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Spatio-Temporal Features and Influencing Factors of Homesteads Expansion at Village Scale

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Abstract: The current research on the change of homesteads has rarely combined spatial information, and no expansion research has been found with a scale as detailed as the level of the homestead plots. Understanding the changing rules of homesteads expansion and its influencing factors are important to homestead reform, optimization of village layout, and cultivated land protection. In order to explore the direction, level, and spatial pattern of homesteads expansion from 2010 to 2020 and the influencing factors, by taking six villages in Deqing County as an example, this research proposed a tract division scheme based on multidistance spatial clustering and intersecting area index and used homesteads expansion index and geographical detector. The results showed that (1) 83.3% of the villages had a decreasing trend of homesteads expansion, and half of the villages’ homesteads remained unchanged in their distribution direction. (2) The average order of factors influencing the expansion of homesteads was: distance from road > altitude > slope > policy restriction > distance from water area > slope aspect. This study helps to understand the spatio-temporal features of homesteads expansion in small-scale areas, provides an empirical reference for deepening homesteads reform and policy formulation, and also provides new methods for quantitative research on homesteads expansion.

Keywords: village scale; homesteads; expansion pattern; spatio-temporal features; influencing factors

1. Introduction

Changes in the distribution of rural settlements have been an important topic in spatial planning and rural management internationally [1–3]. Rural settlements include all buildings and associated facilities, such as rural roads, industries, stores, houses, and barns. In China, rural homestead refers to the land used by rural villagers to build houses and facilities related to living, so rural homestead is an important part of rural settlements. Chinese “Property Law” states that homestead is the land allocated by the Chinese government to 557 million farmers for free use to ensure the most basic living needs of farmers, maintain social stability [4], and assume the function of welfare security [5].

With the progress of urbanization, a large number of farmers have moved into cities, but the area of homesteads has increased instead of decreased [6]. Unpaid or low-cost homesteads lead to the disorderly expansion of rural homesteads [7], and the phenomena of “multiple homes per household” and “hollow villages” has appeared in some places [8,9]. In addition, the scope of rural land is limited, and homesteads are the second major land type after cultivated land in rural areas [10]; its expansion will encroach on high-quality and scarce farmland [11], which is not conducive to the protection of cultivated land and the maintenance of natural ecological diversity [12,13]. The “Opinions of the
Central Committee of the Communist Party of China and the State Council on the Implementation of the Rural Revitalization Strategy" proposes that rationally planning homesteads and optimizing the layout of village land have become important tasks for agricultural management departments [7,14]. To accomplish this task, it is necessary to discover many problems existing in the evolution of rural homesteads, master the characteristics of homesteads expansion, and identify the factors that affect the expansion. Yansui Liu [15] published an article in *Nature* stressing that “in the process of global urbanization, it is urgent to pay attention to promoting rural revitalization”. In order to rationally utilize land resources and realize rural revitalization, China has introduced a series of homesteads reform measures in recent years [14,16–18]. Therefore, it is important to study the temporal and spatial evolution characteristics of homesteads and their influencing factors in this context.

The nature of homesteads in China are collectively owned by the state [19]. Internationally, it is related to rural settlements or rural housing, and research about them mainly focuses on layout patterns [20], spatial planning [21], and spatio-temporal features [22]. Unlike private ownership in developed western countries, Chinese homesteads are collectively owned, and Chinese scholars have conducted a lot of research in this direction. At present, research on homesteads has mainly focused on the utilization status [23–25], function [26–28], circulation [29–31], regulation [32–34], and system [35,36]; most of the studies were conducted through questionnaires and qualitative methods and lacked spatial information support. However, the change in landscape pattern was spatially heterogeneous [37,38], that is, the spatial distribution of homesteads is uneven, so it was incomplete to study the expansion of homesteads by ignoring the spatial information. There were many international studies on rural settlements [20,21] or urban expansion [3,39,40] that used quantitative spatial analysis methods, but they did not focus on the field of homesteads. In terms of changing regarding homesteads, although a small number of studies have combined spatial information [41]; no studies have been found on the expansion of homesteads at the level of the homestead patch. We believe that the main reason is that it is difficult to obtain spatial data of homesteads. On one hand, due to the small size and fragmented distribution of homesteads, it is impossible to identify this feature if the resolution is too low, so the low spatial resolution image accuracy cannot meet the requirements of homesteads research. On the other hand, the acquisition cost of the high-resolution image is high, and there was a lack of a mature algorithm to distinguish homesteads from rural construction land. In addition, it needs to trace back many years of historical homestead spatial information for spatial evolution analysis, which makes it more difficult to obtain data. In terms of research scales, current research focused on provincial [42], city [43], county [41], township [44], and other scales, and rarely went deeper into the countryside or even plots of homesteads. Carmen [39] argues that urban studies at medium and large scales based on the density of rural settlements ignore discontinuities, and research at the plot level is an important factor in land use conversion decisions, so it is necessary for homesteads studies to go deep into the patch or plot scale.

The convex hull is the smallest convex polygon of the set of points, and the convex hull model was commonly used in the study of urban expansion [40,45,46], that is, to determine the positional relationship between the newly constructed land and the convex hull. The homesteads patches are small in size and most of them are not connected. Macroscopically, they are aggregated, and microscopically, they are discretely distributed, and the aggregated homesteads do not have a unified external boundary line. Therefore, it is impossible to directly apply the convex hull model to determine the relationship between a new homestead and the existing contiguous patches. Therefore, it is important to provide a method to quickly delineate the outer boundary of discrete patches.

The disorderly expansion of homesteads is not conducive to protecting cultivated land and maintaining natural ecological diversity. Before formulating regulatory policies to optimize the layout of homesteads, it is necessary to find out the law of spatial change of homesteads. However, there are few studies on the change of homesteads combined
with spatial information, so we have carried out research on homesteads expansion based on village scale and spatio-temporal information. In order to reflect the features of most villages in China as much as possible, six sample villages were selected based on different factors such as orientation, topography, landform, transportation, and economic development. In order to solve the problems of homesteads classification and expansion pattern recognition, a tract division scheme based on multidistance spatial clustering and intersecting area index was proposed; in order to more accurately present the expansion characteristics of the homestead, a finer scale of the homestead patch was selected.

