


## Article

# Research on Spatial Restructuring of Farmers' Homestead Based on the "Point-Line-Surface" Characteristics of Mountain Villages

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**Abstract:** The spatial restructuring of rural settlements is conducive to the realization of rural transition and development. This study constructed a "point-line-surface" framework for the spatial reconstruction of the homestead in a typical mountain village and used the weighted Voronoi diagram and buffer analysis method to analyze. The results are as follows. (1) The development capacity of rural homesteads in Longfeng Village was divided into three levels: high, medium, and low. Among them, the high-level homesteads clustered in the north and south of the village in the form of a "T" and a long strip, respectively; the medium-level homesteads are mostly aggregated in the middle of the village; the low-level homesteads are mainly distributed along the Fenghuang Mountain. (2) The layout of homesteads in Longfeng Village was axis-oriented, which is manifested by the number and scale being in a gradient-decreasing pattern with the main road axis as the centerline. (3) According to the principle of "maximum" development capacity of the homestead, nine reconstruction units are divided. By calculating the location entropy, it is found that the dominant functions of each reconstruction unit mainly include supporting life services, operational production, ecological agricultural production, and traditional agricultural production, and there are obvious differences in the development patterns of homesteads in different functional units. (4) Based on the "point-line-surface" characteristics of the homestead, four reconstruction modes, namely, modern community type, field and garden integration type, road-pointing type, and traditional residential type, are summarized, and the reconstruction strategies are proposed accordingly. The "point-line-surface" framework of rural settlements is of practical significance and theoretical value, which can provide a decision-making reference for the optimization and reorganization of residential land space in villages of the same type in mountain areas. Moreover, the integrated and innovative framework proposed in the paper has also international significance, thanks to the possibility of replicating the research strategy and methodological approach in other contexts.

**Keywords:** rural homestead consolidation; rural restructuring; "point-line-surface"; rural settlements; mountain area; agglomeration and upgrading village; rural revitalization



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## 1. Introduction

Rural decline is becoming a global issue, and a rural revival is needed around the globe, especially for developing countries [1]. The connotation of rural revitalization is to stimulate internal motivation and absorb external resources through economic, political and cultural construction to cope with the loss and decline of internal factors in the countryside [2], so as to optimize the structure of factors, enhance regional functions, reshape rural forms, and realize the comprehensive rejuvenation of rural regional economy, society and ecology and the new pattern of urban-rural integration and development [3]. The core objective of rural revitalization is to systemically establish a coupling pattern of various rural development elements including population, land, and industry [4]. As one of the prerequisites, land

resources are required to be optimally allocated via land consolidation [5]. Consequently, land consolidation contributes greatly to population agglomeration, industry development, and resource support under the context of combating rural decline [2–4]. As one of the most important types of land in rural space, the optimization of the spatial layout of rural settlements has always been a major difficulty in land consolidation.

Land issues can be harnessed to improve rural lives and economies [1,6], particularly through spatial planning and reconfiguration, land use restructuring, and community design. Similar to the Contemporary European Union (EU) and Pan-European policies stressing the importance of spatial planning for the long-term sustainability of regions [7], many countries and regions have carried out many theoretical and practical explorations on rural spatial planning and community renovation. Particularly, the common rural settlement pattern in many developing countries is dispersion [8], which tends to be one of the major contributing factors to rural disadvantage and under-development [9]. Therefore, concentrated residential planning as a rural development approach has been introduced around the world to reverse rural recession under urbanization and cope with rural settlement dispersion [10]. For example, as early as the 1960s, the Tanzanian government developed spatial plans for clustering several residential clusters or hamlets surrounding an area in which farms were to be established, with each cluster of houses accommodating about 60 families in plots of about half an acre each, making four clusters as a full-fledged settlement [11]. Moreover, the UK, the former Soviet Union, Japan, the USA, South Africa, Thailand, and other countries had also carried out key settlement construction or settlement rationalization projects, with ambitious schemes to reorganize the dispersed settlement pattern, modernize the infrastructures, diversify the economy, and slow the depopulation in rural areas [12–17], and these experiences have effectively demonstrated the above viewpoint.

In the vast traditional rural areas of China, the homestead is the place of production, life, and development of rural residents and the core of interaction between rural man-land relationships [18,19]. The optimization and reconstruction of its spatial layout is an important thrust to realize the fine management of land and improve the level of intensive use of rural land [3,20]. For a long time, the spatial layout of the homestead has been affected by natural environmental conditions, economic and social conditions, humanistic customs, and the absence of village planning [3,20,21], and caused many problems such as scattered and disorderly space, extensive utilization, backward facilities, and environmental pollution [22–24], which are still far from the overall requirements of building beautiful and livable villages in the new era [25]. The village area is the basic unit of rural social and economic activities in China, and the development of village areas requires scientific and comprehensive planning to make both spatial and temporal arrangements for the social and economic construction of villages [26]. The current academic community has mainly studied the process and influencing factors of rural restructuring in typical villages [27,28], the morphological characteristics of village settlements [29], the process of spatial evolution and its driving mechanism [30–32], and constructed the model of spatial reconstruction of village settlements based on the mutual attractiveness between settlements, the integration of the driving factors and the suitability evaluation [33–36], then proposed the strategies of spatial reconstruction for village settlements from the perspective of symbiosis [37]. The above research findings provide references for the practice and follow-up study of spatial governance of village settlements.

Under the background of the implementation of China's rural revitalization strategy, it is necessary to separately construct the method system of spatial reconstruction for settlements in the category of four types of villages: agglomeration and upgrading, suburban integration, characteristic protection, relocation and evacuation, to better realize the construction of an ecological and livable rural environment. At the village level, as a complex system with production, living, and ecological functions, the homestead is a "point-surface" complex intertwined with a single land use type and multiple system elements [38], and its spatial layout has obvious characteristics of point-shaped distribution

and development along the axis. China has a vast territory and diverse geomorphic types. Among them, mountainous areas account for about 75% of the total area of the country, and the number of mountainous counties accounts for 43.21%. Affected by the special natural geographical and human environment, compared with the plain area, the spatial distribution and evolution of rural settlements in mountainous areas are characterized by low concentration, rapid decline, and complex types. Spatial reconstruction, as an important means to optimize rural spatial organization, promote rural sustainable development, and boost comprehensive revitalization, has become a hot topic of continuous attention in the field of rural geography in recent years [39]. China has a large mountainous area, a low level of economic and social development, and the phenomenon of empty and abandoned homesteads is serious [20]. It is urgent to promote the intensive and efficient use of residential space based on the spatial restructuring of rural residential land [40]. So, this paper established a “point-line-surface” analysis framework for the spatial optimization of homesteads at the village level and took Longfeng Village, Meitan County, Guizhou Province as an example. Based on the analysis of the development capacity, development axis, and dominant function of farmer’s homesteads in the case village, the research formed the spatial restructuring technology system for farmer’s homesteads in the agglomeration and upgrading village in mountainous regions from the two aspects of spatial restructuring direction and strategy selection for different reconstruction units, which is expected to provide references for improving the governance capacity for spatial optimization of rural residential land in the process of rural revitalization in the new era.

## 2. Research Framework and Methods

### 2.1. Theoretical Construction

“Point, line and surface” are the basic elements of plane space, and the distribution of regional spatial elements has obvious structural characteristics of “point-line-surface”. Therefore, the “point-line-surface” analysis framework constructed based on these characteristics is of great significance to the in-depth understanding of comprehensive regional development. The framework of “point-line-surface” has multiple characteristics such as multi-scale, multi-content, multi-elements, and multi-function. At different spatial scales, the conceptual connotation, manifestation form, and value function of “point”, “line”, and “surface” are not only different but also collinear [41]. Generally, “surface” contains “line” and “point” of the same scale, “line” contains “point” of the same scale, and “point” is used as the “face” of the lower scale. With the transformation of scale and the change in elements and environments, the three can realize mutual transformation [42]. The process can be briefly described as follows. With the continuous increase in the number of scattered point elements derived from the progress of economy and society, the continuous strengthening of the degree of connection between “points” will inevitably give birth to axis elements such as roads. These “axes” will connect many scattered points into small-scale “point-line” complexes by giving full play to the exchange function of elements, and the expansion of multiple small-scale complexes will form a boundary blend in a larger scale space, and then evolve into a large-scale “surface” complex. In addition, the “point-line-surface” framework is not only limited to analyzing the evolution process of geographic elements on the time scale but also extends its application scenarios and scope of application due to its basic attributes of scale, systematicity, and dynamism. In other words, the framework is also applicable to analyzing the layout of regional elements at a certain time point on the spatial scale. It should be noted that when using the “point-line-surface” framework to analyze the spatial characteristics of regional elements in a specific year, it is necessary to control the connotation and scope of elements within the same scale (macro, meso, or micro) as a precondition. The framework of “point-line-surface” is applicable to analyze regional development at any scale, so the development according to the point-axis system model can achieve the optimal spatial combination between production layout and linear infrastructure, and achieve the optimal regional factor structure [43].

