, while other variable didn't identified as significant. The results need more examination; however, the approach can apply to future studies if there are supporting data since this is the first time to apply the model to a Linpan study.

An in-depth analysis of the survey result and spatial relationships shapes an impression of the life the villagers are living. The statistical comparative research of the semi-concentration development model and traditional model are the grounds for future planning and decision making in Western Sichuan Plain area.

6.2 Limitations and Future study directions

The process of defining the Linpan patches in the study area for purposes of tracing their boundaries and measuring them in GIS is prone to errors. Also, the definition of the Linpan boundary is quite different from the literature such as Xue (2016). In this study, the wood around

the LInpan are calculated into the area of the Linpan, however, Xue(2016) only identified the construction land in a large scale. Furthermore, the regression analysis on the available survey result with a sample size of 63 is relatively small for a factor examination and analysis. The results of the study are only preliminary..

I conducted a regression analysis on the available survey result with a sample size of 63 which is relatively small for a factor examination and analysis. The results of the study are only preliminary. In terms of comparing the two models themselves, I did analyze them separately but the sample size was so small within these individuals that they were not robust statistics results.

The design of questionnaire is lacked in preciseness and conciseness in many aspects and it is not a perfect survey for this study. Firstly, it is too complicated to see the alternative answers for the respondent who is rural population. Then, the questions are hard to analyze in a statistical way without a precise purpose. For instance, their exact livelihood choice is the key information for extended study. There are three questions related to the household head, the income form agriculture, and income of non-agriculture work which are kind of mixed with each other. Also, some people did not reply to all the questions which bring some difficulty to do statistical analysis.

A better questionnaire might focus on the questions we are caring about and can be designed to be more convenient for statistically summarizing the result. Based on the methodology and approaches of this study, the questionnaire for future research can be designed in a more effective way.

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Appendix A Questionarie in English

Questionnaire code (filled by administrator only)

Village Number	Group Number	Month	Day		Hour			Minutes

Hello! I am a student of the planning department of Sichuan university and am doing a research and internship project on rural planning in Chengdu plain. We divided into three groups and going to three villages in Sandaoyan, this research is only used as an academic research to ensure privacy,you do not to worry about anything because we will not disclose any information obtained. The questionnaire is expected to last about half an hour.

If you decide to participate in this research, please express your consent to the investigator.

Contents of the questionnaire

1.Basic information of individuals and families

2.The use of land , the work of agricultural production and non-agricultural

3.Household consumption and expenditure

4.Daily activities, social contacts and the use of public facilities (including the use of networks, etc.)

Questionnaire 1.Basic information of individuals and families

NO.1 1 Parents; 2 Children; 3 Brothers and sisters; 4 Grandparents; 5 Grandchildren; 6 Son-in-law and daughter - in - law; 7 Others (listed)

NO.2 1 This village;2 Other villages in this town; 3 Other towns in this county; Other counties in this province; Other provinces; 8 Other countries

NO.6 1 Kindergarten; 2 Primary school; Junior high school; 4 Secondary / Vocational schools; 5 High school; 6 Junior college; 7 Universities

NO.7 1 Farming; 2 Industry and construction (2 - 1 Industry, listed; 2 - 2 Construction industry); 3 Public (3 - 1 Government organs; 3 - 2 Education; 3 - 3 Medical treatment; 3 - 4 Military);

		B	**C**		**D**						
	ID Number	Related relationship	Sex	Age	Present location	Education background	Present work	Work/study place *	Whether live or study outside	The total income of this job in past 12 months(If seeking job,write the working month	The total income in last 12 months
	1Hoste 2spouse	**NO.1**	1Men; 2Women	Birth year	**NO.2**	Highest education NO.6	NO.7	**NO.2**	1Yes; 2No		Yuan
1	1Hostle										
2	2Spouge										
3	3										
4	4										
5	5										
6	6										
7	7										

* 8. If interviewee has children in study,shall they live in the school? Yes _____ No _____

Questionnaire 2：The position of household ownership and availability of resources

House：Heads of households and their family members(including those who have moved out to form new families)