2. Materials and Methods

2.1. Research Area and Data Sources

2.1.1. Research Area Selection and Overview

Deqing County is located in the eastern coastal area with rapid economic development and belongs to Zhejiang Province, the most economically developed province in China. In 2021, the comprehensive strength of Deqing County ranked 36th among 2634 counties and cities in the country [47], representing an economically developed area. Deqing County was selected into the list of the first batch of pilot counties for the reform of the rural homestead system in 2015 in China and set several records such as the first case, the first certificate for registration, and the first order for mortgage in Chinese homesteads reform, and it was rated as a county with outstanding achievements in rural homesteads reform [48]. It is of strategic significance to research the characteristics and influencing factors of homesteads expansion, which can provide valuable experience for subsequent homesteads reforms in other regions. At present, most of the spatial and temporal research scales on homesteads are accurate to the county or town level. In order to deepen the research scale to the meter level of the homesteads patch, the research energy was reduced, and some typical villages were selected as the research area. This paper integrates factors such as location, topography, geomorphology, transportation, and degree of economic development, and selects six unconnected villages as the study area, including Jiayuan Village, Dongheng Village, Wusi Village, Houwu Village, Yangdun Village, and Changchun Village. These represent various types of villages such as Jiangnan Water Village, being mineral-rich and near urban areas, having tourist attractions and frequent demolition and construction, and being closed mountainous areas (as shown in Figure 1 and Table 1), which can encompass most village categories in China. Deqing County covers an area of 936 square kilometers and is high in the west and low in the east, with convenient transportation and abundant water resources. It belongs to the subtropical humid and hot monsoon belt with four distinct seasons. Deqing County had a permanent population of 650,000, a per capita disposable income of CNY 57,837, and a county-wide GDP of CNY 61.55 billion in 2021 [49].
Figure 1. Distribution of study areas. Note: Map is from bzdt.ch.mnr.gov.cn, accessed on 3 March 2022.

Table 1. Basic information on typical study areas.

| Name    | Area (km²) | Number of Villagers (person) | Per Capita Income (yuan) | Characteristics of the Village                  |
|---------|------------|------------------------------|--------------------------|-------------------------------------------------|
| Jiayuan | 5.59       | 3141                         | 36,580                   | A water town with flat land and many rice fields |
| Changchun | 8.07      | 1548                         | 31,000                   | A closed village at the intersection of two mountains |
| Yangdun | 6.01       | 4151                         | 36,792                   | Big changes in demolition and relocation         |
| Wusi    | 5.63       | 1605                         | 52,000                   | Convenient transportation near the city          |
| Houwu   | 8.70       | 1674                         | 43,000                   | A tourist attraction with many lodges            |
| Dongheng | 10.54     | 3101                         | 48,700                   | Rich in mineral resources                       |

Note: “Number of villagers” and “Per capita income” are for the year 2020.

2.1.2. Data Sources and Preprocessing

The data and preprocessing of this manuscript mainly include: (1) Remote sensing images. The 2020 images were from the Geographic Information Center of Deqing County, which were 0.25 m high-resolution aerial images collected by an Unmanned Aerial Vehicle (UAV). The 2010 and 2015 images were from Google Earth. (2) Homesteads patches. The 2020 map data came from the Deqing County Agriculture and Rural Bureau, which commissioned a mapping company to take field measurements. Based on high-resolution Google remote sensing images of villages, the homesteads data in 2010 and 2015 were formed after digitization, spatial registration, and field verification. (3) Road network and water data. The acquisition method was the same as the historical homesteads patches data. (4) The Digital Elevation Model (DEM) was downloaded from Google Earth with an accuracy of 1 m. The slope and slope aspect data were made according to the DEM data. See Table 2 for the classification description. (5) Policy-restrictive construction data were obtained from the Deqing County Geographic Information Center. The flow chart of this study is shown in Figure 2.

Table 2. Classification of influencing factors.

| Level | Elevation (m) | Slope (°) | Slope Aspect | Distance from Water Area (m) | Distance from Road (m) | Policy Restriction on Construction |
|-------|---------------|-----------|--------------|-------------------------------|------------------------|----------------------------------|
| 1     | 0–10          | 0–5       | North (0–22.5 or 337.5–360) | 0–50                        | 0–20                   | Allowed construction             |
2.2. Research Method

2.2.1. Homesteads Expansion Index

Urban land spatial expansion intensity was defined as the ratio of the expansion scale to the total study area, per unit of time [50]. To evaluate the rate of homesteads expansion in the study area, the rural homesteads expansion index (SI) is constructed. It characterizes the relative expansion rate of rural homesteads in the village over a certain period and can reflect the temporal dynamics of homesteads in the study area [33]. The formula is as follows [33]:

\[
SI = \frac{RL_j - RL_i}{RL} \times \frac{1}{j-i} \times 100\% \tag{1}
\]

In the formula: SI is the rural homesteads expansion index; \( RL_i \) and \( RL_j \) are the number of homesteads in the year \( i \) and \( j \); \( RL \) is the total number of rural homesteads in
the village. Negative numbers represent shrinkage of the homestead, and the larger the absolute value, the greater the degree of expansion or contraction.

2.2.2. Multidistance Spatial Clustering

The convex hull model method was widely used in the field of urban expansion [44,45], but for agglomerated homesteads, because of the lack of a unified external boundary line, it is impossible to directly determine the spatial relationship between the new patch and the existing homesteads, so it is necessary to determine the method of area division first.

Multidistance spatial clustering can solve the problem of category division. It evaluates the degree of aggregation or dispersion within a certain distance according to the spatial location of geographical elements [51], which is suitable for the best partition distance of the buffer zone. After “expansion”, the intersecting homesteads belong to the same category, namely, the same area (Figure 3a). The Rile’s K function is commonly used to estimate the distance threshold, and the calculation formula is as follows [51]:

\[
L(d) = \sqrt{\frac{A \sum_{i,j=1}^{N} k(i,j)}{\pi N(N-1)}}
\]

where: \(A\) is the area of the study region, \(d\) is the distance, \(N\) is the number of homesteads patches, and \(k(i,j)\) is the weight between the \(i\)-th and \(j\)-th homestead. If the distance between \(i\) and \(j\) is greater than \(d\), \(k(i,j) = 0\), otherwise it is 1.