As far as the specific urban–rural settlement pattern is concerned, the “points” mainly refer to settlements and central cities at all levels, and the “lines” mainly refer to axis infrastructure such as transportation and waterways (for example, a large number of settlement patterns along waterways in the Pearl River Delta, China), and the “surfaces” mainly refer to integrated agglomeration areas developed dynamically from “point-line”. The existing distribution pattern of rural settlements (at a certain point in time) is not suddenly formed, but evolved from a long history, and to a large extent with a “historical imprint”. Correspondingly, the spatial evolution process of rural settlements affects the existing distribution pattern, while the existing distribution pattern effectively reflects the evolution process, and the two are interrelated and inseparable. Based on the above theory, it can be seen that the “point-line-surface” framework can be a theoretical basis for explaining the dynamic spatial evolution process of rural residential land, as well as the main features of the static distribution pattern of rural residential land at a certain time point. In other words, “point-line-surface” can simultaneously describe the vertical evolution process and horizontal plane characteristics of the spatial layout of rural residential land. However, since the conceptual connotation and change process of rural settlements have significant multi-scale complex relationships, the “point-line-surface” framework should be strictly differentiated according to the scale when analyzing the spatial structure characteristics of rural settlements at different scales, of which the micro-scale is suitable for analyzing the distribution pattern characteristics of rural residential land, whereas the medium- and macro-scales are suitable for staging the historical evolution of rural settlements. If the scale is further sunk to the micro-scale of the village, the “points” are mostly manifested as concrete residential land patches, the “axes” are manifested as roads or rivers, and the “surfaces” are shown as settlements or functional areas. From the existing studies, it is not difficult to find that the spatial layout of rural settlements in China (especially in mountainous areas) has obvious characteristics of point-shaped distribution and axis direction of transportation and water systems [44,45]. Most of them form planar agglomerations in intermontane valleys and have widespread problems such as scattered distribution and chaotic structure [46]. In summary, using the framework of “point-line-surface” to analyze the spatial characteristics of farmers’ homesteads in mountainous regions and putting forward the reconstruction strategies had theoretical adaptability and realistic demand.

## 2.2. Main Research Thoughts

On this basis, this paper builds a spatial “point-line-surface” analysis framework of farmers’ homesteads in mountainous areas at the microscopic scale (Figure 1). First, this paper selected 20 indicators such as “areas” to construct the measurement model of farmers’ homestead development ability, described the development characteristics of the point-shaped homestead, and divided the spatial reconstruction unit of the homestead by using the principle of “taking the large” and the weighted Voronoi diagram. Second, the study interpreted the distribution characteristics of homesteads under different buffer distances from the road axis and analyzed the “surface” characteristics of the homesteads based on the dominant function of each reconstruction unit as assessed by the location entropy value. Finally, four types of spatial restructuring models and strategies for farmers’ homesteads were proposed based on the “point-line-surface” characteristics to provide references for solving the problems of rural land use and promoting rural revitalization in mountainous areas.

## 2.3. Research Methods

### 2.3.1. Measurement of Development Capacity of “Point”

The spatial layout of farmers’ homesteads is a projection of the results of long-term activities of rural man–land relationships in geographic space under the strong traction and restriction of various environmental factors [47]. The distribution of homesteads comprehensively reflects the development of agriculture, rural areas, and farmers [19,48]. In order to systematically express the congenital conditions of homestead space, this

paper took the homestead plot as the basic unit, constructed a measurement index system from five aspects, including farmers’ homestead endowment, location conditions, public service system, farmers’ characteristics, and farmers’ willingness (Table 1), and used the comprehensive evaluation method to calculate the value of development ability of each farmers’ homestead plot (Formula (1)). When processing the raw data of the indexes, the min–max normalization method is used to standardize the indexes. In the process of calculating the index weights, this study used a combination of “the entropy weight method and the analytic hierarchy process (AHP)” to overcome the shortcomings of much subjectivity in the subjective empirical weighting method and the over-dependence of the objective quantification method on data quality. The entropy weight method and the analytic hierarchy process method were applied separately to determine the weight of each index, and then the weighted average method was used to calculate the comprehensive weight of the index (Table 2).

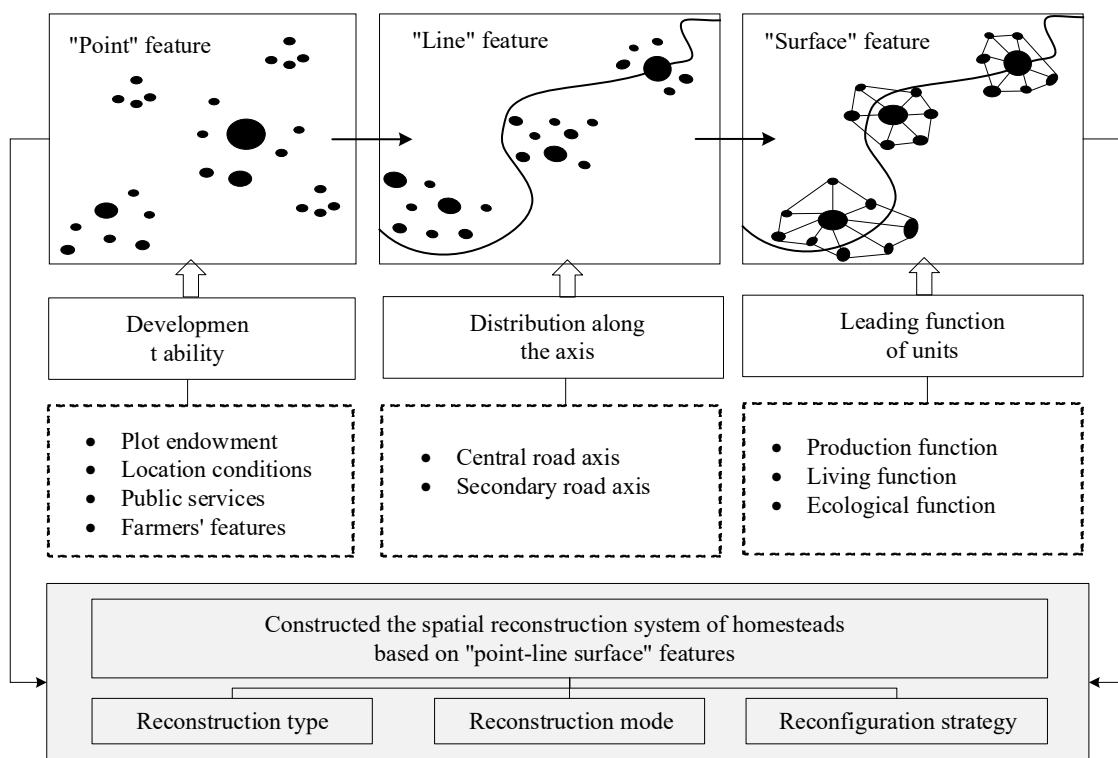


Figure 1. Research framework.

Table 1. Measurement indexes and description of farmers’ homestead development capacity.

Goal Layer	Index Layer	Index Description	Action Direction
Homestead endowment	Homestead area (X1)	The area of farmers’ homestead plot (m <sup>2</sup> )	+
	Housing structure (X2)	Reflecting the building structure of the homestead: wood shingles = 1, brick and tile = 2, brick masonry = 3, steel-concrete = 4	+
	Building type (X3)	There are mainly three types of housing construction for farmers, assigned values respectively: houses with multi-layer and continuous arrangement = 1, houses with multi-layer or continuous arrangement = 2, single-family houses = 3	+
	Housing damage grade (X4)	The old and new degrees of homesteads were obtained according to arrange the farmers’ oral statements during the survey	+

Table 1. Cont.