		A Total number of houses	B Current state (1 Family living; 2 Rental; 3 Idle; 4 Other, listed)
1	This village：		
2	In town		
3	In county		
4	In downtown of Chengdu		
5	In other place		

Transportation：The position of transport owned by family members

		C Quantity	D Owner and user	E Utilization
1	Bicycle			
2	Motor			
3	Cars			
4	Tractor			
5	Other			

Land：

		A	**B**	**C**	**E**	**F**	**G**
		Collectively distributed land	Rent someone else's land	The rent of per mu	Land leased to others	Rental price per mu	How long does the distance you walk to your farthest field
		Mu	Mu(**0>>D**)	Yuan / Mu	Mu (**0>>G**)	Yuan / Mu	Minutes
1	Homestead						
2	Field						
3	Others，listed						

4.How long is the transfer period of the land you transfer ?

A、Less than 5 years B, 6-10 years C,11-20 years D, 21-40 years E, 41 years

5.Who is the transferee of your land transfer?

A, Individual villagers B, Enterprises / Cooperatives and other organizations C Other (please explain)

Questionnaire 3：The situation of farming

1 Are the families have income from farming in the past 12 months? (1) Yes; 2 No):

If yes, fill in the following information:

Total annual household income from farming: _ _ _ _ _ _ _ _ _ _ _ _ _

Annual fund input for farming: _ (1 Deposit; 2 Bank loans; 3 Cooperative loans; 4. Relatives and friends borrow money; 5 Others)

Net income from farming year: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

		A	B			C		D		
		Specific characteristics	Scale	Participated family member	Unit input	United yield	Yield of self use	Total sales	Ways of sale	Annual income
1	Type of production		Mu/ head		Yuan(including breeding, fertilizer pesticides and mechanical costs; Excluding land rental and labour costs）	（Yield per mu or unit livestock weight ）	（Ten thousand） Jin or head	（Ten thousand） Jin or head	1 go to the market for sale (No. 2 fill in the location of market); 2 company acquisition ; 3. state's acquisition ; 4 customers come here to buy directly; 5 internet sales; 6 others, listed	Yuan
2	Food(rice, wheat, corn and other grains)									
3	fruit									
4	vegetables									
5	Loveingstock breeding(non-aquatic)									
6	Aquatic product									
7	Landscape garden plant									
8	other									

Interviewee's family (ask the interviewee himself, then add up the input of other family members and fill in the total number):

(1) how long have you been involved in agricultural production (year):

(2) The number of days that you have been involved in agricultural activities in the past year :

(3) The number of farming hours per day during the slack season in the past year:

(4) The number of days to participate in agricultural leisure in the past year:

(5) The number of farming hours per day when participating farming in slack season the past year:

(6) How to decide what to plant / how to raise and how many of it? (open question)

(7) Plans for the next five years (e.g. whether agricultural production will continue):

Questionnaire 4：The position of non-farming

（Family members have worked and earned wages? (1) yes; 2 no > > next table)

If yes, please wtite down the total working income of family members (RMB):

A

Interviewee's family (ask the interviewee himself, then add up the input of other family members so that fill in the total number):
(1) non-farm work days in the past year:

(3) non-farm work hours per week in the past year:

Questionnaire 5：Other income

		G
		Family income in past 12 month
1	**Government subsidy**	Yuan
2	Social security fund association	
3	Directly food subsidy	
4	The fund tillage protection and insurance	
5	Land acquisition subsidy	
6	Other,indication	

Questionnaire 6 :Family expenditure （last year）

			A
			Yuan
1	Basic living expenses	Rental housing,housing maintenance	
2		Water fee	
3		Telephone charge	
4		Internet fee	
5		Cloth	
6		Daily essentials	
7	Food beverage	Food	
8		Fruit ,vegetable	
9		neat	
10		Restaurant dining	
11	Transportation	Public transportation	
12		Public transportation（fuel fee、insurance）	
13	Education expense	Tuition and fees，book，Cram school.etc	
14	Heath expense	Insurance	
15	Expendable assets	Furniture or electrical appliance	
		Transportation	
		Agricultural machinery	
16	Other	Listed	