It is a difficult problem to determine the classification distance. Through several iterations and analysis of the scatter plot of the observed \(k\) value and the expected \(k\) value (Figure 3b), we determined that the ordinate of the first intersection formed by the two curves was the optimal distance. If the distance threshold is too large, homesteads of the whole village will be divided into a few categories or even into one category, and if it is too small, it will result in multiple regions and the number within the category will be small, which is not conducive to analyzing the expansion patterns. The intersection point is the critical point of aggregation and dispersion.
2.2.3. Spatial Expansion Pattern Recognition

There are three basic types of spatial expansion patterns in the field of urban expansion: enclave, sprawl, and infill [52,53], on which other types evolve. In this study, the convex hull was defined as the smallest circumscribed convex polygon surrounded by the same type of homesteads patches. In order to quickly judge the expansion pattern through the spatial location relationship between the newly emerged homesteads and the historical homesteads, the intersection area index was proposed, that is, the expansion pattern of homesteads through the common area was identified. The calculation formula is as follows:

\[ R = \frac{S_{\text{AN}}}{S_N} \]  

where: \( R \) is the intersection area index, \( S_{\text{AN}} \) is the area of the common region, and \( S_N \) is the area of the newly constructed homesteads. If \( R = 0 \), it means that there is no intersection between the new homesteads and the original homesteads, which belong to enclave expansion. If \( 0 < R < 0.5 \), it means there is sprawl expansion; if \( R \geq 0.5 \), it signifies infill expansion. The judgment description is shown in Figure 4.

Figure 4. Schematic diagram of homesteads expansion pattern.

In order to analyze these three types of expansion patterns, this study has adopted spatial clustering, buffer analysis, spatial fusion, and overlay analysis. The key processes are as follows: (1) The multidistance spatial clustering analysis function of ArcGIS 10.2 software to explore the appropriate classification threshold for each village was used. That is, the distance between homesteads less than this threshold is the same category, as shown in Figure 5a,b. (2) According to this distance threshold, the external buffer zone of the homesteads patches was made, and the overlapping homesteads belonged to the same area, as shown in Figure 5c. (3) Spatial fusion analysis, forming a large patch (area) of overlapping homesteads, that is, each category as a whole, and assigning a classification number, then superimposing the category patch with the original homesteads layer so as to achieve the purpose of assigning the classification number to each independent homesteads patch, as shown in Figure 5d. (4) To obtain different types of homesteads convex
hulls, the function of Hull Accumulator under the workbench platform in FME Desktop 2022 was used to process the classified homesteads patches, as shown in Figure 5c. According to the convex hull model and the intersection area index, the expansion pattern of the newly constructed homesteads was identified, as shown in Figure 5f.

2.2.4. Influencing Factor Selection and Method

Research has shown that the rural settlements were affected by many factors such as the natural environment and social economy [54,55]. Homesteads belong to a special subcategory of rural settlements and are also affected by such factors with high probability. Thus, this study selected the dimensions of elevation, slope aspect, slope, distance from water area, distance from road, and policy restrictions on construction to carry out exploratory research. The classification results are shown in Table 2. The distance calculation method is the distance from the geological center of the homesteads to the geographical elements.
Geographical detector (Geodetector) was a tool to quantitatively analyze, detect, and determine the contribution rate of influencing factors [56–58], and factor detection was commonly used to analyze spatial heterogeneity. The calculation formula is as follows [57]:

\[
q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N \sigma^2} = 1 - \frac{SSW}{SST}
\]

(4)

\[
SSW = \sum_{h=1}^{L} N_h \sigma_h^2
\]

(5)

where: the q represents the degree of explanation of the independent variable to the dependent variable; the larger the value, the more significant the impact on the expansion of the homestead. L is the number of categories in the study region; \( N_h \) and \( N \) are the number of units in subarea \( h \) and the whole area, respectively. \( \sigma^2 \) represents the overall variance. SSW is the sum of intralayer variance and the SST is the total regional variance.

3. Results

3.1. Characteristics Analysis of Spatio-Temporal Expansion Evolution

3.1.1. Spatio-Temporal Evolution Characteristics

The changes in the number and area of homesteads in the sample villages from 2010 to 2020 are shown in Table 3. It can be found that the number of homesteads in Jiayuan and Yangdun decreased substantially from 2015 to 2020, and that in Yangdun decreased slightly from 2010 to 2015, while other villages showed an increasing trend in any period. In terms of area, it gradually increased in the village of Wusi, Changchun, and Houwu, while Jiayuan Village, Dongheng Village, and Yangdun Village decreased significantly from 2015 to 2020.

Table 3. Quantity and total area of homesteads in each village from 2010 to 2020.

| Village Name | Number of homesteads (parcel) | Total area of homesteads (m²) |
|--------------|-------------------------------|-----------------------------|
|              | 2010 | 2015 | 2020 | 2010 | 2015 | 2020 |
| Jiayuan      | 807  | 846  | 690  | 278,600 | 280,900 | 196,700 |
| Dongheng     | 746  | 752  | 714  | 254,000 | 241,300 | 226,200 |
| Wusi         | 430  | 455  | 474  | 243,600 | 291,400 | 305,500 |
| Houwu        | 521  | 529  | 552  | 138,600 | 141,700 | 162,200 |
| Yangdun      | 877  | 871  | 589  | 316,800 | 315,900 | 205,000 |
| Changchun    | 424  | 457  | 476  | 171,600 | 201,300 | 214,900 |

3.1.2. Expansion Direction Analysis

The direction of spatial expansion of the study area’s homesteads (Figure 6) and related indicators (Table 4) of the standard deviation ellipse (SDE) were calculated relying on ArcGIS 10.2 software. Overall, the expansion direction of homesteads in half of the six villages remained unchanged from 2010 to 2020, while the other three villages changed greatly. The spatial distribution pattern of homesteads shows that the villages in the south-north and southeast-northwest directions accounted for 50%, respectively. Except for Yangdun Village, the change in the rotation angle of other villages are small. In terms of individual villages, the distribution direction of homesteads in Jiayuan Village has changed significantly in the latter five years, with the center of the ellipse shifting southwards, a decrease of 301.6 m on the long axis, and an insignificant change on the short axis. In addition, the area of the standard deviation ellipse has decreased by 336,710 m² over the decade. These results indicated a contraction in the direction of expansion and a nonpolarizing evolution of homesteads in Jiayuan. The elliptical area of Dongheng village decreased and then increased, the short axis continued to increase, and the long axis showed a decreasing trend, indicating that this village was developing toward dispersion. The orientation of the homesteads in Yangdun changed dramatically, with a decrease in the turning angle of 84.2 degrees, and it evolved from an ellipse to a circle, indicating that
the expansion of the homesteads showed a nondirectional and discrete distribution. The homesteads’ expansion direction of Wusi, Houwu, and Changchun remained stable, which was a natural evolution.