Goal Layer	Index Layer	Index Description	Action Direction
Location conditions	Elevation (X5)	Elevation of homestead plots (m)	–
	Slope (X6)	Slope of homestead plots (°)	–
	Average farming distance (X7)	Extracted by the nearest neighbor analysis tool of GIS software and processed by mean value (m)	–
	Distance from road (X8)	Extracted by the nearest neighbor analysis tool of GIS software (m)	–
	Distance from ditch (X9)	Extracted by the nearest neighbor analysis tool of GIS software (m)	–
Public service system	Electricity, water, and gas accessibility (X10)	Access to water, electricity, and gas: all three = 0, only one = 1, two = 2, all three = 3	+
	Perfection of public service facilities (X11)	Configuration of public service facilities for farmers' homesteads: complete = 1, relatively complete = 0.75, incomplete = 0.5, poor = 0.25	+
	Perfection of commercial facilities (X12)	Configuration of commercial facilities for farmers' homesteads: complete = 1, relatively complete = 0.75, incomplete = 0.5, poor = 0.25	+
	Satisfaction of health cleaning (X13)	Farmers' satisfaction with the health cleaning of their homesteads: poor = 1, general = 2, good = 3	+
Farmers' characteristics	Culture degree of the householder (X14)	Expressed using the year of education of the head of the household (years)	+
	Number of family members (X15)	Total number of farm household members (persons)	+
	Diversity of farmers' livelihoods (X16)	Farming, work, scale cultivation, self-employed business, others (each source of income is assigned a value of 1, cumulative calculation)	+
	Gross income (X17)	Annual total income of peasant households (ten thousand Yuan)	+
Farmers' willingness	Residential satisfaction (X18)	Reflecting farmers' residential satisfaction: dissatisfaction = 0, satisfaction = 1	+
	Willingness of living in village (X19)	Whether the farmers intend to stay in the village in the future: stay = 1, no stay = 0	+
	Willingness to support the spatial reconstruction of homesteads (X20)	When personal interests conflict with planning, whether will give way: will = 1, depending on the situation = 0.5, will not = 0	+

The formula for calculating the development capacity of farmers' homesteads is:

$$Z = \sum_{i=1}^n X_i W_i \quad (1)$$

where  $Z$  represents the development capacity value of the  $No.i$  sample unit, which reflects the development conditions of the farmers' homestead plot.  $X_i$  stands for the standardized processing value of the  $No.i$  index.  $W_i$  represents the comprehensive weight of the  $No.i$  index,  $n$  stands for the number of indexes.

An in-depth analysis of the index weight is conducive to clarifying the value, relative importance, and proportion of each specific index in the development process of farmers' homesteads. Specifically (Table 2), the comprehensive impact of public service system and farmers' characteristics on the spatial change in rural homesteads is as high as 40.03%, in which villagers are especially concerned about the degree of improvement of public utility services and commercial facilities in the vicinity of the housing (the cumulative proportion of the two indicators is 32.1%). In addition, the influence of the diversity of farmers' livelihood and household income on rural homesteads has continued to increase, and the willingness of farmers to renovate is the smallest influence on the change in homesteads. This is mainly because farmers' willingness is susceptible to fluctuations in income,

livelihood, social values, and policy changes, among other factors. It can be found that, at the village scale, accelerating the construction of a sound network system of public service facilities, improving the rural human settlement environment system, promoting farmers' diversified livelihood methods, and ensuring farmers' income sources have become the key policy fulcrum to promote the spatial reconstruction of rural residential land.

**Table 2.** Weights of indexes for measuring the development capacity of farmers' homesteads.

Index	Weight of AHP Method	Weight of Entropy Weight Method	Comprehensive Weight
X1	0.0342	0.0632	0.0487
X2	0.0401	0.0418	0.0409
X3	0.0480	0.0052	0.0266
X4	0.0201	0.0441	0.0321
X5	0.0244	0.0160	0.0202
X6	0.0348	0.0074	0.0211
X7	0.0417	0.0031	0.0224
X8	0.1054	0.0042	0.0548
X9	0.0513	0.0185	0.0349
X10	0.0664	0.0114	0.0389
X11	0.1766	0.1780	0.1773
X12	0.0985	0.1889	0.1437
X13	0.0513	0.0220	0.0367
X14	0.0160	0.0250	0.0205
X15	0.0195	0.0394	0.0295
X16	0.0363	0.1851	0.1107
X17	0.0508	0.0902	0.0705
X18	0.0348	0.0204	0.0276
X19	0.0277	0.0113	0.0195
X20	0.0221	0.0247	0.0234

### 2.3.2. Selection of Spatial Reconstruction Axis "Lines"

The unique conditions of topography and resource endowment have created the basic spatial pattern characteristics of "large scattering and small concentration" of rural homesteads in mountainous areas, while roads lay the foundation for mountain settlements at all levels to cross geographical barriers and form spatial inter-coupling and linkages. The axis transportation network centered on roads has an overall impact on the spatial pattern evolution of homesteads in mountainous areas, which is mainly manifested as follows. (1) The road is the axis connecting the settlements in different locations in mountainous areas and the main channel for the transfer of material flow and information flow between each other, as well as the foundation of the high-intensity rural link network [49]. By giving full play to the carrier function of the road, it will effectively promote the correlation and mutual flow of multiple remote elements such as value concepts, production modes, material resources, and information technology, thus realizing the complementary supply and demand of spatial elements and the balanced development of the spatial pattern of mountain settlements. (2) The road has a profound impact on the changing process of spatial characteristics such as the scale structure, morphological layout, and utilization mode of specific homesteads in mountain settlements. The perfect road axis network system in the mountains can provide various conveniences for the outward expansion and development of homesteads. So in reality, the closer the buffer zone is to the road, the more dramatically the landscape pattern of the homesteads changed [50]. In general, mountain roads have strong cohesion and attraction to scattered homesteads in nearby areas. The rural homesteads in mountainous areas will first gather in a belt or cluster in the area with a sound road axis network and then form several small clusters on a large scale. With the continuous development and expansion of the agglomeration point, the road will guide the various elements and subjects to communicate and exchange along its directions and paths internally and spread the "potential energy flow" to the periphery to form new

agglomeration potential zones externally. Finally, the microscopic shaping of the spatial distribution pattern of homesteads in mountainous areas and the macroscopic control of its spatial distribution pattern are realized. Thus, roads should generally be selected as the key axis of spatial reconstruction in mountain villages.

### 2.3.3. The Division of “Surface” of Reconstruction Unit and Its Dominant Function Measure

According to the principles of physics, all things in space have their potential energy and constantly transmit and diffuse this potential energy to the surrounding environment, which in turn affects each other [41]. Similarly, the spatial distribution pattern of homesteads is the result of the mutual game of the spatial potential energy of each rural residential land. The homesteads with high spatial potential energy and good conditions (the growth poles) have more advantages in the game, which can often attract homesteads with low spatial potential energy and poor conditions to move closer to them and form new agglomeration points. Therefore, the accurate identification of growth poles and their spatial influence range are crucial to the spatial reconstruction of farmers’ homesteads. The weighted Voronoi diagram has obvious advantages in identifying and analyzing the influence and radiation range of homesteads [51,52]. Based on the measurement of farmers’ homestead development capacity, this paper selected the farmers’ homestead plots with high-level ability as the growth poles according to the principle of “taking the large” and used the weighted Voronoi diagram to divide the actual influence range of each growth pole on the spatial layout of the homestead as its spatial reconstruction unit.

According to the land use classification in the Technical Guidelines for the Preparation of Land Use Planning in Villages, and considering the actual land use situation, five main types of land use are classified in mountain areas: agricultural land, rural construction land, land for transportation and water conservancy facilities, tourism land, and ecological land. Among them, agricultural land mainly included arable land, garden land, and other agricultural lands; rural construction land included residential land, public service, and infrastructure land, and operating construction land; ecological land included ecological forests, waters, and natural reserves. Based on the relevant research results [53–56], the dominant function classification system of land use in mountain villages was established (Table 3), and the information entropy of each land use function is calculated to determine the dominant function of each reconstruction unit [57–59].

