

Article

Research on the Influencing Factors of the Cropland Abandonment Behavior of Different Typical Types of Farming Households: Based on a Survey in Mountainous Areas

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Abstract

Cropland abandonment (CA) is a critical environmental issue globally, with balancing food security and ecological protection vital for sustainable development. This study explores CA behavior differences and drivers between out-of-poverty farming households (OPFHs) and non-poverty farming households (NPFHs) in China's mountainous areas, using stepwise regression on survey data from 321 households in Liping County, Guizhou. The results show that: (1) The differences in CA behaviors between the two types of farming households are mainly reflected at the farmer level and the plot level. Plot integrity is a common influencing factor of CA areas for both types of farming households. (2) The driving factors affecting the area of CA by OPFHs also include the average age of the labor force, the proportion of the resident population in the total household registration population, and plot type, while the drivers affecting the area of CA by NPFHs include per capita income, non-agricultural income, per capita cropland area, and commuting time. (3) The differences in CA behavior and its driving factors between OPFHs and NPFHs in mountainous areas are characterized by diversity and interaction. Based on the results of the study, we propose the management of farming households and cropland, which can contribute to rural revitalization in China and the world, to a certain extent.

Keywords: heterogeneous farming households; cropland abandonment; stepwise regression; man–land relationship; Liping County



Academic Editor: Wei Song

Received: 12 September 2025

Revised: 13 October 2025

Accepted: 14 October 2025

Published: 15 October 2025

Citation: Feng, Y.; Li, J.; Feng, D. Research on the Influencing Factors of the Cropland Abandonment Behavior of Different Typical Types of Farming Households: Based on a Survey in Mountainous Areas. *Land* **2025**, *14*, 2057. <https://doi.org/10.3390/land14102057>

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1. Introduction

Cropland abandonment (CA) is very common in many countries and regions of the world, and it is one of the most pressing concerns around the world [1,2]. As global industrial development and urbanization accelerate, farmers' agricultural income continues to decline, and more and more farmers and farming households are abandoning cropland and gradually changing their livelihoods to work in cities in order to increase their disposable income [3,4]. To achieve rural revitalization, China must fundamentally clarify the new relationship between people and land, focusing on coordinating issues between farmers and land to achieve a virtuous cycle of mutual promotion between people and land. Land use serves as a mirror of socio-economic development and is the vehicle for rural human-land activities. Issues such as the development of farming households and land optimization in the process of rural transformation and development can be reflected in land use and can also be alleviated through the control and management of land use transformation [5].

Therefore, from the perspective of land use, constructing a comprehensive analytical framework that includes both special groups such as people who have been lifted out of poverty and core elements such as land is the basis for enhancing the endogenous strength of rural people who have been lifted out of poverty and optimizing the rural land structure, and is the breakthrough point for achieving comprehensive rural revitalization [6].

CA as one of the most important manifestations of land use change [7], is the process and state of farmers, and reveals their cropland use morphology attributes by adjusting land use types. Accordingly, the types and attributes of farmers are different, and the characteristics of CA will also be different. Existing research on CA mainly covers the definition of concepts related to the factors contributing to CA [8], the spatial distribution and extent of CA [9], the drivers of CA [10], and the institutional factors leading to CA [11]. In recent years, the abandonment of cropland in China has shown obvious spatial heterogeneity and phased characteristics: generally, it is concentrated in the hilly and mountainous areas in the south, the northern mountainous regions, and the agropastoral ecotone. It was more prominent from the mid-late 2000s to 2015, and then declined to some extent under the background of strengthened food security policies, but the total amount remains non-negligible [12]. In regions such as Jiangxi, Sichuan, and the karst plateau in eastern Yunnan, remote sensing interpretation using GF/Landsat data combined with ground verification has identified a coexisting pattern of “agglomeration-fragmentation” in CA patches, characterized by “more in the north than in the south, and more in mountainous areas than in flatlands”. Additionally, the corresponding relationship between the abandonment rate and the terrain-accessibility gradient has been quantified, providing spatial anchor points and benchmark data for subsequent micro-behavior research [13–15]. In terms of factors contributing to the formation of CA, studies have shown that operational conditions and terrain accessibility (such as plot slope, distance from homesteads/roads, irrigation conditions, and plot fragmentation) play a decisive role in the “priority abandonment” of marginal plots. Moreover, this phenomenon of “selective abandonment of marginal plots” is particularly prominent in the hilly and mountainous areas of southern China [16]. In the context of China, farming households that have escaped from poverty are those that have been identified as poor during the period of China’s poverty alleviation efforts. As a special component in the new era, knowing how to improve sustainable development capacity is the key to effectively bridging China’s poverty eradication and rural revitalization strategies. At present, the scholars’ analysis of out-of-poverty farming households mainly focuses on the effectiveness of poverty reduction [17], livelihood vulnerability [18], and livelihood sustainability [19], and has proposed representative views such as “land is the most important wealth of the poor, and activating the land elements is of great significance for preventing farmers from returning to poverty and promoting the sustainable rural development” [20], which also confirmed the important influence of cropland on fostering the endogenous power of farmers who live in poverty [21,22].