**Table 4.** Parameters of SDE of homesteads in villages for different years.

| Village | Years | Ellipse Center X (°E) Y (°N) | Short Axis (m) | Long Axis (m) | Rotation Angle (°) | Area (m²) |
|---------|-------|-----------------------------|----------------|--------------|------------------|----------|
| Jiayuan | 2010  | 120.2379 30.6200            | 377.07         | 1438.19      | 179.11           | 1,703,160.00 |
|         | 2015  | 120.2380 30.6170            | 376.36         | 1410.54      | 178.95           | 1,667,290.00 |
|         | 2020  | 120.2380 30.6139            | 392.29         | 1108.94      | 179.26           | 1,366,450.00 |
|         | 2010  | 120.1065 30.6106            | 903.56         | 1888.56      | 164.23           | 5,360,380.00 |
| Dongheng| 2015  | 120.1082 30.6098            | 925.00         | 1753.49      | 163.71           | 5,095,130.00 |
|         | 2020  | 120.1086 30.6094            | 941.40         | 1730.78      | 165.19           | 5,118,370.00 |
|         | 2010  | 119.9221 30.5732            | 558.47         | 767.09       | 120.94           | 1,345,760.00 |
| Wusi    | 2015  | 119.9222 30.5732            | 561.29         | 763.91       | 119.50           | 1,346,950.00 |
|         | 2020  | 119.9221 30.5732            | 558.47         | 767.09       | 120.94           | 1,345,760.00 |
|         | 2010  | 119.8279 30.6031            | 433.50         | 1073.45      | 3.02             | 1,461,720.00 |
| Houwu   | 2015  | 119.8279 30.6031            | 435.28         | 1071.95      | 2.77             | 1,465,680.00 |
|         | 2020  | 119.8279 30.6032            | 435.59         | 1066.94      | 2.14             | 1,459,860.00 |
|         | 2010  | 120.1270 30.4932            | 742.37         | 1047.36      | 171.99           | 2,442,550.00 |
| Yangdun | 2015  | 120.1268 30.4928            | 743.82         | 1019.94      | 169.69           | 2,383,250.00 |
|         | 2020  | 120.1269 30.4892            | 684.45         | 750.52       | 87.79            | 1,613,720.00 |
|         | 2010  | 119.9587 30.4554            | 529.19         | 1210.66      | 153.35           | 2,012,490.00 |
| Changchun| 2015 | 119.9586 30.4555            | 515.12         | 1192.18      | 152.53           | 1,929,090.00 |
|         | 2020  | 119.9586 30.4556            | 522.37         | 1209.00      | 154.08           | 1,983,820.00 |
3.1.3. Measurement of Expansion Level

From 2010 to 2020, all six villages in Deqing County except for Houwu Village, where the rate of homesteads expansion increased, showed a downward trend, as shown in Figure 7. During the period 2010–2015 (called the first stage), except for Yangdun Village, the homesteads showed expansion, and there was little difference between them. The average expansion index of homesteads in the six villages was 0.64%. From 2015 to 2020 (called the second stage), the homesteads in Yangdun Village and Jiayuan Village shrunk dramatically, and the homesteads in Dongheng Village shrunk slightly. Furthermore, Wusi Village, Houwu Village, and Changchun Village showed expansion, and the difference in SI among the three was small, with a floating range of 0.8–0.96, and the average expansion index of homesteads in the six villages was −2.08%. It showed that in the sample villages of Deqing County, the first five years of homesteads were mainly characterized by expansion, and the expansion trend in the next five years weakened and showed a shrinking trend. The reason for the contrast phenomenon was that in 2015, the reform of rural homesteads was implemented here, and the approval of rural housing construction was strict, preventing one family from having multiple houses.

In terms of the individual village, the level of homesteads expansion can be divided into three categories: (1) Continued contraction, such as Yangdun, where the homesteads expansion index continued to decline, from −0.20% in the first stage to −9.358% in the second stage, which is due to the construction of the high-tech industrial park in the north of Yangdun, which provides land by means of extensive demolition. (2) First expansion and
then contraction, such as Jiayuan Village and Dongheng Village; the former contrasted sharply while the latter changed relatively little. The reason for the dramatic shrinkage of Jiayuan Village was that the large county-level garbage station has a great impact on the surrounding residents. With the support of policies, a large number of homesteads in the north have been demolished. (3) Continued expansion, such as Wusi, Changchun, and Houwu. The level of the first two villages slowed down, while that of the latter has accelerated. This is due to its location in a special tourist attraction and the development of the homestay, and the villagers further accelerated the construction of houses after expanding their homesteads profitably. This showed that the “homesteads reform” policy had a weak impact on the expansion of village homesteads in tourist attractions, and the attractiveness of economic benefits was greater than the policy constraints. The phenomenon of shrinking first and then expanding in the study area did not occur, mainly due to the influence of the homesteads reform policy.

Figure 7. Expansion index of the sampled village homesteads.

There was an inverse trend between cultivated land and rural residential land, together with a certain degree of volatility [59]. From the perspective of arable land conservation, this study focused on exploring the changes and impacts of newly constructed homesteads and did not consider reducing homesteads. The spatial distribution of homesteads in 2010 and new homesteads in 2015 and 2020 is shown in Figure 8, from which it can be found that there was concentrated construction of homesteads in Jiayuan and Dongheng, while newly constructed homesteads in other villages showed a scattered distribution.
3.1.4. Identification of Spatial Expansion Patterns

The expansion patterns and evolution characteristics of homesteads in six villages in Deqing County are shown in Figure 9, from which the following conclusions could be found: (1) In general, before the “homesteads reform” (2010–2015), the expansion of homesteads was mainly in the form of filled and enclave. After the “homesteads reform”, the type of enclave slowed down significantly, and the type of sprawl increased slightly. At the same time, the infill increased significantly and became the majority, accounting for 67%, while the enclave was very rare, accounting for 12%. The reason for this change was that before the implementation of the “homesteads reform” policy in 2015, there was a lack of unified management of rural homesteads, so villagers had a large degree of freedom to build houses, which led to an obvious enclave-type disorderly expansion. With the promulgation and implementation of the “homesteads reform” policy, the approval of rural housing construction was strict, so the phenomena of “multiple houses for one family” and “over-standard and over-occupation” are suppressed, which prompted the development of rural homesteads from blind expansion to intensification. Judging from the data, the overall control effect in the sample area was relatively good, effectively curbing the disorderly expansion of homesteads. (2) In terms of individual villages, firstly, the proportion of enclave-style homesteads in Dongheng Village was still relatively high. The reason was that there were centralized resettlement houses in this area, and high-rise buildings are specially divided in the middle of the village. As shown in Figure 10c1, because the first phase of construction was completed in 2015, the enclave-style expansion was reduced to 38% after the “homesteads reform”. Secondly, the enclave-style expansion
of homesteads in villages such as Jiayuan, Dongheng, and Houwu had decreased significantly. Thirdly, the expansion of homesteads in Changchun Village was better controlled, and the number of infill expansion of homesteads in this area accounted for 74.8% from 2010 to 2015, which was related to the fact that there was less land available for building houses in mountainous areas. Fourthly, the homesteads of enclave-style expansion in Wusi Village near the urban area showed a rising trend, so managers should pay more attention to the approval of homesteads.