**Table 3.** Dominant function classification system of land utilization with “Production-Living-Ecology” in mountain village.

Function Form	Function Type	Land Use Type
Producing function	Traditional agricultural production function	Cultivated land
	Production function of ecological agriculture	Garden land
	Operational production function	Operating construction land, tourism land
Living function	Life function of habitability	Rural residential land
	Life service supporting function	Public services and infrastructure land, land for transportation and water conservancy facilities
Ecological function	Ecological conservation function	Ecological forest, other agricultural land, water areas, natural reserved area

## 3. Case Study

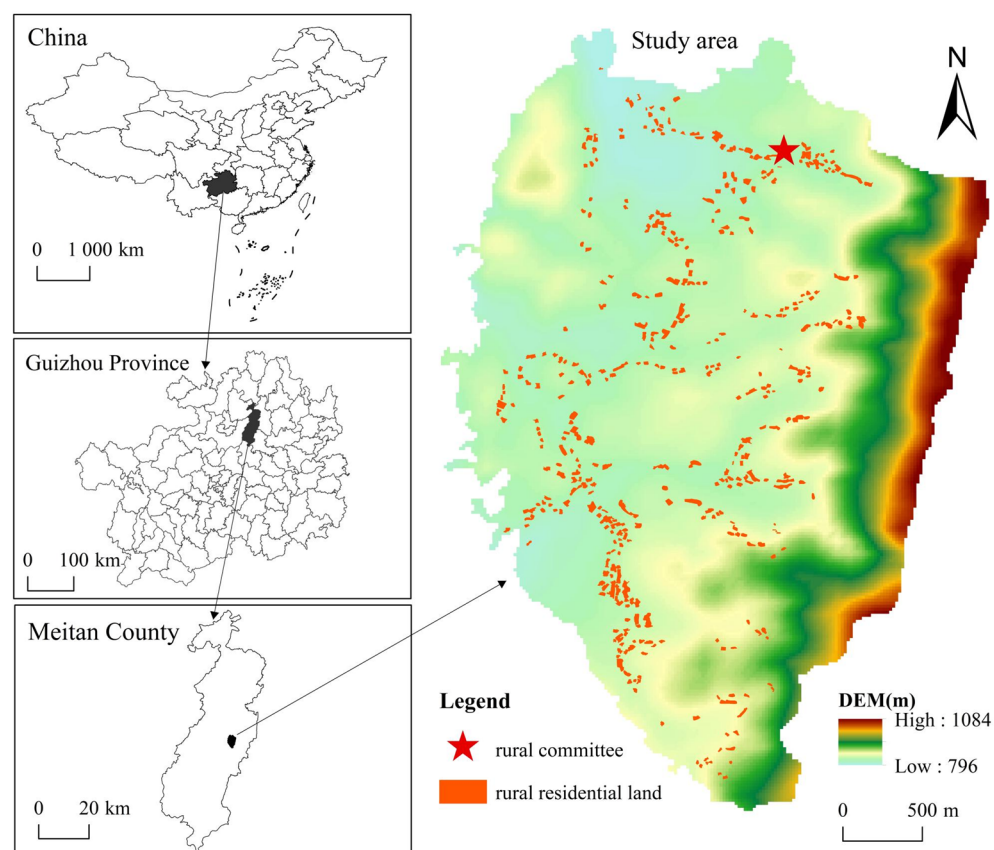
### 3.1. Overview of the Study Area and Data Sources

#### 3.1.1. Study Area

Longfeng Village is in Xinglong Town, southeast of Meitan County, Guizhou Province, 12 km from Meitan County (Figure 2). The village has a good climate and ecological environment with rain and heat in the same season, an average annual temperature of 15.2 °C, an average annual precipitation of 1115.6 mm, and average annual sunshine hours of 1033.9 h. The land area of the whole village is 951.42 hm<sup>2</sup>, with four villager groups under the juris-



diction of the Baodongba group, Fenghuang group, Pingshang group, and Egongba group. In the whole village, the arable land area is 257.43 hm<sup>2</sup>, accounting for 27.06% of the total land area; the tea garden area is 174.03 hm<sup>2</sup>, accounting for 18.29%; the forest land area is 422.27 hm<sup>2</sup>, accounting for 44.38%; and the construction land area of the village is 46.32 hm<sup>2</sup>, accounting for 4.87%. Longfeng Village is one of the demonstration sites of socialist new rural construction in Meitan County, with the tea industry as the leading industry and rural tourism as the supplement, focusing on the development of ecological tourism and leisure industry. Longfeng Village has been successively awarded the titles of “National Agricultural Tourism Demonstration Site”, “National Demonstration Village of Democracy and Rule of Law” and “National Rural Tourism Key Village”. In 2020, the village had a total of 3011 people, with a total annual per capita income of RMB 20,800 and an average household ownership rate of 91% for family cars. Farmers’ household income is mainly derived from self-employment, labor income, farming, and so on. Due to the good location conditions and the basis of agricultural industry, Longfeng Village was positioned as a village of agglomeration and upgrading class in the rural revitalization strategy of Meitan County, which is also widely representative. From a comprehensive point of view, Longfeng Village has a high altitude (796–1084 m), complex and changeable terrain, and its natural endowment is basically same as that of most mountain villages. Meanwhile, the village also possesses unique cultural genes such as lantern drama and revolutionary culture and integrates traditional agriculture and modern tourism in its industrial structure. It can be seen that Longfeng Village not only has the common characteristics of general mountain villages in terms of natural conditions, industrial development, and social culture but also has its own unique differences. In addition, in recent years, under the background of industrial structure adjustment, rapid tourism development, and external policy support in this village, the changes in the scale, function, and layout of rural residential land have been very active, which is typical and of great practical significance as a study area, and it is expected to provide a strong reference for the spatial reconstruction of mountainous villages.



**Figure 2.** Location, elevation, and homestead distribution of the case village.

### 3.1.2. Data Source

The land use change data and remote sensing image map of Longfeng Village in 2020 were provided by Meitan County Natural Resources and Planning Bureau, and the farmers' data were obtained from the authors' field survey in June 2020. First, the farmer's questionnaire was prepared. The questionnaire includes 7 major items, including the farmers' basic situation, the utilization of homesteads, the situation of contracted land, farmers' industrial development, policy awareness and response, village planning awareness and other conditions, and 117 minor items such as farmers' income, housing endowment, and infrastructure status. Then, we took the form of field visits and communicated with farmers face-to-face. Considering the differences in educational level of farmers, take the path of "farmers respond, investigators record". Finally, in the ArcGIS10.2 software platform, we superimposed and registered the range of farmers' homestead plots with remote sensing image maps, and cut out farmers' homestead plots with the unit of farmers, and then fused the farmers' data and spatial attribute data obtained from the survey into a plot-scale homestead attribute database with farmers as the basic unit through data links and other tools.

## 3.2. Analysis of "Point-Line-Surface" Features of Spatial Reconstruction of Farmers' Homesteads in Longfeng Village

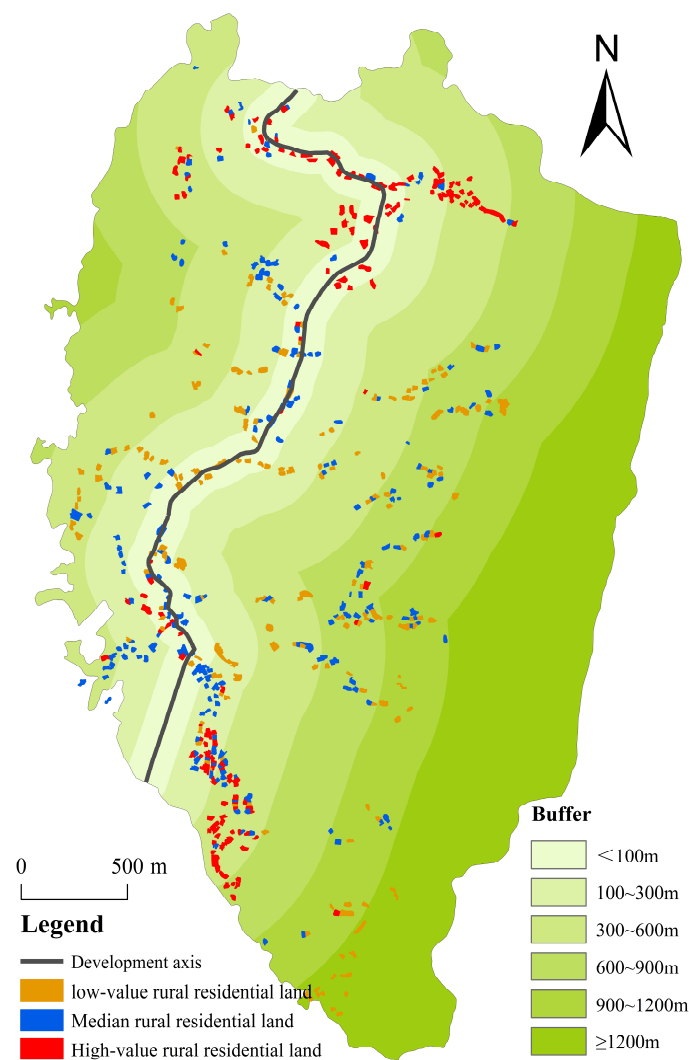
### 3.2.1. Analysis of the Characteristics of Farmers' Homestead Development Ability