Compared with the established literature, at this stage, there is a lack of comparative research on CA from a heterogeneous perspective that focuses on the large number of farming households that are unique in nature but have been lifted out of poverty. Therefore, this manuscript attempts to compare the specific component of out-of-poverty farming households (OPFHs) with the majority group of non-poverty farming households (NPFHs). The classification of these two types of farming households is based on clear criteria for defining poverty scope specified in national policies [23,24]. Specifically, OPFHs refer to those that were once included in the registered poverty list, later achieved poverty alleviation standards through poverty alleviation policy support or their development, and stably exited the poverty sequence [25]. In contrast, NPFHs refer to farming households that have never been included in the registered poverty list, whose income levels and

living conditions have long remained above the poverty line, and who have not received support from major targeted poverty alleviation policies. A comprehensive analytical framework that incorporates the core elements of rural poor farming households and land use is constructed from the perspective of land use, which then analyzes the differences between farmer-level and land-level factors in the two types of farming households' CA behaviors, as well as the significant factors influencing farming households' abandonment behaviors. It is expected that the study will help to enhance the endogenous motivation of rural people coming out of poverty and optimize the basis of rural land structure. It also provides new references and experience samples for other countries and regions to enhance the development capacity of farming households and optimize the use of cropland.

This paper is structured as follows. In the second part, we construct a research approach for analyzing the driving factors that influence different farming households to abandon their cropland in the context of rural revitalization, and introduce a research methodology, research area, and data collection and sources. The third part describes the research process and results of this paper. The fourth part discusses the research results, shortcomings, and policy recommendations, while the fifth part serves as the conclusion of the paper.

2. Materials and Methods

2.1. Study Area

The nature and characteristics of mountainous areas restrict the expansion of human activities to breadth and depth; thus, mountainous areas are always considered to be permanent natural barriers. As a typical mountainous country, China's mountainous region accounts for about 75% of the total area of the country [26]. In the new period, the revitalization of China's mountainous rural areas is an important topic in the overall situation. The socioeconomic characteristics of Guizhou are closely intertwined with its poverty background, forming unique driving factors for CA. In terms of economic structure, although its GDP reached 2.10 trillion yuan in 2023 with a growth rate of 4.90%, the primary industry still accounted for 13.80% of the total GDP, reflecting the deep dependence of rural areas on agricultural production. However, harsh natural conditions restrict agrarian production efficiency. Data from the Third National Land Survey shows that 85.06% of Guizhou's cultivated land is distributed on sloping land with a slope of more than 6 degrees, among which 16.84% is steep land with a slope of more than 25 degrees, and there are an additional 2.87×10^5 of rocky desertified cropland. Such cropland conditions lead to high planting costs and low returns. Taking grain cropland as an example, after deducting costs such as chemical fertilizers, pesticides, and labor, the net income of farming households is negligible.

In terms of population structure, with the advancement of industrialization and urbanization, the contradiction between labor supply and agricultural production demand has become increasingly prominent [27]. The "labor shortage" in mountainous areas is particularly acute, fragmented, steep land requires more manual input, and farming households often have to manage dozens of scattered plots, which further reduces their willingness to cultivate. At the policy level, although poverty alleviation policies such as industrial support and land consolidation have achieved remarkable results, they have also indirectly changed the pattern of land use. For instance, large-scale poverty alleviation relocation has altered the spatial relationship between farming households and land; meanwhile, the preferential support for high-value cash crops (such as tea) has led some farming households to abandon low-yield grain fields. In addition, insufficient agricultural infrastructure, and the imperfect land transfer mechanism have further exacerbated the phenomenon of CA [28]. Against this backdrop, exploring farming households' behavior of CA is not only

scientifically necessary to reveal the interactive mechanism between poverty alleviation governance and land use change in mountainous areas, but also of great practical value in preventing return to poverty, ensuring food security, and promoting rural revitalization in former poverty-stricken areas.

Liping County in the Guizhou province (Figure 1) is situated at $108^{\circ}31' \sim 109^{\circ}3' \text{ E}$ and $25^{\circ}41' \sim 26^{\circ}08' \text{ N}$. It is located at the junction of the Guizhou, Hunan, and Guangxi provinces (regions), and is the transition area from the Yunnan–Guizhou Plateau to Jiangnan Hills. It has the characteristics of a south subtropical monsoon climate, with an average annual temperature of 16.2°C and an annual precipitation of 1235 mm. All over the territory, there are mainly low mountains, low mountain canyons, low hills, and other geomorphic types; the average altitude is about 695 m. Liping County has favorable climatic conditions for the development of agriculture, and the proportion of the agricultural economy is relatively large. However, the relatively backward economy forces more and more rural populations to continuously flow out, and the phenomenon of CA continues to emerge with a growing trend. It is of practical significance to study the CA behavior of farming households in this region.