![Figure 9](image)

**Figure 9.** Evolution of homesteads expansion patterns in the research areas. (a) summary of 6 villages, (b) statistics by village.

To explore the influencing factors of the expansion pattern of rural homesteads, we selected roads and rivers, which are two natural objects that are relatively close to homesteads. The typical regional spatial distribution is shown in Figure 10. From this, it can be found that the enclave-style homesteads were mainly built around roads, especially the main roads. The main reason for this was that in the early days, homesteads were built along the roads, so convenient areas were occupied. Constrained by the policy of “homesteads reform” that new homesteads cannot occupy arable land, homesteads were forced to be located in second convenient places. Most of the sprawling homesteads were ones that had been renovated or expanded from existing houses, and the overall phenomenon was that they were close to the road. For homesteads that are adjacent to roads and have no more space between them, they will be chosen to expand away from the road. In addition, water resources were not attractive to homesteads with three expansion patterns, such as a1, a2, d1, and d2 in Figure 10, because farmers in Deqing County live on tap water and did not rely on waterways for travel.
3.2. Analysis of Influencing Factors

3.2.1. Detection Factor Impact Analysis

After statistical analysis, we derived the results (Table 5) of the factors influencing the expansion of homesteads in six villages in Deqing County from 2010 to 2020. The blank area in the table indicates that the corresponding factors have little change in the village, and they all belong to the same classification range, that is, the villages are not affected by this factor. For example, the altitude range of Jiayuan Village is 0–9 m, which is in the first category. Dongheng Village is special because its mining area has been reclaimed a lot in recent years, and there is no matching up-to-date DEM data, so we discarded the terrain factor. By comparing the average q-values of each factor influencing the expansion of homesteads in the six villages, we found that the influencing factors were ranked as follows: distance from road > elevation > slope > policy restrictions on construction > distance from water area > slope aspect. This ranking is not suitable for all villages; some of them may show inconsistency due to resource specificity. For example, Jiayuan village, in which the land is flat and there are many rice fields, had a strong correlation between homesteads expansion and policy restrictions, while Dongheng and Wusi were less influenced by this factor. By comparing the p-values, it was found that the correlations of some regions and factors did not pass the hypothesis test (* represents not passing the test), which meant there was no correlation [57].

**Figure 10.** Spatial distribution of homesteads expansion patterns in the research areas. (a1) Jiayuan in 2010–2015, (a2) Jiayuan in 2015–2020, (b1) Houwu in 2010–2015, (b2) Houwu in 2015–2020, (c1) Dongheng in 2010–2015, (c2) Dongheng in 2015–2020, (d1) Yangdun in 2010–2015, (d2) Yangdun in 2015–2020, (e1) Wusi in 2010–2015, (e2) Wusi in 2015–2020, (f1) Changchun in 2010–2015, (f2) Changchun in 2015–2020.
Table 5. Statistics on the q-value of the impact factor of homesteads expansion from 2010 to 2020.

| Impact Factor               | Jiayuan | Dongheng | Wusi | Houwu | Yangdun | Changchun | Average |
|-----------------------------|---------|----------|------|-------|---------|-----------|---------|
| q                           | 0.594   | 0.247    | 0.531| 0.532 | 0.896   | 0.589     |         |
| p                           | 0.733   | 0        | 0.531| 0.532 | 0.345   | 0.408     |         |
| Distance from road          |         |          |      |       |         |           |         |
| Elevation                   | 0.471   | 0.27     | 0.264| 0.381 | 0.381   | 0.305     |         |
| Slope                       | 0.471   | 0.27     | 0.264| 0.381 | 0.381   | 0.305     |         |
| Policy restrictive          | 0.276   | 0.144    | 0.324| 0.018 | 0.07    | 0.018     | 0.036   |
| Distance from water area    | 0.041   | 0.175    | 0.025| 0.186 | 0.049   | 0.073     | 0.087   |
| Slope                       | 0.089   | 0.028    | 0.086| 0.013 | 0.051   | 0.049     | 0.028   |

Note: * represents not passing the test.

3.2.2. Analysis of Natural Environment Factors

From 2010 to 2020, the relationship between the distribution of expanding homesteads and natural environment factors is shown in Table 6. In terms of elevation, the newly constructed homesteads in Changchun Village and Wusi Village occupied the largest proportions at elevations of 10–20 m, accounting for 35% and 77%, respectively. Changchun village is located at the junction of two mountains with rugged terrain, and only one of the increased homesteads was in the range of elevation 0–10 m. It was more evenly distributed in other classified elevation ranges, accounting for about 20%. The elevation of Wusi Village gradually decreased from southwest to northeast, and the newly constructed homesteads were concentrated in the valley and the middle of the elevation range of 10–20 m, followed by the semisloping land of 20–30 m, accounting for 16%, the cultivated land area of 0–10 m, accounting for 7%, and no newly constructed homesteads in the area larger than 30 m, as shown in Figure 11c.

In terms of slope, the increased homesteads in Changchun and Wusi villages were mainly distributed in the area with a slope of 0–5°, accounting for 54% and 83%, respectively. It showed the rule that the greater the slope, the lower the number of homesteads. Changchun village has undulating terrain, and most residents chose flat places to settle down for the convenience of travel. Houwu Village also belongs to the mountainous area, but the newly built homesteads were concentrated in the area of 5–10° because the village is located in the tourist scenic area of Moganshan, so residents mostly chose to build houses in the mountainous area with beautiful scenery.

In terms of distance from water area, the newly constructed homesteads in Jiayuan village were mostly concentrated in the fifth grade (beyond 200 m), and the proportion increased with the increase in distance from the water area. The newly emerging homesteads in Dongheng Village were also mostly distributed in the fifth grade, and the concentration was stronger than that of Jiayuan Village, accounting for 88%. In addition, other grades accounted for less, showing negative hydrotropism.