According to the model constructed in this paper to measure the development ability value of farmers' homesteads in village domain, the development ability value of 667 farmers' homesteads is calculated between 0.2784 to 0.8439 in Longfeng Village, and the average value is 0.5160. Among them, 302 plots are greater than the average, accounting for 45.28% of the total number of homesteads, indicating that the overall level of farmers' homestead development ability in Longfeng Village needs to be further improved. The Natural Breaks method was used to classify the development ability value of whole farmers' homesteads into three grades in the present study: high (greater than or equal to 0.5898), medium (0.4571~0.5898), and low (less than 0.4571). Specifically, there are 185 homesteads with high ability value, accounting for 27.74%, and their area is 8.8132 hm<sup>2</sup>, accounting for 29.19% of the total homestead area. There are 245 homesteads with medium ability, accounting for 36.73%, and their area is 10.9381 hm<sup>2</sup>, accounting for 36.23%. The number of homesteads with low ability value is 237, accounting for 35.53%, and their area is 10.4385 hm<sup>2</sup>, accounting for 34.58%. The homesteads with different ability values in Longfeng Village show significant spatial heterogeneity, and the overall value decreases from the northern and southern parts of the village to the interior. The homesteads with high-level ability values are clustered in a "T" shape in the Northern Baodongba group and show a long-strip agglomeration distribution in the Southern Egongba group. The homesteads with medium-level ability values are mostly distributed in the central region of the village and around the development axis. The homesteads with low-level ability values are mostly distributed along Fenghuang Mountain, and the rest are scattered throughout the village (Figure 3).

### 3.2.2. Analysis of the "Line" Characteristics of the Spatial Reconfiguration Axis of Farmers' Homesteads

The Eguan highway, which runs through the north and south of the village, is taken as the central development axis of the spatial reconstruction of the homesteads, while the other general roads in the village are taken as secondary or tertiary development axes, which together constitute the spatial development axes network of the homesteads in Longfeng Village. Based on the main development axis of the whole village, the buffer analysis was carried out according to the linear distances of 100 m, 300 m, 600 m, 900 m, and 1200 m (Figure 3), and the spatial distribution characteristics of the distance of homesteads in Longfeng Village from the Eguan Highway are obtained. In general, there are 593 homesteads within 900 m of the Eguan Highway, with an area of 27.0693 hm<sup>2</sup>, and the

proportion of both the number and area of homesteads reach about 90%. Among them, there are 152 homesteads within 100 m from the main development axis, accounting for 22.79% of the total, and the area of homesteads is 7.7798 hm<sup>2</sup>, accounting for 25.77% of the total area. The number of homesteads located from 100 to 300 m away from the main development axis is 158, accounting for 23.69%; the area is 7.1612 hm<sup>2</sup>, accounting for 23.72%. The number of homesteads located from 300 to 600 m away from the main development axis is 181, accounting for 27.14%; the area is 7.5515 hm<sup>2</sup>, accounting for 25.01%. The number of homesteads from 600 to 900 m from the main development axis is 102, accounting for 15.29%; the area is 4.5767 hm<sup>2</sup>, accounting for 15.16%. From the distribution characteristics of homesteads with different grade capability values along the main development axis (Table 4), within 600 m of the main development axis, the number and area of homesteads with high-level ability reach about 94%, indicating that homesteads with high-level ability are concentrated within 600 m of the main development axis. In the same distance (600 m) range, the proportion of the number and area of medium and low-capacity homesteads only reach about 74% and 58%. Under the condition of the same number and area ratio of homesteads (about 94%), the homesteads with medium and low-capacity values are 900 m and 1200 m away from the main development axis, respectively, which further illustrates that the number and area of homesteads with different grade ability values in Longfeng Village have significant gradient differentiation along the main development axis.



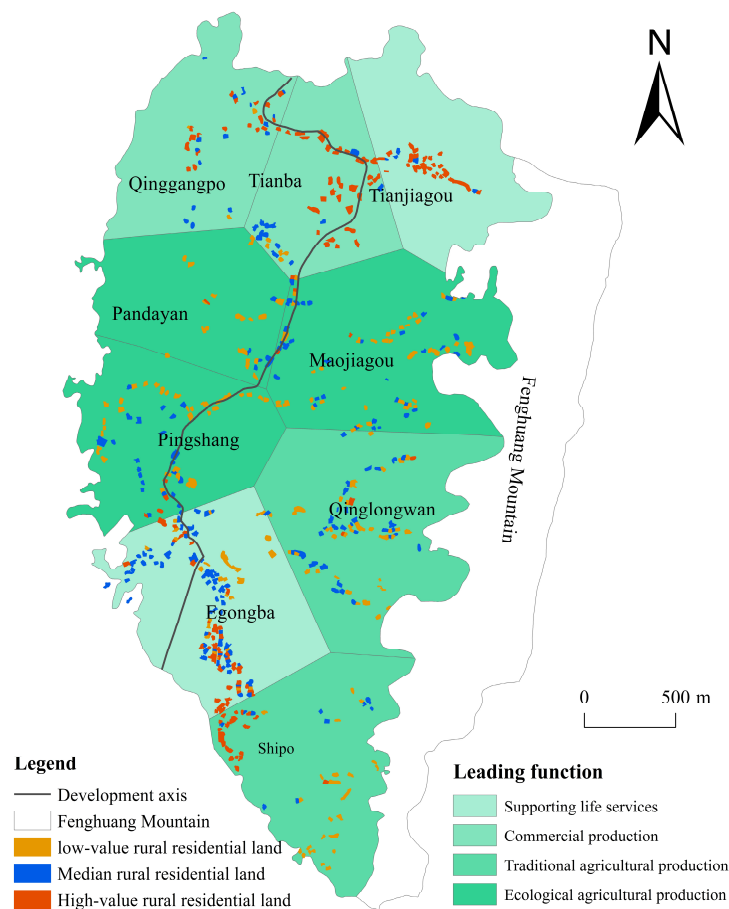
**Figure 3.** Distribution of homesteads with different capacity values along the main development axis in Longfeng Village.

**Table 4.** Distribution table of distance from homesteads to main development axis of different grade capacity values in Longfeng Village.