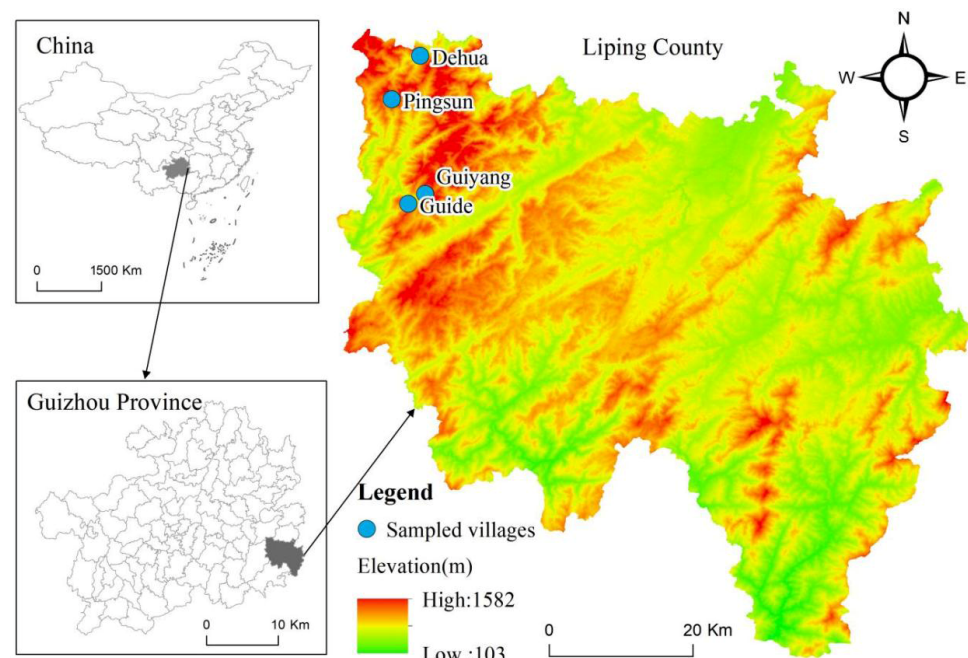


Figure 1. Location and elevation of the study area.

2.2. Data Sources

The scientific research team conducted a questionnaire survey of farming households in four villages in Liping County, Guizhou province, in December 2023. For the research, the team used a random sampling method to ensure the representativeness of the respondents. The specific process was used to select two townships (Shangchong Township and Dehua Township) from the study area and randomly select two villages in each place, i.e., Guide Village, Guiyang Village, Pingsun Village, and Dehua Village. Through face-to-face interviews with the farming households, we obtained a total of 388 questionnaires. Finally, 67 of the questionnaires with “no CA” were excluded based on the research requirements, leaving 321 valid questionnaires, with an effective rate of 82.7%. The content of the questionnaires mainly included the location of the farm household, basic information about the farm household, the income and expenditure of the farm household, land status, agricultural production inputs, etc. (Table 1).

Table 1. The main contents and indicators of the questionnaire.

Main Contents	Main Indicators
Household zone bit	Location, traffic distance, traffic mode, transportation time
Basic information of farmers	Population, education level, age, worksite, employment industry, the structure of the households' labor force
Household income and expenditure	Gross income, agriculture income, non-agricultural income, consumption situation
Household livelihood asset	Farmers' planting and breeding behaviors, the number of production tools, the number of durable consumer goods
cropland utilization	cropland area, the number of cultivated plots, farming conditions, the types of cropland, farming distance, and abandonment situations

2.3. Methods

2.3.1. Evaluation Model

Regression analysis is used to study the interdependent relationships among multiple variables, while stepwise regression analysis is often used to establish optimal or appropriate regression models [29,30]. Using the stepwise regression analysis method, the most important variables can be identified and selected from a large number of possible variables, and an “optimal” multiple linear regression model and explanatory framework can be established based on this, providing important support for identifying the degree and direction of the effects of key influencing factors. The basic formula is as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \beta_p x_p + \varepsilon \quad (1)$$

In the formula, y is the explained variable and refers to the CA area of farming households in this paper; x refers to the explanatory variables that will be described in detail below; β_p is the partial regression coefficient, which indicates the average change value of the explained variable caused by each unit change in the β variable when other explanatory variables remain unchanged; and ε is the random error.

2.3.2. Construction of the Indicator System

Based on the relevant literature [31–33], from a micro perspective, the area of CA is taken as the dependent variable. The indicators were compared one by one, and the representative indicators from “human” and “land” were selected as independent variables. Among them, the “man” element level mainly included specific indicators such as labor quantity, labor structure, age, education, and income. The “land” element level mainly included specific indicators such as land type, area, and quality (Table 2).

Table 2. Index system of driving factors of CA.