In terms of aspect, the four villages had failed the hypothesis test, which meant that the slope aspect factor most probably did not affect the expansion of homesteads. The new homesteads in Changchun Village that passed the test were mainly on the northeast slope.
Table 6. Relationship between the distribution of expanding homesteads and natural environment factors from 2010 to 2020.

| Natural Factors Class | Jiayuan | Dongheng | Wusi | Houwu | Yangdun | Changchun |
|-----------------------|---------|----------|------|-------|---------|-----------|
|                       | n       | p/%      | Area/m² | n       | p/%      | Area/m² | n       | p/%      | Area/m² | n       | p/%      | Area/m² |
| DEM                   |         |          |         |         |          |          |         |          |          |         |          |          |
| 1                     | 86      | 100%     | 14,863  | 10      | 7%       | 5099     | 62      | 100%     | 26,041  | 1       | 1%       | 13       |
| 2                     | 112     | 77%      | 50,120  | 52      | 35%      | 18,485   |         |          |          |         |          |          |
| 3                     | 24      | 16%      | 8171    | 30      | 20%      | 12,174   |         |          |          |         |          |          |
| 4                     | 0       | 0%       | 0       | 32      | 22%      | 9030     |         |          |          |         |          |          |
| 5                     | 0       | 0%       | 0       | 57      | 100%     | 23,919   | 32      | 22%      | 7135    |         |          |          |
| Slope aspect          |         |          |         |         |          |          |         |          |          |         |          |          |
| 1                     | 10      | 12%      | 1848    | 32      | 22%      | 13,422   | 3       | 5%       | 143     | 9       | 15%      | 5301     |
| 2                     | 5       | 6%       | 912     | 44      | 30%      | 18,759   | 3       | 5%       | 106     | 5       | 8%       | 2899     |
| 3                     | 7       | 8%       | 1530    | 45      | 31%      | 21,283   | 9       | 16%      | 2530    | 13      | 21%      | 12,025   |
| 4                     | 12      | 14%      | 2297    | 17      | 12%      | 5149     | 6       | 11%      | 1111    | 6       | 10%      | 3931     |
| 5                     | 24      | 28%      | 3717    | 3       | 2%       | 2544     | 11      | 19%      | 4504    | 7       | 11%      | 397      |
| 6                     | 7       | 8%       | 1059    | 0       | 0%       | 0        | 12      | 21%      | 6044    | 8       | 13%      | 1709     |
| 7                     | 2       | 2%       | 162     | 0       | 0%       | 0        | 12      | 21%      | 8777    | 8       | 13%      | 3544     |
| 8                     | 19      | 22%      | 3336    | 5       | 3%       | 2233     | 1       | 2%       | 705     | 12      | 19%      | 14,077   |
| Slope                 |         |          |         |         |          |          |         |          |          |         |          |          |
| 1                     | 86      | 100%     | 14,863  | 121     | 83%      | 55,029   | 7       | 12%      | 1985    | 62      | 100%     | 26,041   |
| 2                     | 22      | 15%      | 7468    | 32      | 36%      | 11,635   | 42      | 29%      | 13,175  |         |          |          |
| 3                     | 3       | 2%       | 893     | 13      | 23%      | 7120     | 23      | 16%      | 5401    |         |          |          |
| 4                     | 5       | 9%       | 3179    | 2       | 1%       | 365      |         |          |          |         |          |          |
| Distance from water area |      |          |         |         |          |          |         |          |          |         |          |          |
| 1                     | 10      | 12%      | 1530    | 2       | 1%       | 416      | 13      | 21%      | 3517    |         |          |          |
| 2                     | 14      | 16%      | 2820    | 5       | 3%       | 416      | 24      | 39%      | 7675    |         |          |          |
| 3                     | 14      | 16%      | 2820    | 9       | 5%       | 3115     | 9       | 15%      | 7394    |         |          |          |
| 4                     | 18      | 21%      | 2561    | 4       | 2%       | 1453     | 12      | 19%      | 5524    |         |          |          |
| 5                     | 30      | 35%      | 5132    | 152     | 88%      | 28,734   | 4       | 6%       | 1931    |         |          |          |

Note: n: number, p: proportion.

3.2.3. Analysis of Socioeconomic Factors

From 2010 to 2020, the relationship between the distribution of expanding homesteads and social and economic factors is shown in Table 7. In terms of the distance from the road, the newly constructed homesteads in Dongheng Village, Yangdun Village, and Changchun Village were mainly concentrated in the first grade (0–20 m) from the road, and the proportion decreased with the increase in the distance from the road, as shown in Figure 11a. The proportion of newly emerged homesteads in Dongheng Village located in the area 0–20 m from the road was as high as 86%. The reason for such a high proportion was that the new homesteads were concentrated in the open area on the south side after the mine rehabilitation, which is an area with mature infrastructure and a dense road network, so the homesteads and the road were very close to each other, greatly increasing the percentage of homesteads of the first grade. The expanded homesteads in Jiayuan village were concentrated in the first two levels of the road; in addition, the difference between the last three levels is small. Because some new homesteads were distributed in the central relocation and resettlement area, which has only one road on the east side, the distance of newly constructed homesteads from this road showed an even distribution, reducing the correlation between the road and new homesteads. For the newly emerging homesteads in Wusi Village and Houwu Village, the places located 20–40 m away from the road accounted for the largest proportions, accounting for 29% and 32%, respectively, while the rest of the areas accounted for a relatively average proportion, because the newly constructed homesteads in these two villages were dominated by the expansion of infill, and most of the advantageous positions closest to the road were already occupied, so the newly emerging homesteads were chosen in the next closest positions.

In terms of policy restrictions on construction, the newly constructed homesteads in the villages of Jiayuan, Dongheng, Wusi, Houwu, and Changchun were mainly concentrated in the restricted construction zone, accounting for 88%, 97%, 83%, 58%, and 87%, respectively, and those in Houwu Village are shown in Figure 11b. The construction land index in the restricted construction zone was strictly controlled, and commercial land was
generally not allowed. In order to protect cultivated land, most of the historical homesteads in the countryside were classified into this category. For new homesteads, they were allowed to be built here after passing multilayer approval, which was the case in all of the current sample areas. Most of the newly constructed homesteads in Yangdun village were located in the conditional construction zone, accounting for 89%.

Figure 11. Spatial relationship between newly homesteads and impact factors. (a) relationship between the newly constructed homesteads and the distance from the road in Changchun Village; (b) relationship between the newly constructed and policy restrictions on construction in Houwu Village; (c) relationship between the newly constructed homesteads and elevation in Wusi Village.

Table 7. Distribution of homesteads by social factor classification.
### 4. Discussion

In the analysis of the 10 years of data, we found that there were some differences in the level, direction, pattern, and influencing factors of homesteads expansion in six different locations of rural villages in Deqing County, and although it was difficult to find a unified answer for a large number of rural villages in China, this did not prevent us from exploring the main laws.