Index	Homestead with High-Level Ability				Homestead with Medium-Level Ability				Homestead with Low-Level Ability			
	Amount	Ratio (%)	Area (hm <sup>2</sup> )	Ratio (%)	Amount	Ratio (%)	Area (hm <sup>2</sup> )	Ratio (%)	Amount	Ratio (%)	Area (hm <sup>2</sup> )	Ratio (%)
Distance < 100 m	58	31.35	3.0727	34.92	54	22.13	2.7752	25.34	40	16.81	1.9319	18.51
100~300 m	39	21.08	1.8423	20.94	73	29.92	3.1592	28.85	46	19.33	2.1596	20.69
300~600 m	77	41.63	3.3477	38.05	53	21.72	2.1422	19.56	51	21.43	2.0616	19.75
600~900 m	9	4.86	0.4155	4.72	47	19.26	2.1302	19.45	46	19.32	2.0309	19.46
900~1200 m	2	1.08	0.1208	1.37	15	6.15	0.6612	6.04	36	15.13	1.5797	15.13
Distance ≥ 1200 m	0	0.00	0.0000	0.00	2	0.82	0.0841	0.76	19	7.98	0.6747	6.46

### 3.2.3. Analysis on “Surface” Characteristics of Spatial Reconstruction Unit of Farmers’ Homestead

This research selected the homestead plots with the high score as the growth poles from the settlements of Longfeng Village, took the growth poles as quality hearts and the development ability values of farmers’ homesteads as the weight, then generated the weighted Voronoi diagram and divided out the spatial reconstruction units of farmers’ homesteads through ArcGIS10.2, and the spatial reconstruction units were named according to the local small place names. Since the Fenghuang Mountain area in the eastern part of Longfeng Village is all ecological forest land, which has little influence on the spatial reconstruction of farmers’ homesteads, this ecological forest land has been distinguished according to the boundary of the patches when dividing the reconstruction units (Figure 4).



**Figure 4.** Leading functions of different reconstruction units and homestead distribution in Longfeng Village.

This paper divides Longfeng Village into nine spatial reconstruction units of farmers' homesteads. From the distribution of farmers' homesteads in each reconstruction unit, there are 41 households in Tianjiagou, accounting for 6.15% of the total number of households in the village; its homesteads have an area of 1.9388 hm<sup>2</sup>, accounting for 6.42%. Tianba has 65 households, accounting for 9.75%; its household area is 3.7373 hm<sup>2</sup>, accounting for 12.38%. Qinggangpo has 43 households, accounting for 6.45%; its household area is 1.7648 hm<sup>2</sup>, accounting for 5.85%. Pandayan has 25 households, accounting for 3.75%; its homestead area is 1.2675 hm<sup>2</sup>, accounting for 4.20%. Pingshang has 71 households, accounting for 10.64%; its homestead area is 3.5972 hm<sup>2</sup>, accounting for 11.92%. Maojiagou has 98 households, accounting for 14.69%; its homestead area is 4.5254 hm<sup>2</sup>, accounting for 14.99%. Qinglongwan has 92 households, accounting for 13.79%; its household area is 3.9001 hm<sup>2</sup>, accounting for 12.92%. Egongba has 165 households, accounting for 24.74%; the household area is 6.7887 hm<sup>2</sup>, accounting for 22.49%. Shipo has 67 households, accounting for 10.04%, and the area of homesteads is 2.6699 hm<sup>2</sup>, accounting for 8.84%. From the perspective of the proportion of the number and area of farmers' homesteads in each reconstruction unit, the average household area of homesteads in Tianjiagou, Pandayan, and Maojiagou were basically equivalent to that of the whole village, and the average household area of homesteads in Tianba and Pingshang was larger than that of the whole village, while the average household area of homesteads in Qinggangpo, Qinglongwan, Egongba, and Shipo was smaller than that of the whole village. Judging from the classification of farmers' homesteads development capacity in each reconstruction unit (Table 5), the proportion of homestead area with high-level ability in Tianjiagou was 100%, the proportion of homestead area with high-level ability in Tianba and Qinggangpo was about 90%, and the proportion of homestead area with high-level ability in Egongba was 80.16%. The development capacity value of farmers' homesteads in the above four reconstruction units was high. The proportion of the medium and high-level capacity values of farmers' homesteads in the two reconstruction units of Qinglongwan and Shipo, which are located in the southern area of Longfeng Village, was between 50% and 60%, with general development capacity. And the development capacity value of farmer's homesteads in the three reconstruction units of Pandayan, Pingshang, and Maojiagou, which are located in the central area of Longfeng Village, was low. Overall, the development capacity value of the farmer's homestead of each reconstruction unit in Longfeng Village has the spatial differential features of "high in the northern region, low in the central region, and general in the southern region".

**Table 5.** Grading summary of development capacity of farmers' homestead in each reconstruction unit of Longfeng Village.

Reconstruction Units	Homestead with High-Level Ability		Homestead with Medium-Level Ability		Homestead with Low-Level Ability	
	Area (hm <sup>2</sup> )	Ratio (%)	Area (hm <sup>2</sup> )	Ratio (%)	Area (hm <sup>2</sup> )	Ratio (%)
Tianjiagou	1.6217	83.64	0.3172	16.36	0.0000	0.00
Tianba	2.4142	64.60	0.9211	24.65	0.4020	10.76
Qinggangpo	0.9510	53.89	0.6834	38.73	0.1304	7.39
Pandayan	0.0472	3.73	0.2732	21.55	0.9470	74.72
Pingshang	0.2027	5.64	1.4368	39.94	1.9577	54.42
Maojiagou	0.1229	2.71	1.7634	38.97	2.6391	58.32
Qinglongwan	0.1841	4.72	1.8458	47.33	1.8703	47.95
Egongba	2.1685	31.94	3.2734	48.22	1.3468	19.84
Shipo	1.0868	40.71	0.4380	16.40	1.1451	42.89

According to calculating the location entropy of the dominant function of each reconstruction unit (Table 6), the dominant land use function of the reconstruction unit was determined in line with the principle of maximum value. The dominant functions of Tianjiagou and Egongba are life services, and the proportion of this functional area is 22.00%.

The dominant functions of Tianba and Qinggangba are operational production, accounting for 18.61%. The dominant functions of Pandayan, Pingshang, and Maojiagou are ecological agriculture production, accounting for 33.90%. The dominant functions of Qinglongwan and Shipo are traditional agricultural production, accounting for 25.49%. In the regional space, Longfeng Village has initially formed a multi-functional coexistence pattern. Tianjiagou and Egongba, at both ends of the north and south, are the supporting polar nucleus for village living services. Tianba and Qinggangba in the north are the operational production areas characterized by rural tourism, agri-business, and tea production, processing, and sales. Pandayan, Pingshang, and Maojiagou in the middle are the ecological agricultural production areas with the main features of tea planting. Qinglongwan and Shipo in the south are the traditional agricultural production functional areas characterized by rice, rape, and maize planting.

**Table 6.** Information entropy of dominant function of each reconstruction unit in Longfeng Village.

Reconstruction Units	Traditional Agricultural Production Function	Production Function of Ecological Agriculture	Operational Production Function	Life Function of Habitability	Life Service Supporting Function	Ecological Conservation Function
Tianjiagou	1.05	1.12	0.46	0.66	1.48	0.98
Tianba	0.62	0.77	3.98	1.47	1.25	0.93
Qinggangpo	0.86	0.77	2.16	0.57	0.58	1.17
Pandayan	0.43	1.66	0.76	0.45	0.61	1.27
Pingshang	0.75	1.50	0.66	1.08	0.97	0.96
Maojiagou	1.04	1.29	0.31	1.11	0.93	0.86
Qinglongwan	1.20	0.69	0.51	0.93	0.54	1.15
Egongba	1.37	0.53	0.69	1.83	2.32	0.83
Shipo	1.37	0.80	0.50	0.77	0.34	0.90

### 3.3. The Leading Modes and Strategies for the Spatial Reconstruction of Farmer's Homestead in Longfeng Village

#### 3.3.1. Spatial Reconstruction Modes of Homestead in Different Reconstruction Units

Based on the spatial distribution features of the "point-line-surface" of farmers' homesteads in Longfeng Village, this article combined the conditions of farmers' needs, regional functions, and village resource endowments, then constructed four spatial reconstruction models of homesteads for different reconstruction units (Figure 5), to provide decision support for improving human settlement quality and creating beautiful and livable villages at the village level.

(1) Modern community type refers to the rural spatial development model with concentrated and orderly housing, a better public service system, a more sound infrastructure network, and co-governance by multiple social subjects, which has the remarkable features of infrastructure urbanization, community-based life service, and lifestyle citizenization. The centralized agglomeration area formed by this model has a spillover effect and domino effect on the surrounding areas [60]. It has a driving effect on the development of the surrounding areas, which has been widely popular in Europe and the United States, and other developed countries. The two units of Egongba and Tianjiagou in the north and south of the village domain have relatively flat terrain and good external traffic conditions, and the public service facilities such as the village committee, nursing home, and cultural center are concentrated in distribution. The areas of high-level and medium-level capacity homesteads also account for more than 80% of the total, which has the basic conditions for transformation into the modern rural community. Based on the spatial reconstruction of homesteads, it is necessary to standardize the site selection and housing construction style of farmers' homesteads, unify and improve the modern living conditions such as internal roads, greening, sanitation facilities, hydropower, and gas networks (tap water, electricity,

natural gas, broadband networks) of the supporting communities, and build it into a model of the rural inhabitable environment in the new era.