Types of Variables	Variables Name	Variables Explanation	OPFHs		NPFHs	
			Average Value	Standard Deviation	Average Value	Standard Deviation
Dependent variable	Abandoned area(Y)	The sum of abandoned cropland area of farming households (hm ²)	1.865	1.170	2.371	1.348
	Average age of labor force (X1)	Total age of labor force/Total number of labor force (year)	38.657	7.012	37.955	9.215
Independent variable	Elements of “man”	Education level of householder (X2)	1.162	0.802	1.366	0.794
		Proportion of agricultural labor force (X3)	0.215	0.212	0.214	0.231

Table 2. Cont.

Types of Variables	Variables Name	Variables Explanation	OPFHs		NPFHs	
			Average Value	Standard Deviation	Average Value	Standard Deviation
Independent variable	Elements of “man”	Proportion of resident population in total household registration population (X4)	0.452	0.310	0.499	0.318
		Per capita income (X5)	1.018	0.450	1.593	0.870
		Non-agricultural income (X6)	3.384	1.342	5.969	3.658
		Policy subsidy income (X7)	0.214	0.200	0.070	0.138
	Elements of “land”	Plot type (X8)	1.643	0.234	1.603	0.234
		Per capita cropland area (X9)	1.025	0.340	1.044	0.430
		Degree of land plot integrity (X10)	0.030	0.013	0.040	0.016
		Commuting time (X11)	58.143	31.079	55.760	31.869
		Quality of land (X12)	1.821	0.452	1.690	0.469

Table 3. Differences in CA by farming households.

Indexes		Indexes Calculation	OPFHs	NPFHs
Plot area	Abandonment rate of the overall sample	Area of CA/total cropland area	45.154%	58.595%
	Average area of abandoned plots per household (hm ²)	Abandoned cropland/number of farmers	0.124	0.158
	Per capita abandoned area (hm ²)	Area of abandoned cropland/total number of households	0.029	0.037
Plot type	Average number of abandoned dry cropland per household (per piece)	Total number of abandoned dry cropland/number of farmers	1.354	2.084
	Average area of abandoned dry cropland per household (hm ²)	Total area of abandoned dry cropland/number of farmers	0.041	0.066
	Average number of abandoned paddy fields per household (per piece)	Total number of abandoned paddy fields/number of households	2.177	2.037
	Average area of abandoned paddy field per household (hm ²)	Total area of abandoned paddy field/number of households	0.057	0.092
Density of abandoned land plots		Total number of abandoned plots/total area of abandoned plots	28.400	26.068
Quality of abandoned land plots		Assignment value according to farmers’ oral statements: bad = 1, general = 2, good = 3, excellent = 4	1.840	1.710
Average crop yield per household on plots before abandonment (kg)		Direct statistics from questionnaires	340.955	217.500

2.4. Research Framework

The man–land relationship abroad has an early origin and has given rise to a series of scientific propositions that synthesize multidisciplinary ideas. Philosophically speaking, the man–land relationship can be first derived from the findings of Plato [34] and Aristotle [35],

but their ideas are limited to the relationship between population and land based on quantity, and therefore are called simple man–land relationship thoughts. In the economics community, David Ricardo built on Malthus' work to promote the interrelationship between population and economy, forming the classical thought of the man–earth relationship [36]. In geography, Ritter first proposed the principle of “man–land relations” and founded human geography. In 1983, the British scholar H. Durr defined the concept of the man–land system as a giant system composed of a population system and a land system based on a certain degree of regularity, and interpreted its concept [37]. Differences between regions have led to differences in man–land relations between regions, and it is this geographical variability that provides insight into the production potential and appropriate development directions of different regions, thus providing a better theoretical reference for decision-making. Based on man–land relationship, Chinese academician Wu [38] regarded the functionality of the territory, the structured system, the orderly process of spatiotemporal variability, and the variability and modifiability of effects as the essence of the theory of the man–land relationship areal system.

The formation of CA in mountainous areas is a result of the combination of macro-environment and micro-elements. The macro-environment determines the overall trend of regional CA, and the micro-factors affect the individual differences in regional CA [39]. The natural environment, socio-economic, and policy system together constitute the macro-driving factors set of CA, while the elements of the farming households and plots together constitute the micro “man–land” elements set of CA. Under the influence of urban-rural dual structure, the innovation of regional socio-economic policy systems, and other macro-factors will promote the rapid development of regional industrialization and urbanization [40]. On the one hand, the rapid development of industrialization and urbanization brings opportunities to rural areas, such as urban capital backflow and non-agricultural economic growth. On the other hand, it also brings challenges, such as a large number of labor outflows, increased opportunity costs of farming and reduced comparative profit in agriculture [41]. These opportunities and challenges are intertwined with the realities of imperfect rural land management policy systems and the relatively fragile natural environment in mountainous areas, all these under the cumulative effect of long-term cycles, eventually forming a regional CA, and continuing to influence its overall trend. On the micro-scale, CA is essentially a micro manifestation of man–land relationship, which is also a combined function of farmers' capital and croplands' capital. Specifically, under the influence of regional macro-environment, farmers will make “bounded rationality” judgments on the direction of family development, land demand, and livelihood choices by integrating the background of family resources, such as population, age and health status with the background of cropland resources such as soil fertility, elevation and slope, and commuting distance. When farmers show obvious non-agricultural tendencies, they will correspondingly reduce or even interrupt the input of labor, capital, technology, and other factors to the cropland, thus resulting in CA. However, in this process, different farmers often show obvious differences in CA, which brings different social effects, ecological effects, household economic effects, and has an impact on the subsequent development of farmers and rural areas.