Questionnaire 7：Fuel fee

		A	B	C	D
		Will this kind of fuel be used for cooking at home?	Will this kind of fuel be used for heating in families?	Average amount of fuel used per year	Energy consumption in the past 12 months
				Jin	Yuan
1	Wood				
2	Bamboo				
3	Coal				
4	Gas				
5	Biogas				
6	Natural Gas				
7	Electricity				

Questionnaire 8：Transportation

1 The market; 2 To see a doctor; Visiting relatives; 4. Meeting; 5 Others (listed)

NO.9

			A
1	Has the householder ever been to the chess and card room?	1YES；2NO (**>>4**)	
2	How many times have the householder been to the chess and card room in the past month?	#	
3	How long has the householder stay on mahjong on average every time you ?	TIME	
4	Has the owner ever been to a tea house?	1YES；2NO (**>>4**)	
5	How many times has the householder been to tea houses in the past month?	#	
6	How long has the householder stay in the tea house on average time?	TIME	
7	Has the head of the household been to the village Committee?	1YES；2NO (**>>4**)	
8	How many times have the householder visited the village Committee in the past month?	#	
9	How long has the householder stay on the village Committee on average every time you	TIME	
10	What is the purpose of going to the village Committee?	NO.9	
11	Has the householder been to a township?	1YES；2NO (**>>7**)	
12	How many times has the householder been to villages and towns in the past month?	#	
13	What is the purpose of going to the county township? Has the head of household been to county seat?	NO.9	
14	How many times has the owner of house ever been to county town?	1YES；2NO (**>>10**)	
15	How many times has the owner of house ever been to county town last month?	#	
16	What is the purpose of going to county town?	NO.9	
17	Has the owner of house ever been to urban district of Chendu?	1YES；2NO (**>>12**)	
18	How many times has the householder been to Chengdu in the past 12 months?	#	
19	Has the head of household been to an area outside Sichuan province?	1YES；2NO (**>>14**)	
20	How many times has the head of household visited a province except Sichuan in the past 12 months?	#	

Questionnaire 9：The health of Children(if children living in school, look at questionnaire 1 question # 8)

1	Do you think children eat well at home comparing with school?	1 Yes；2 No；3 Not clearly	
2	Do you think children exercise more at school or at home?	1 School；2 Home；3 Almost	

Questionnaire 10：Social network(each group of people please mark the option letter in the box of the corresponding column)

Related person / question	Neighbor	Adjacent production	Other village	Town	Chendu urban district	Other cities in Chendu	Other province
Please tick the corresponding crowd column (multiple choices are allowed)							
Who do you often go shopping with or take part in leisure activities?							
If you encounter some difficulties: A Look after children (or the elderly) B Sudden illness C Borrow money							
____							

The following questions are only for Qing gangshu village:

Are all your former neighbors, relatives and friends still living in the new neighborhood of the green bar tree?

A Most of them are still there; B Most of them are absent; C Not clear

How is the situation your contact with them?

A As often as before; B Most of them have connections; C Most of them have little contact.

Appendix B. Questionarie in Chinese

问卷编码(只管理者来填写)

村编号 小组号 月 日 小时 分钟

四川大学 2017 UIP 城乡规划交流营－成都郫都区农户调查问卷

你好！我是四川大学的规划系学生，正在进行一个有关于成都平原乡村规划的研究与实习项目。 我们分成三个组前往三道堰三个村子，这个调研仅作为学术研究，保证私密性，我们不会泄露任何所得信息，请你们放心。本次问卷预计大概进行半小时左右。

如果您决定参加此项调查研究，请对调查者表示你的同意。

调查表内容
1．个人及家庭基本情况
2．土地利用，农业生产与非农业的工作
3．家庭消费与支出
4．日常活动、社会交往与公共设施使用（包括网络的使用，等）

问卷 1：个人及家庭成员基本信息

编号 1 1 父母；2 子女；3 兄弟姐妹；4 祖父母；5 孙子，孙女；6 女婿,儿媳；7 其他(列出)