#### 4.1. In Terms of Expansion Pattern

The expansion types of homesteads were divided into sprawl, infill, and enclave, and their proportion can directly reflect the degree of disturbance to the continuity of cultivated land caused by the expansion of rural homesteads. Among the three expansion types, the infill type interfered the least with the continuity of cultivated land, and the enclave type had the greatest impact. From the perspective of arable land protection, the rural village layout should avoid enclave expansion. In addition, the expansion of rural settlements could not replace rural homesteads because the results of the analysis of the expansion patterns of homesteads in our research from 2010 to 2015 were different from the results of the study [60] on the characteristics of rural settlement expansion in Guangdong Province, which was also an economically developed region. The former was dominated by infill and enclave types, with relatively few sprawl types, while the latter was dominated by sprawl types, which showed that although rural homesteads were an important part of rural settlements, the expansion patterns were not necessarily the same. In addition, what factors affect the expansion pattern of homesteads? After an on-the-spot investigation, it was found that the sprawl-style expansion was rebuilt or expanded based on the original house, most of which was due to preparing the house for the next generation to get married, and some because the house was dilapidated and could not save face [61].

Enclave-style expansion was mostly performed because of household division, for example, brothers built houses separately or sons chose another place to build houses. The infill-style expansion was mainly due to policy constraints, and there was less land available for building houses. In general, with the fertility rate in China maintaining a balanced or declining trend, house building due to insufficient living space per capita is rare, and social factors have a greater impact on expansion patterns of homesteads than natural factors.

#### 4.2. In Terms of Influencing Factors

In the analysis of the correlation between the expansion of the homesteads and the distance from the water, it was found that the newly constructed homesteads did not show strong hydrophilicity, and even Jiayuan Village and Dongheng Village showed negative hydrotopism. This was different from conventional research conclusions. The reasons were as follows: First, as early as 2007, the installation rate of tap water in rural areas

| Social Factor | Jiayuan | Dongheng | Wusi | Houwu | Yangdun | Changchun |
|---------------|---------|----------|------|--------|---------|-----------|
|               | n       | p% area/m² | n     | p% area/m² | n    | p% area/m² | n | p% area/m² | n | p% area/m² |
| Distance from road |        |          |       |          |       |          |   |           |   |           |
| 1              | 26.30%  | 4840     | 148.86% | 27,754  | 21    | 14%       | 9035| 27.44%     | 8156| 69        | 47%      | 16,555    |
| 2              | 26.30%  | 4606     | 13.8    | 3254    | 42    | 29%       | 20,335| 18.32%     | 5726| 20.32%    | 12,382   | 64        | 44%      | 26,802    |
| 3              | 11.13%  | 1732     | 5.3     | 1043    | 25    | 17%       | 9616| 12.21%     | 4724| 7         | 11%      | 3817      | 8%       | 3290      |
| 4              | 13.15%  | 2015     | 6.3     | 2082    | 24    | 16%       | 8297| 4.7%       | 4650| 1         | 2%       | 553       | 1%       | 60        |
| 5              | 10.12%  | 1671     | 0       | 0       | 34    | 23%       | 16,107| 11.19%     | 5615| 7         | 11%      | 1133      | 5%       | 130       |
| Policy restriction |       |          |        |         |       |          |     |           |     |           |          |           |          |          |
| 1              | 4.5%    | 153      | 5.3    | 1299    | 18    | 12%       | 8770| 22.39%     | 5473| 7         | 11%      | 3980      | 18.12%   | 4411      |
| 2              | 0       | 0        | 0      | 0       | 3     | 2%        | 1777| 0         | 0    | 55.89%    | 22,061   | 0         | 0%       | 0         |
| 3              | 76.88%  | 13,171   | 167.97%| 32,834  | 121   | 83%       | 50,569| 33.58%     | 16,187| 0         | 0%       | 128.87%   | 42,422   |
| 4              | 6.7%    | 1539     | 0      | 0       | 4     | 3%        | 2274| 2         | 4%   | 2260      | 0%       | 1         | 1%       | 5         |

Note: n: number, p: proportion.
in the county reached 95.7%, and the penetration rate of rural sanitary toilets was 93.5% [62], so the dependence on domestic water from rivers was not as strong as it was in the past. Second, in modern times, the status of waterway transportation declined, and land transportation, especially road transportation, played an important role [63], which was also the reason for the absence of hydrophilicity. So, the attractiveness of water for building homesteads was relatively weak, and the government could reduce the weight of water resources when making decisions.

In the study of the relationship between the expansion of homesteads and the slope, we found that homesteads in Changchun Village and Houwu Village, which were both in mountainous areas, showed different results. The distribution of the former decreased with the decrease in the slope, and the latter concentrated in the range of 5–10° (in the beautiful place near the Mogan Shan tourist attractions), like an inverted “U”. This was because, in ordinary mountains, the most important thing for residents to build their houses was the convenience of travel, so they tended to choose low slopes. The conclusion was consistent with the research conclusion on the distribution characteristics of rural residential areas in Gongyi City [64], which was also an ordinary mountain. Tourist attractions are special resources. Compared with the convenience of travel, residents paid more attention to economic benefits, so they chose the location where the economic benefits are maximized [54]. Therefore, when the rural management department optimized the layout, it was necessary to combine the characteristics of the region and try to reserve low-slope areas for settlement, or by building roads and creating cultural and tourist attractions to attract farmers to settle down.

In the study of the correlation between the expansion of the homesteads and the distance from the road, it was found that the newly constructed homesteads showed a strong closeness to the road. This rule was the same as the conclusion of the expansion of urban construction land in Shenzhen [65], which is also a developed area, like the area in our study. Furthermore, it was also consistent with the findings of Guo Kairui’s research on the near-road expansion of rural settlements in the Himalayas with a backward economy [66]. The production and life of rural residents are inseparable from transportation and improving road accessibility in areas where roads are the main mode of transportation can promote the concentration of residents [67]. Therefore, the construction of roads is conducive to the adjustment of rural layout.