To sum up, CA is an obvious form of uncoordinated development between rural farmer households and cropland in mountainous areas. Analyzing CA from the micro-scale can not only effectively decipher the differences in CA behaviors of different types of rural farmer households, but also help to identify the regional social, economic, and ecological effects caused by these differences, and then guide the regulatory behaviors of local departments. Therefore, based on the macro background of the organic linkage between the strategies of poverty alleviation and rural revitalization, this paper takes CA as the main research

line, and stood on the two key factors of cropland and farmer households, analyzes the differences in farmer households' characteristics such as demographic structure, education level, income level and livelihood mode, as well as the differences in abandoned plots such as area, type and farming distance between OPFH and NPFH in the process of CA. Then, the multiple linear regression models are used to identify the significant variables that affect the difference between the two types of farmers' abandonment. Finally, the regression model is used to identify the significant variables affecting the abandonment of the two types of farming households, and then a classification and control strategy is proposed based on the differences in the significant variables to build a new human–land relationship (Figure 2).

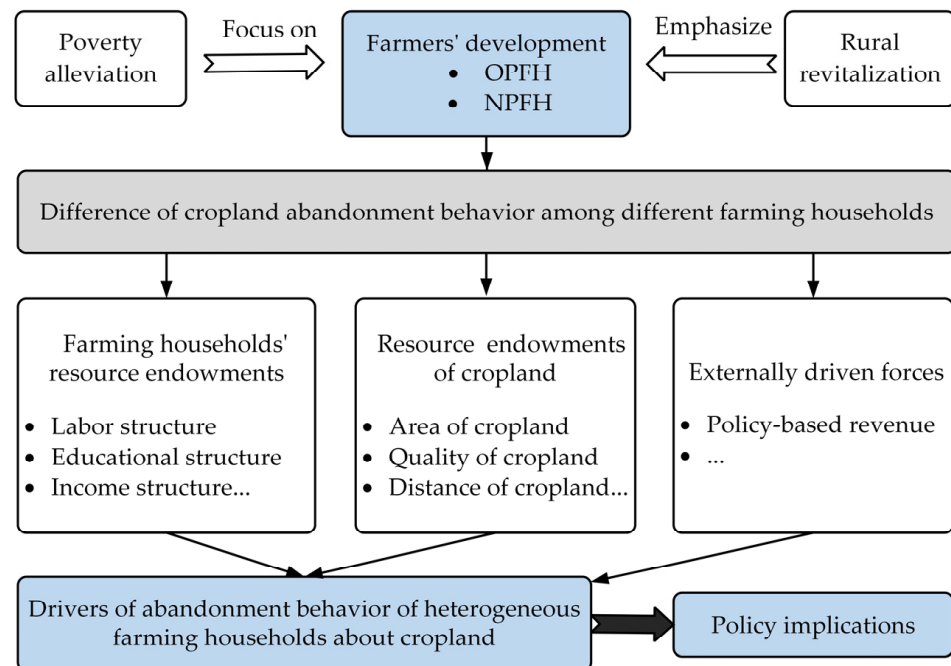


Figure 2. Analysis of the influencing factors of the CA behavior of different typical types of farming households.

3. Results

3.1. Characteristics of Farming Households' CA Behavior Differences

3.1.1. Farming Households' Different Characteristics

As the main decision maker and fundamental unit of cropland utilization, the characteristics of farming households' members have an interaction effect on CA [42]. As farmers change from high self-similarity to complex heterogeneity, their CA behavior will also take on complex features [43]. Therefore, according to the national policy documents and the standard of poor households established by the governments, this standard is mainly based on the income of farming households as a reference. In the study, we used the registered impoverished families who came out of poverty and those who were not poor as the different types of farming households. Exploring the characteristics of different farming households is the foundation and prerequisite to deeply understanding the differences in their CA behavior. With regard to the existing research results [44,45], this paper will analyze the differences in the basic characteristics of two types of farming households based on population structure, cultural structure, and income structure (see Figure 3 for specific indicators).