编号 2 1 这个村庄；2 这个镇其他村庄；3 这个县其他镇；4 这个省其他县；5 其他省；8 其他国家

编号 6 1 幼儿园； 2 小学；3 初中；4 中专 / 职校；5 高中；6 大专；7 大学

编号 7 1 务农；2 工业及建筑业（2-1 工业，列出；2-2 建筑业）；3 公共（3-1 政府机关；3-2 教育；3-3 医疗；3-4 军事）；4 服务行业 （4-1 餐饮；4-2 交通；4-3 互联网、媒体；4-4 银行、保险；4-5 其他，列出）

	B	C		D						
	身份编号	与受访者关系	性别	年龄	现在所在地	教育背景	目前职业	工作/学习地点＊	工作/读书时是否离开家居住	过去十二个月，这份工作的总计收入	过去十二个月中给家庭金额
	1 户主本人;2 配偶;	**编号 1**	1 男;2 女	（填出生年）	**编号 2**	填最高学历 编号 6	编号 7	**编号 2**	1 是;2 否	元（如务工,请填写每年务工月数）	元
1	1 户主本人										
2	2 配偶										
3	3										
4	4										
5	5										
6	6										
7	7										

＊8. 如果受访者有上学的孩子，他们住在学校马？ 是 _____ 否 _____

问卷 2：家庭拥有及可用资源情况

住房：户主及其家庭成员（包括已经搬出组成新家庭的家人）

		A 住房总数	B 目前使用状况 （1 家人居住；2 租出；3 闲置；4 其他，列出）
1	在本村：		
2	在镇区		
3	在县城		
4	在成都市区		
5	在别处		

交通工具：家庭成员拥有交通工具情况

		C 数量	D 所有者及使用者	E 用途
1	自行车			
2	摩托车			
3	小轿车			
4	拖拉机			
5	其他			

土地：

		A	B	C	E	F	G
		集体分配的土地	租别人的土地	每亩的租价	出租给别人的土地	每亩的出租价	走路到你最远的田地需要多久
		亩	亩 (0>>D)	元 / 亩	亩 (0>>G)	元 / 亩	分钟
1	宅基地						
2	田地						
3	其他，列出						

4. 您进行流转的土地的出让年限为？

A、5 年以下 B、6~10 年 C、11~20 年 D、21~40 年 E、41 年以上

5. 您所进行的土地流转的受让方为？

A、个体村民 B、企业 / 合作社等组织 C.其他（请说明）

问卷 3：务农情况

1 过去十二个月中，家庭是否有务农收入? (1 是；2 否)：

若是，填写如下信息：

家庭年务农总收入：_____

务农年资金投入：_____资金来源：_____（1 存款；2 银行贷款；3 合作社贷款；4 亲友借钱；5 其他）

务农年净收入：_____

		A	B			C			D	
		具体品种	规模	参与家庭成员	单位投入	单位产量、	自用总量	销售总量	销售途径	年收入
1	生产种类		亩/头		元（含育种、化肥农药及机械成本；不含土地租金和人工费）	**（亩产量或单位牲畜重量）**	（万）斤或头	（万）斤或头	**1 去市场销售（编号 2 填写市场位置）；2 公司收购；3 国家收购；4 顾客来此地直接购买；5 互联网销售；6 其他，列出**	元
2	粮食（水稻、小麦、玉米及其他谷物）									
3	蔬菜									
4	水果									
5	牲畜养殖(非水产）									
6	水产									
7	景观园林植物									
8	其他									