(2) Field and garden integration type refers to the construction of a comprehensive gathering platform based on the original rural residential area, led by the elements of industry, ecology, leisure, and tourism, focusing on the living life of multiple types of subjects (local villagers, industrial workers, foreign tourists), based on ecologically sustainable agriculture and supported by rural landscape leisure. This model embodies the integration of various resource elements, agricultural production, living, cultural landscape, leisure agglomeration, and comprehensive service are its main functions. Recently, the world has formed the development models of the advantageous and characteristic agricultural industry, cultural creativity driving the integration of three industries, urban and suburban modern agricultural sightseeing garden, agricultural creativity, and agricultural experience. The two units of Tianba and Qinggangpo in the northern part of the village are rich in resources and diverse in functions, and there are many modern rural agricultural tourism industry statuses such as Wanhuayuan scenic spots (including modern agricultural demonstration areas, flower and seedling display areas, leisure and health hot spring resorts, water parks, and other functional areas), homestay inn, agritainment, and tea production and processing bases, etc. And the employment channels of farmers mainly focus on rural tourism, tea production, and sales services, while the spatial utilization of homesteads in the domain has the composite features of residential and production services. Based on the background of developing rural tourism in Longfeng Village, relying on the beautiful pastoral scenery and good productive and living service supporting facilities in the domain, it is necessary to emphasize the harmonious coexistence of farmers' homesteads and pastoral (tea garden) landscape and create the homestead aggregation area of the field and garden integration type with both residential suitability and business service.

(3) Road-pointing type: unlike the natural elements, the influence between improving road traffic conditions and the spatial distribution of rural settlements is interactive. The rural settlement distribution remains unchanged while the road conditions are improved, and the road conditions remain unchanged and rural settlements are arranged towards the road, both can make the distribution of settlements tend to "road-pointing". This housing type often relies on the advantages of road traffic to achieve development, and its utilization activities and functions are mostly closely related to the "road economy". For example, the closer a rural residential area is to a road, the more road service-oriented places such as kiosks, water filling stations, automobile repair stores, and hotels are found significantly. The road is the axis connecting the homesteads, and the characteristics of rural homesteads distributed along the road axis in mountainous areas are significant. The number and area of homesteads within 100 m of the main development axis (Eguan Highway) in Pandayan, Pingshang, and Maojiagou units in the middle of Longfeng Village are about 65%, and the proportion of homesteads within 300 m reaches more than 95%. And the homesteads in the reconstruction unit of Maojiagou are mainly distributed along the roads of through-group roads. Therefore, the optimization of the spatial layout of homesteads in the above three units is mainly carried out along the main development axis of the Eguan Highway and the through-group roads. Among them, the terrain of Pandayan and Pingshang is gentle, and the main development axis of the Eguan Highway can be established as the middle line, which is symmetrically arranged along both sides of the road, while the main reconstruction measures of the Maojiagou unit are scattered layout along the through-group roads.

(4) Traditional residence type mainly refers to the architectural history of long-term, rich cultural genes, and unique architectural style with the characteristics of the traditional residential. Such buildings have significant national and local colors and also have important historical and cultural values. This type of residence is suitable for protection as a historical building, and it is particularly necessary to pay attention to the inheritance and renewal of key elements such as its cultural connotation, historical context, and architectural style. In the two units of Qinglongwan and Shipo in the southeast of the village, the area of

low-level capacity homesteads accounts for about 45%. The farmers are mainly engaged in cultivating traditional crops such as rice, rape, and corn, and their homesteads carry out the functions of living and agricultural production. Villagers' houses are represented by elements like small green tiles and sloping roofs, which are the traditional residential building forms in Northern Guizhou. It is a relatively complete area of traditional farming production and housing construction form in Longfeng Village. Therefore, based on giving full play to their living and production functions, the reconstruction directions of homesteads in the above two units are mainly to pay attention to the maintenance of the house facades and improve its external facilities (roads to homes, tap water, electricity, broadband networks, etc.).

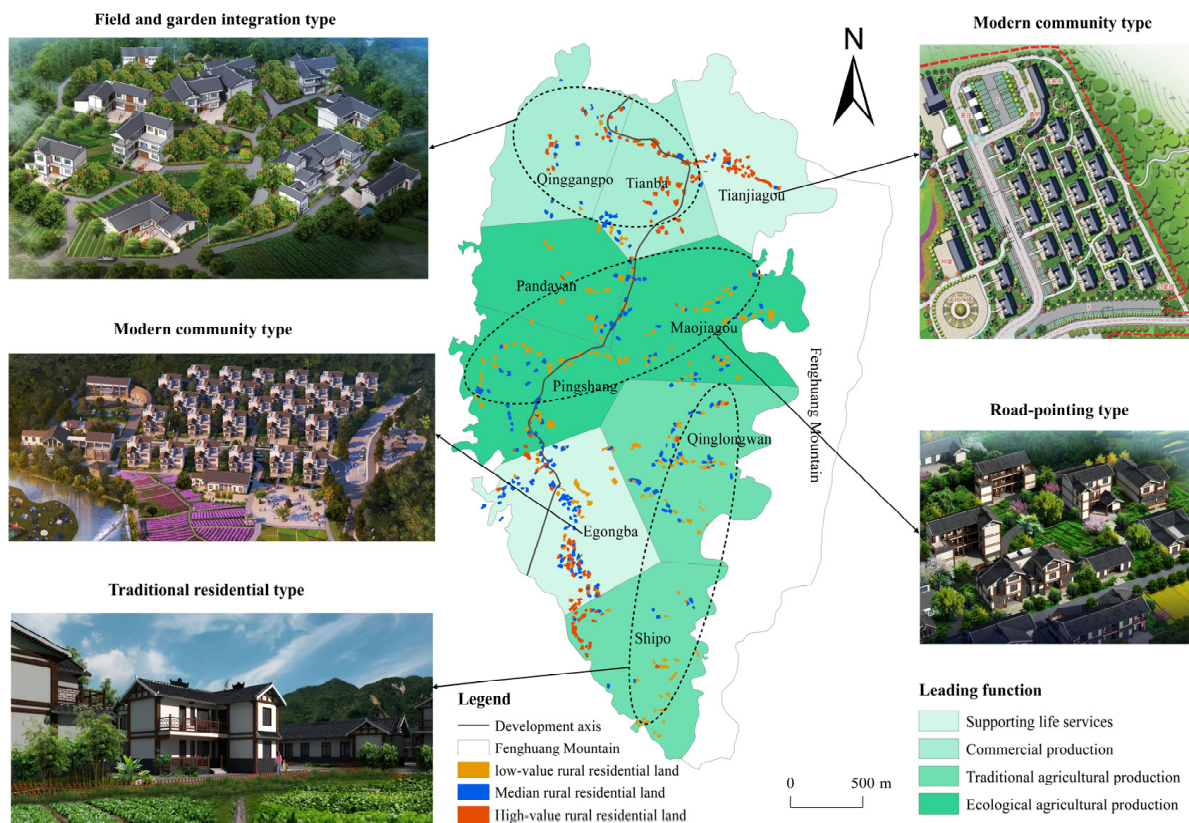


Figure 5. Distribution of spatial reconstruction patterns of farmers' homestead in Longfeng Village.

### 3.3.2. Analysis of Spatial Reconstruction Strategies of Homestead in Different Reconstruction Units

Considering the differences in resources and functions of different reconstruction units in the village domain, as well as the potential and positioning of the internal homesteads, the spatial reconstruction strategies of homesteads in different reconstruction units were formulated separately (Table 7).

Table 7. Spatial reconstruction strategies of different reconstruction units in Longfeng Village.

Reconstruction Units	Dominant Functions	Reconstruction Modes	Reconstruction Strategies
Tianjiagou, Egongba	Life service supporting	Modern community type	Improve the construction of modern community life supporting facilities, create a “dual-core” center in the north and south of Longfeng Village, and improve the degree of homesteads agglomeration. Gradually transform the existing houses according to unified standards, and guide residents to change to modern rural community life.