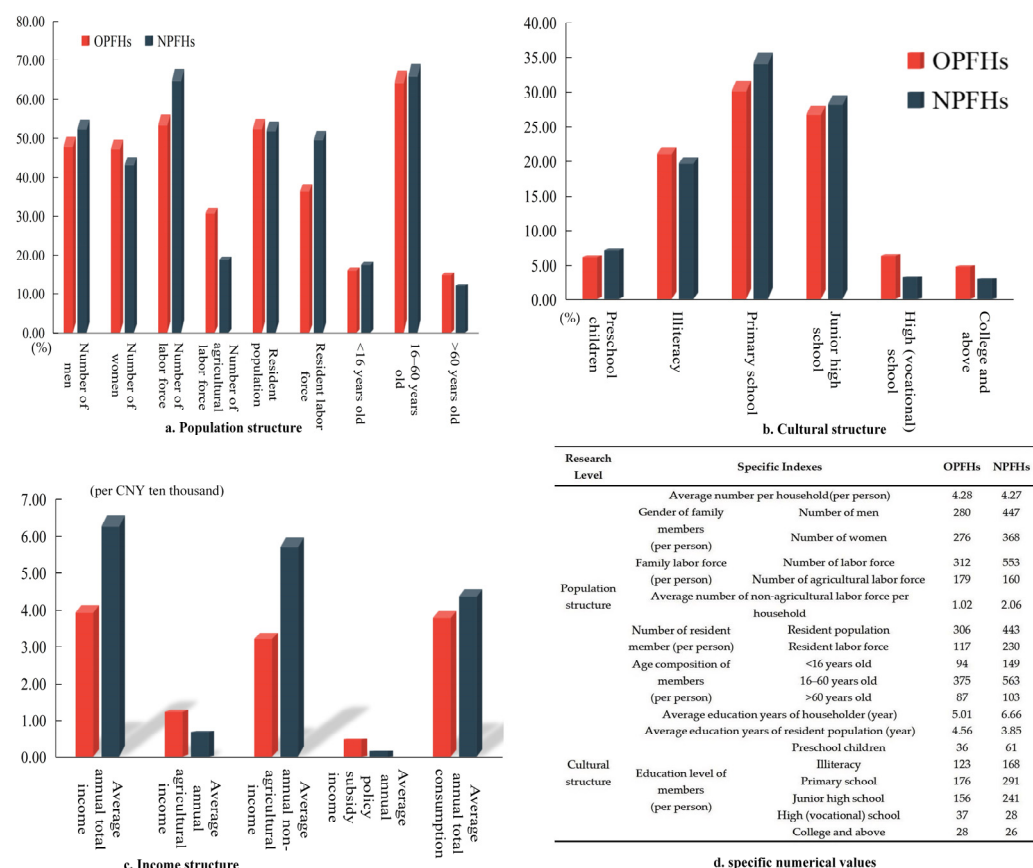


Figure 3. Characteristic indexes of sample farming households.

There are distinct hierarchical differences in the basic characteristics among different types of farming households. Overall, the 321 sampled farming households have a total population of 1371, with 865 laborers. Among them, OPFHs have a total population of 556, including 312 laborers, accounting for 56.115% of their total population; NPFHs have a total population of 815, with 553 laborers, making up 67.852% of their total population. It can be seen that NPFHs have advantages in the total number of laborers.

From the perspective of population structure, both types of farming households have a relatively small average household size, but the proportion of male members in NPFHs is higher—a demographic feature that theoretically endows them with relatively better physical strength and stamina for production activities. However, this apparent labor advantage does not translate into reduced CA; instead, as shown in Table 3, NPFHs exhibit higher abandonment rates, larger average abandoned plot areas per household, and greater per capita abandoned areas compared to OPFHs. This contradiction can be attributed to their livelihood strategy preferences: despite having stronger labor capacity, NPFHs are more inclined to allocate their labor to non-agricultural sectors. Driven by higher returns from non-farm work, they prioritize non-agricultural employment over agricultural production, thereby reducing their dependence on cropland and increasing the likelihood of abandonment. Education plays a role in optimizing farmers' development decisions and guiding families toward optimal livelihood choices. As the core of household decision-making, the householder's educational level often correlates with their ability to acquire knowledge, master skills, and accumulate experience. Generally, a higher educational level enables more rational decisions regarding family livelihood strategies. Moreover, it can be seen that all farming households in mountainous areas show an obvious choice preference for non-agricultural income.