受访者家庭（从受访者本人问起，然后把其他家庭成员的投入加总，填写总数）：

（1）参与农业生产多久了（年）：

（2）过去一年参与农忙天数：

（3）过去一年参与农忙时每日务农小时数：

（4）过去一年参与农闲天数：

（5）过去一年参与农闲时每日务农小时数：

（6）如何决定每年种/养什么以及多少？（开放问题）

（7）未来五年打算（如是否会继续农业生产）：

问卷 4：非农工作情况

A

1　过去十二个月中，家庭成员工作并有工资收入?（1 是；2 否**>>下一张表**）

如有，请填写家庭成员工作总收入 （元）：

受访者家庭（从受访者本人问起，然后把其他家庭成员的投入加总，填写总数）：

（1）过去一年参与非农工作天数：

（3）过去一年每周非农工作小时数：

问卷 5：其他收入来源

		G
		过去十二月中家庭收入
1	**政府补助**	元
2	社保基金	
3	粮食直补	
4	耕保基金	
5	土地征收补助	
6	其他，注明	

问卷 6：家庭支出 （过去一年）

			A
			元
1	基本生活开支	租房、房屋养护	
2		水费	
3		电话费	
4		上网费	
5		服装	
6		日用品	
7	食物、餐饮	粮食	
8		蔬菜水果	
9		肉类	
10		餐馆就餐	
11	交通	公共交通	
12		非公共交通（加油费、保险）	
13	教育支出	学杂费，书本，补习班等	
14	健康支出	保险费	
	可耗损资产	家具或电器	
		交通工具	
15		农机	
16	其他	列出）	

问卷 7：能源消费

		A	B	C	D
		是否在家庭会使用此种燃料烹饪	是否在家庭会使用此种燃料取暖	平均每一年使用的燃料量	过去十二个月，能源消费
				斤	元
1	木材				
2	竹子				
3	煤				
	煤气				
4	沼气				
5	天然气				
6	电				

问卷 8：出行

1 赶场；2 看病；3 拜访亲戚；4 开会；5 其他（列出）

编号 9

			A
1	户主是否去过棋牌室?	1 是；2 否 (>>4)	
2	过去一月中，户主去过几次棋牌室?	#	
3	每次去麻将平均会待多久？	时间	
4	户主是否去过茶馆?	1 是；2 否 (>>4)	
5	过去一月中，户主去过几次茶馆?	#	
6	每次去茶馆平均会待多久？	时间	
7	户主是否去过村委会?	1 是；2 否 (>>4)	
8	过去一月中，户主去过几次村委会?	#	
9	每次去村委会平均会待多久？	时间	
10	去村委会的目的是什么？	编号 9	
11	户主是否去过乡镇?	1 是；2 否 (>>7)	
12	过去一月中，户主去过几次乡镇?	#	
13	去乡镇的目的是什么？	编号 9	
14	户主是否去过县城?	1 是；2 否 (>>10)	
15	过去一月中，户主去过几次县镇?	#	
16	去县镇的目的是什么？	编号 9	
17	户主是否去过成都市区?	1 是；2 否 (>>12)	
18	过去十二个月中，户主去过几次成都?	#	
19	户主是否去过四川省以外的地区?	1 是；2 否 (>>14)	
20	过去十二个月中，户主去过几次四川以外的省？	#	

问卷 9：孩子的健康 （如果有孩子住在学校，看问卷 1 问题＃8）

1	你觉得孩子在学校里有没有在家里吃得好?	1 是；2 否；3 不清楚	
2	你觉得孩子的运动量在学校大还是在家里大?	1 学校；2 家；3 差不多	

问卷 10：社会网络（请在每类人群相应一列的方框内标出选项字母）

关系人 / 问 题	隔壁邻居	相邻生产队	其他村	镇上	成都市里	四川其他市	其他省
请在对应的人群一列中打勾（可多选）							
您常和谁一起买菜购物，参加休闲活动？							
如果遇到的困难：A 看孩子（或老人）　B 突发疾病　C 借钱							
——							

以下问题仅供青杠树村：

您以前的邻居、亲戚、朋友都还在青杠树新社区里居住吗？

A 大部分都还在；B 大部分都不在；C 不清楚

您与他们的联系情况如何？A 和以前一样常联系；B 大部分都有联系；C 很多都不怎么联系了；

Appendix C Regression test

The regression model was done for the linear, semi-log, double-log and exponential equation at the first stage. The best equation was identified to be the semi-log considering the value of adjusted-R2, VIF, F-value, BIC, AIC, and the number of significant variables with priority expectations (table 19).