Although we considered policy-restricted construction when analyzing the influencing factors of homesteads expansion, and it was found that the correlation of this factor ranked fourth from the average influence of the six sample villages, and this did not represent the influence of all policies. Due to the diversity of policies, it was impossible to quantify the analysis one by one. In fact, the policy has a huge impact on the expansion of homesteads. For example, the violent demolition and construction of Yang dun, Jiayuan, and Dongheng in the study were all caused by mandatory policies; only under the policy of “homesteads reform” area constraints, the expansion of homesteads in adjacent urban areas and closed mountainous areas would not be rapidly changed from expansion to contraction.
4.3. Recommendations for Regulation

(1) Strengthen village planning and guide implementation. The phenomenon of “name only” in Chinese village planning is common [7]; therefore, implementable plans should be made according to local resource endowments, and reward and punishment plans and law enforcement departments should be established to control the number and layout of homesteads on a macro level. From the results of this study, the “homesteads reform” policy was conducive to reducing the trend of homesteads expansion. (2) Formulate a homestead exit mechanism to guide farmers to withdraw with compensation. When investigating the reasons for the expansion, this study found that the phenomenon of “old houses” was common, that is, the old houses only provided memories, and the farmers built new houses in the villages or bought commercial houses in big cities to meet the living needs. In order to avoid the waste of resources, farmers could be guided to withdraw from their homesteads through compensation [68]. (3) The low-slope area should be considered first in the selection of the resettlement area for farmers; in addition, it was conducive to attracting farmers to move-in voluntarily by constructing convenient travel roads and creating cultural resources that could bring tourists.

5. Conclusions

We studied Deqing County, being in the first batch of pilot counties and advanced representatives of the rural homesteads reform in China, in terms of its evolution and influencing factors of homesteads expansion at the village scale, which has reference significance for the optimization of homesteads layout in the developed eastern coastal areas of China. Based on multidistance spatial clustering, this study innovatively proposed the method of homesteads patch division. To quantitatively analyze the direction, level, and pattern of homesteads expansion in six different types of villages in Deqing County, an advanced county in homestead reform, from 2010 to 2020, we used the methods of homesteads expansion index, standard deviation ellipse, and intersection area index, as well as the spatial information of homesteads. In addition, to explore the influencing factors of homesteads expansion, a geodetector model was used. The conclusions of the empirical case study are as follows:

(1) Through the analysis of the expansion level, it was found that before the reform of the homesteads, 83.3% of the village homesteads in the study area showed the phenomenon of expansion. After the “homesteads reform”, 83.3% of the villages’ homesteads expansion showed a downward trend, which revealed that the “house reform” policy had an obvious effect and should be supported and implemented. In addition, the drastic changes in homesteads were all due to the strong interference policy of demolition and relocation. Only under the area constraint policy of “homesteads reform”, the trend of homesteads expansion has slowed down for villages near urban areas and in mountainous areas. Furthermore, the policy of “homesteads reform” had a weak impact on the expansion of village homesteads in tourist attractions, indicating that the lure of economic benefits was greater than the constraints of the policy.

(2) After the standard deviation ellipse analysis, it was found that the expansion direction of the homesteads in half of the villages remained the same from 2010 to 2020, and the remaining villages showed south-north and southeast-northwest directions. Due to the impact of the demolition policy, the homesteads in Jiayuan Village, Dongheng Village, and Yangdun Village have changed greatly. The center of the homesteads in Jiayuan Village with flat terrain has moved southward, showing a state of contraction and nonpolarized evolution. Dongheng Village, which is rich in minerals, developed toward discreteness, while Yangdun Village evolved from ellipse to circle, and its expansion showed no direction and tended to be discrete. Only affected by the “homesteads reform” policy, the expansion direction of rural homesteads had changed little.

(3) After the analysis of the spatial expansion pattern of homesteads, it was found that the overall effect of the “homesteads reform” policy was significant, but its impact on
the villages near the main urban areas was limited. Before the “homesteads reform”, the expansion of homesteads was mainly in the form of infill and enclave style; after the “homesteads reform”, the type of enclave slowed down significantly, and the type of sprawl increased slightly. At the same time, the infill increased significantly and became the majority, accounting for 67%, while the enclave was very rare, accounting for 12%. In terms of individual villages, Changchun Village, located at the junction of the two mountains, had the best effect on controlling the expansion of homesteads. Wusi Village, which is close to the main urban area, needed to pay more attention to the approval of homesteads.

(4) By analyzing the influencing factors of homesteads expansion, it was found that the influence factors of homesteads expansion in villages with different resource endowments were different, and the order of influence from strong to weak was as follows: distance from road > elevation > slope > policy restrictions on construction > distance from water area > slope aspect. In terms of roads, newly constructed homesteads were mainly concentrated in the area of 0–20 m away, and the greater the distance was, the fewer new homesteads there would be. In terms of elevation, there was no unified standard due to the wide variation in different villages, and the new homesteads in Changchun village with undulating terrain were mainly distributed at 10–20 m. In terms of slope, Changchun and Houwu villages, which are also in mountainous areas, showed different results in the distribution of newly constructed homesteads. The distribution of the former decreased with the decrease in the slope, and the latter concentrated in the range of 5°–10°. In terms of policy restrictions on construction, 83.3% of the newly homesteads in the sample were mainly distributed in the restricted construction zone. In terms of water area, the homesteads in Jiayuan Village and Dongheng Village showed negative hydrotropism. In terms of slope aspect, it did not show obvious uniform characteristics, and the new homesteads in Changchun Village were mostly distributed on the northeast slope.

We selected six common types of villages and tried to exclude the impact of cultural factors in order to explore the common rules of the expansion and changes of rural homesteads. This study can provide some references for other economically developed regions with similar problems as China, although the situation may vary from region to region [7]. Firstly, the government needs measurement methods to explore the level and pattern of homesteads expansion, which is “what”, and determines whether the project is worth starting. Secondly, the government needs to find out the reasons for the expansion of rural houses before interfering, which is “why”, and determines whether the project conforms to objective rules. Thirdly, the government needs to consider the resettlement location, which is “where”, and determines the sustainability of the project.

Due to the limitation of data, the research time range was from 2010 to 2020, the research areas were all concentrated in Deqing County, and the sample number was limited, which made it impossible to explore the change law of homesteads expansion in large-span areas for a longer period. Therefore, long-term, multitype, and cross-regional research on rural homesteads expansion and comparison will be the next research direction.

Author Contributions: J.Z.: conceptualization, methodology, visualization, writing; B.F.: resources, conceptualization, funding acquisition; S.L.: project administration, software, editing; Z.Z.: investigation, data curation; B.L.: validation, visualization, writing; G.Z.: supervision, funding acquisition, editing, review. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the Innovation Research Fund of Agricultural Information Institute of CAAS, China (CAAS-ASTIP-2016-AII, CAAS-ASTIP-2021-AII), and the Basic Research Fund of the Chinese Academy of Agricultural Sciences, China (JBYW-AII-2022-02).

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding authors upon a reasonable request.

Acknowledgments: We thank the Deqing County Bureau of Agriculture and Rural Areas and Geographic Information Center, Huzhou City, Zhejiang Province, for the data provided.
Conflicts of Interest: The authors declare no conflict of interest.

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