3.1.2. Difference Characteristics of Farming Households' CA Plots

The circumstances of CA plots are expected. CA is a concrete manifestation of the imbalance of the microscopic relationship between “farmer and cropland”, and the difference in the resource endowment of land plots is an important factor for farmers to make abandonment choices. Conversely, the features of abandoned land plots can also effectively reflect the changes in farming households and regional cropland utilization. So, it is urgent to effectively distinguish and grasp the difference in CA plots to accurately master the complex characteristics of regional CA. From the sample data, there were significant differences in CA among different types of farmers, as the abandonment rate of OPFHs was 45.154% and the abandonment rate of NPFHs was 58.595%, which indicates that the CA behavior is widespread among the sample farming households (see Table 3 for more details). In terms of plot types, the number and area ratio of paddy fields and dry cropland abandoned by NPFHs were about 50%, and the majority of abandoned plot types of OPFHs were found to be paddy fields. Through interviews, it was found that paddy field cultivation has higher requirements for the physical strength and endurance of farmers, and OPFHs with weak human capital are difficult to sustain and are forced to be abandoned. In addition, the density of abandoned plots in OPFHs was larger; the number of abandoned plots per unit area (hm²) was higher, which shows the higher degree of fragmentation in their abandoned plots. In terms of abandoned plots quality, according to the discriminated results based on farmers' experience, the mean value of the cropland quality of sample farmers was 2.010, and both types of farmers chose the land plots whose quality was lower than the average in order for it to be abandoned. By comparing the crop yields of the two types of plots before abandonment, we found that the average annual crop yield of each OPFH was 123.455 kg higher than that of each NPFH, which possibly shows that the former had a greater focus on inputs in agricultural production and had the stronger dependence on agriculture.

Table 4 shows the changes in the CA area for different commuting distances. Commuting distance refers to the distance required by farmers to work on land plots, reflecting the difficulty of commuting and the cost of labor. As can be seen from Table 4, the proportion of CA to contracted land of different types of farmers showed a gradient upward trend with the increase in commuting distance, which was consistent with the conclusion that “the farther the farming distance of mountainous land, the higher the rate of CA”, as proposed by Shi Tiechou and other scholars [46]. Specifically, when the commuting distance was less than 2 km, the proportion of CA of the two types of farmers was controlled below 50%; when the commuting distance was more than 2 km, the proportion of CA of the two types of farmers was more than 65%; when the distance exceeded 4 km, all farmers chose to abandon all their cropland. This phenomenon can be explained as follows.

Table 4. The change in abandoned land area in total cropland area under different commuting distances.

Types of Farmers	<1 km		1~2 km		2~3 km		3~4 km		≥4 km	
	Abandoned Area (hm ²)	Proportion (%)	Abandoned Area (hm ²)	Proportion (%)	Abandoned Area (hm ²)	Proportion (%)	Abandoned Area (hm ²)	Proportion (%)	Abandoned Area (hm ²)	Proportion (%)
OPFHs	1.361	22.656	7.931	40.534	4.612	67.172	2.297	85.634	0.120	100.00
NPFHs	1.985	29.780	12.876	46.578	6.076	72.883	2.901	80.458	0.322	100.00

The special topographic conditions make it impossible for large agricultural machinery and equipment to operate in mountainous areas, and agricultural production relies mainly on human labor. With the increased commuting distance, it is difficult to transport agricultural tools, fertilizers, and agricultural products. Farmers need to spend more time within walking distance, thus requiring more labor, sharply increasing the cost of agricultural operation, and increasing the possibility of abandonment. This difference in land abandonment is mainly caused by the different innate member structures and subsequent

member allocation strategies of the two types of farming households. Among them, the OPFH has a congenital short board of family human capital, coupled with the posterior staffing tendency to leave behind the elderly and children, resulting in an insufficient rural labor force, so they can only choose plots of land for cultivation at a relatively closer distance, while the left-behind labor forces of NPFHs are relatively abundant, so they can take into account the cropland within a longer distance.

3.2. Driving Factors of Farming Households' Abandonment Behavior Difference

3.2.1. Test Results of Driving Factors

The stepwise regression analysis method was adopted, and regression tests were conducted for each variable based on the driving factors of abandonment behavior among different types of farming households. From the regression results, with the introduction of independent variables, the goodness of fit (R^2) performed well; the regression model passed the F-test, indicating that the model is valid. The variance inflation factor (VIF) of each significant explanatory variable was less than 5, suggesting that there is no multicollinearity problem among the variables. The output results of the correlation coefficients of the influencing factor model are shown in Table 5.

Table 5. Results of stepwise regression on drivers of CA based on different types of farming households.

Type	OPFHs						NPFHs			
	Constant term	X1	X4	X8	X10	X5	X6	X9	X10	X11
Regression coefficient	0.260 *** (3.938)	0.231 *** (2.528)	−0.286 *** (−6.137)	−0.153 ** (−2.602)	0.551 *** (6.068)	−0.742 *** (−3.066)	1.515 *** (6.386)	0.603 *** (5.849)	0.816 *** (6.367)	−0.190 *** (−2.640)
95% CI	0.131~0.390	0.052~0.410	−0.377~−0.194	−0.269~−0.038	0.373~0.729	−1.217~−0.268	1.050~1.980	0.401~0.805	0.565~1.068	−0.331~−0.049
VIF	—	1.029	1.103	1.012	1.115	4.256	4.316	1.819	1.091	1.017
Tolerance	—	0.972	0.906	0.988	0.897	0.235	0.232	0.55	0.917	0.983
N			130					191		
R^2			0.493					0.472		
Adjusted R^2			0.477					0.458		
F		F = 30.418, $p = 0.000$ ***					F = 33.138, $p = 0.000$ ***			

Note: “*, **, ***” respectively indicate significance at the 10%, 5%, and 1% levels. Values in parentheses are t-values.