Table 24 summarized statistics of regression models

Variables	Linear	Semi-log	Double-log
Development model	-14,123**	-0.220***	-0.198**
	(5,519)	(0.0810)	(0.0810)
Schooling years of household head	1,481	0.0134	0.273
	(984.8)	-0.0145	(0.209)
Age of Household head	-664.3**	-0.0115***	-1.231***
	(256.6)	(0.00377)	(0.433)
Vehicles	-6,592**	-0.0998**	-0.0947**
	(2,768)	(0.0406)	(0.0408)
Farm size	-1,595	-0.0197	-0.0177
	(1,514)	(0.0222)	(0.0225)
Household Asset	2,431	0.0669	0.0593
	(3,556)	(0.0522)	(0.0526)
Household size	-3,513	-0.0333	-0.0359
	(2,274)	(0.0334)	(0.0338)
Female-headed household	-12,546	-0.264	-0.291*
	(11,721)	(0.172)	(0.167)
Constant	88,221***	5.254***	6.621***
	(20,996)	(0.308)	(0.824)
Observations	68	68	68
R-squared	0.352	0.354	0.348
Mean VIF	1.25	1.25	1.22
AIC used by Stata	1568.453	34.903	35.466

BIC used by Stata	1548.478	54.879	55.441

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Then, the income level would be treated as logorthim as dependent variable, and develop model, schooling years of household head, age of household head, vehicle numbers, farm size, household asset, household size and femail-headed households are independent variable in the model. Getting rid of the outliers, the sample size became 63 for the final regression.

First, results indicate that multicollinearity is not a problem because the largest VIF is under 5. The table 25 shows the results of the VIF function which tests for multicollinearity. With a mean VIF of 1.72, the variables used in the regression analysis are moderately correlated. Because the mean VIF is low, there is no concern about the multicollinearity of the data. The regression satisfies the assumption of linearity between the predictors and outcome variables.

Additionally, in the ovtest test (Table 26), p-value is greater than 0.05 as insignificant which means that there is evidence support the null hypothesis that the model is specified correctly. Therefore, the regression model may meet the assumption of the model being specified correctly. Based on these test, the model might statistically significantly predict the dependent variable to some extent.

Table 25 VIF test for the factors influencing household income

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
    jobcount |      2.89    0.346227
     d_model |      2.40    0.415962
    h_school |      1.61    0.619771
       h_age |      1.59    0.628755
      h_farm |      1.56    0.639568
      f_head |      1.45    0.689416
      h_size |      1.37    0.729879
   h_vehicle |      1.32    0.756250
     h_asset |      1.28    0.780078
-------------+----------------------
    Mean VIF |      1.72
```

Table 26 Ovetest test

```
. ovtest

Ramsey RESET test using powers of the fitted values of h_income
       Ho:  model has no omitted variables
                  F(3, 50) =      0.33
                  Prob > F =      0.8028
```

Table 27 BIC and AIC Test

```
. fitstat

Measures of Fit for regress of h_income

Log-Lik Intercept Only:        -12.905   Log-Lik Full Model:            -2.754
D(53):                           5.509   LR(9):                        20.302
                                         Prob > LR:                     0.016
R2:                              0.275   Adjusted R2:                   0.152
AIC:                             0.405   AIC*n:                        25.509
BIC:                          -214.078   BIC':                         16.987
BIC used by Stata:              46.940   AIC used by Stata:            25.509
```

Table 28 Summary of the variables

```
. summarize
```

Variable	Obs	Mean	Std. Dev.	Min	Max
id	0				
h_income	63	4.394762	.2993642	3.95	5.13
d_model	63	.4603175	.5024263	0	1
h_school	63	8.380952	2.738192	0	16
h_age	63	52.84127	11.11843	28	86
vehicleyupes	63	1.920635	.9211071	0	5
h_farm	63	2.565079	1.845409	0	9
h_asset	63	1.428571	.7559289	1	5
h_size	63	4.238095	1.146021	2	7
agrecultur~y	63	.4285714	.4988466	0	1
f_head	63	.047619	.2146694	0	1
sex	63	1.047619	.2146694	1	2
bus_log	63	2.869206	.3630796	2.29	3.43
distanceto~p	63	1023	766.8773	195	2677
job_log	63	1.094762	.6654221	0	1.94
jobcount	63	26.79365	23.57018	0	87
h_vehicle	63	.6984127	.5277744	0	2
dis_health	63	1626.939	775.1854	290.3555	2781.22