Table 7. Cont.

Reconstruction Units	Dominant Functions	Reconstruction Modes	Reconstruction Strategies
Tianba, Qinggangpo	Operational production	Field and garden integration type	Multi-channel financing to create a modern rural demonstration site with multi-functional integration of “residence + business + agricultural tourism + red culture”. Encourage the circulation of vacant homesteads and realize the matching development of infrastructure construction and rural tourism.
Pandayan, Pingshang, Maojiagou	Ecological agriculture production	Road-pointing type	Integrating various preferential agricultural policies, deeply integrating the tea characteristic industry and traditional farming culture, to create ecological houses with tourism and sightseeing. Dividing the red line of the spatial layout of homesteads, strictly limiting the disorderly expansion of homesteads around the road axis, focusing on infrastructure construction, and continuously improving the production and living conditions.
Qinglongwan, Shipo	Traditional agricultural production	Traditional residential type	Carry out homestead consolidation and optimize the structure of rural homestead land. Encourage farmers to voluntarily withdraw from the homesteads for compensation, pay attention to the renovation of housing facades, build the regional houses of Northern Guizhou with cultural genes characteristics, and appropriately increase the basic supporting facilities such as domestic waste and sewage treatment.

#### 4. Discussions

United Nations “Agenda 21” points out that many mountain areas around the world are facing environmental degradation, and, the sustainable development of mountainous areas is more important and urgent than ever [61]. Homestead, as the core component of the rural regional system in mountainous areas, has a good spatial development trend that can open the “meridian blockage” of the rural regional system and promote the “blood circulation” between the various elements in the system, which is an important path to solve the practical problems of empty waste, disorderly expansion, excessive area, and scattered layout of rural settlements in mountainous areas. Under this condition, the “point-line-surface” framework constructed in this study essentially reveals the common linear characteristics of the spatial evolution and layout of urban and rural settlements, which conforms to the general law of the development of urban and rural settlements in the global mountainous areas. To a certain extent, it breaks through the shackles of administrative boundaries, provides a new perspective for the optimization of international urban and rural settlements, and is of great significance for enriching the theoretical system of international rural spatial governance. In addition, although the study area focuses on a specific Chinese village, the typical representativeness of this case village in terms of natural conditions, industrial structure, and living space makes it expected to bring useful reference value to the spatial reconstruction of the same type of villages in other countries around the world (especially mountainous villages). However, this study still has the following limitations to be broken through. Firstly, the conceptual connotation and model framework of “point-line-surface” still need to be further deepened. This paper focuses more on case description and analysis, failing to deeply analyze the connotation and extension, morphological function, driving factors, and operational logic of “point”, “line” and “surface” at different scales. Therefore, how to continuously improve the “point-line-surface” model on this basis will become the focus of subsequent research work. Secondly, this study only uses the survey data of a single year to analyze the “point-line-surface” characteristics of rural housing in the case village and lacks long-term longitudinal analysis, which makes it difficult to grasp the long-term change characteristics of the rural homesteads at the micro level, especially how the internal structure and function of the rural homesteads change with the social and economic development.

With the strengthening of the interaction between urban and rural elements in the new era and the continuous drastic changes in the rural territorial system, the spatial optimization of rural settlements in mountainous regions not only undertakes a variety of

policy management objectives from top to bottom but also appeals to multiple utilization demands from bottom to top. So, how to build a sustainable spatial equilibrium pattern of settlements under the influence of complex variables has become the key to revitalizing the world's countryside. Facing this complex background of global change, future research should focus on the following aspects. (1) Integration of multidisciplinary theories to continually enrich the theory of "point-line-surface" and provide new perspectives for the spatial planning and utilization of regional settlements. "Point-line-surface" is a theoretical framework characterized by openness, dynamism, and inclusiveness, which should not remain unchanged, but continuously update and improve the theoretical framework system through the continuous incorporation and integration of other proven effective theories and strategies, in order to satisfy the theoretical innovation needs raised by socio-economic changes. For example, the significant role of the "SWOT" framework for regional spatial planning has been widely confirmed [62–64]. Therefore, it seems to be a feasible and innovative program to enrich the evaluation index system, development status, and obstacle factors from four aspects of strengths, weaknesses, opportunities, and threats. Similarly, concepts and theories such as resilience [65], rurality [66], and center-periphery [67] should also be considered and integrated into the "point-line-surface" framework, so as to better provide theoretical support for evaluating and formulating regional spatial planning strategies. (2) Explore and expand the application scope and scenarios of the "point-line-surface" framework and evaluate its environmental and economic effects and social response behavior. The theoretical framework of "point-line-surface" should start from serving practice, and its scope of application should be extended from the spatial layout of urban and rural settlements to the fields of regional industrial layout, infrastructure construction, territorial spatial planning, etc. However, the application issues of "point-line-surface" in different fields such as obstacles, scenario simulation, and public response need to be studied in depth.

## 5. Conclusions

### 5.1. Main Conclusions

(1) In terms of the "point" characteristics of the homesteads, the article selected 20 indicators to build a model for measuring the development ability of the homesteads in the village and calculated that the development ability value of farmers' homesteads ranged from 0.2784 to 0.8439, and the overall level of development ability was not high. Among them, the number of high-value homestead plots accounted for 27.74%, with a "T" shape and long strip agglomeration distribution in the north and south of the village, respectively. The number of medium-value homestead plots accounted for 36.73%, which were mostly distributed in the middle village domain and around the development axis. And the number of low-value homestead plots accounted for 35.53%, which were mostly distributed along the Fenghuang Mountain, and the rest are scattered throughout the whole village.

(2) In terms of the "line" characteristics of the homesteads, within the 900 m buffer zone from the main development axis of Eguan Highway, the number and area of homesteads reach about 90%, and the spatial distribution of homesteads is characterized by axial development. In addition, there is a gradient decreasing law between the number and area of the homesteads with different capacity values and the distance from the main development axis in Longfeng Village, and within 600 m of the main development axis, the number and area of homesteads with high-level ability reach about 94%.

(3) In terms of the "surface" characteristics of the homesteads, nine spatial reconstruction units are divided by using the centroid of high-value homesteads as the weighted Voronoi diagram, and there are obvious differences among homesteads in each unit, among which the largest number and area of homesteads is in Egongba and the smallest is in Pandayan. Overall, the development capacity value of homesteads in each reconstruction unit has the spatial characteristics of "high in the northern region, low in the central region, and general in the southern region".

(4) According to the spatial characteristics of the “point-line-surface” of homesteads, this paper proposed four spatial reconstruction modes of homesteads for different reconstruction units in Longfeng Village, including modern community type, field and garden integration type, road-pointing type, and traditional residential type.

### 5.2. Implementing Suggestion

Among them: (1) The modern community type should improve the construction of modern community life-supporting facilities and guide residents to gradually adapt to modern rural community life. Focusing on the various elements of the whole life of the community, effectively integrating various resources, leading the participation of multiple social subjects, integrating various functions, and building a new type of intelligent service community for sustainable development. (2) The field and garden integration type should focus on building a multi-functional integration of modern rural residential demonstration sites and realizing the matching development of infrastructure construction and rural tourism. Based on ecologically sustainable agriculture, vertical integration will be realized by extending the industrial chain and developing the integration of planting (raising), processing, and marketing. And horizontal integration will be realized by expanding the diversified value and developing a variety of business modes of agriculture, culture, and tourism. (3) The road-pointing type should focus on controlling the demolition and construction of homesteads around the road axis and delimiting the boundary line of the spatial layout of homesteads. Give full play to the advantages of road transportation, improve the rural logistics network, open up the e-commerce into the village, the express into the home of the “last kilometer”, and drive industrial products to the countryside and agricultural products into the city. (4) The traditional residential type can be created for regional houses in Northern Guizhou with the characteristics of cultural genes by carrying out rural homestead consolidation and other measures and adding basic supporting facilities. Meanwhile, we should fully understand the local and national culture in traditional architecture and realize the continuation and inheritance of characteristic architecture through innovative design and Internet platforms, online+ offline, architecture+ Internet+ culture, and other modes.

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