Among the driving variables, the degree of land plot integrity has a negative impact on the abandoned area of both types of farmers; in other words, the more incomplete the cropland plots of farmers, the more likely it is to be abandoned. Due to the multiple effects of complex mountainous terrain and the household contract responsibility system, the space and property rights of cropland in China's mountainous areas are significantly fragmented, with farmers owning multiple unevenly sized and spatially disconnected plots. As labor costs continue to rise and labor-saving technologies become more widespread, the use of labor-saving technologies, such as machinery, is limited by the fragmentation of cropland, which increases the commuting time of laborers between plots, exacerbates the increase in agricultural operating costs, and triggers the CA. In addition to the above-mentioned common factors affecting abandonment, different types of farmers also have other factors.

3.2.2. Analysis of Differences in Driving Factors

The driving factors affecting the area of CA by OPFHs include the average age of the labor force, the proportion of the resident population in the total household registration population, plot type, and the degree of land plot integrity. From the regression results, the average age of the labor force and the degree of land plot integrity are significant factors influencing OPFHs. Plot type is a key factor affecting whether poverty-alleviated farming households in mountainous areas choose to abandon their cropland. Young laborers are more physically robust and energetic, which enables them to meet the needs of agricultural

cultivation in mountainous areas. In addition, for plots with better quality, farmers can not only reduce the input of production factors such as labor, chemical fertilizers, seeds, and pesticides but also obtain higher crop yields and greater income. However, young laborers generally prefer to work outside to earn non-farm income. As a result, most people who choose to engage in farming at home for a long time in the study area are middle-aged and elderly. They thus engage in farming selectively, and fragmented plots of cropland gradually become marginalized and then abandoned.

The driving factors affecting CA of NPFHs include per capita income, non-agricultural income, per capita cropland area, degree of land plot integrity, and commuting time. When the non-agricultural production income of a household is higher than the agricultural income, among NPFHs with limited capital, farmers tend to increase capital investment in non-agricultural production activities (such as human and material resources) to maximize their benefits, thereby reducing their attention to cropland. When non-agricultural income is relatively high, a larger area of cropland will be abandoned. In addition, the regression results after standardizing the original data of indicators show that non-agricultural income is the most significant driving factor for CA of NPFHs. When there are more family members, the labor capacity is stronger, and the ways to obtain material means of production are no longer limited to agricultural labor, so non-agricultural income will be higher than agricultural income. At the same time, the relatively poor agricultural production conditions in mountainous areas have higher physical requirements for laborers. Factors such as the degree of plot fragmentation and the cost of commuting time to cropland are all factors that NPFHs need to comprehensively measure. When the time cost is relatively consistent and laborers find that non-agricultural income is greater than farming income after comparison, the phenomenon of CA ensues.

In addition, there are differences in the factors affecting CA between the overall farming households synthesized from different typical types of farming households and the classified samples (Table 6). The overall farming households show that the significant factors affecting CA include the average age of the labor force, education level of the householder, Proportion of the resident population in the total household registration population, per capita income, non-agricultural income, policy subsidy income, per capita cropland area, and Degree of land plot integrity. According to the regression screening results, the order of significance of each driving factor is as follows: $X_{10} > X_9 > X_6 > X_5 > X_4 > X_1 > X_2 > X_7$. This indicates that the degree of plot fragmentation, as the resource endowment of the cropland itself, is the decisive factor for CA. The per capita cropland area and non-agricultural income are important causal factors leading to CA. The consolidated sample represents the reasons for CA among most farming households in mountainous areas. The single form of agricultural income and the small per capita cropland area lead farmers to change their traditional production and lifestyle to meet the daily material needs of their families. The higher the education level of the householder, the stronger the desire for non-agricultural income. In addition, due to the poor endowment of cropland resources in mountainous areas and the differences in agricultural policy-based income between NPFHs and OPFHs, the phenomenon of CA occurs.

3.2.3. Robustness Test

To verify the robustness of the empirical conclusions, this study further adjusted the regression model specification by adopting Ordinary Least Squares (OLS) regression to replace the stepwise regression model, so as to test the stability of the core conclusions (Table 7). The results show that the significance level, effect direction and impact magnitude of the core variables in the model remain basically consistent [4], which indicates that the

influencing factors of cultivated land abandonment behavior among different types of Farming Households have significant robustness.

Table 6. Results of stepwise regression on drivers of CA based on total of farming households.

Type	TOTAL								
Independent variable	Constant term	X1	X2	X4	X5	X6	X7	X9	X10
Regression coefficient	−0.149 *** (−2.677)	0.197 ** (2.535)	0.120 ** (2.412)	−0.319 *** (−4.694)	−1.052 *** (−5.087)	1.585 *** (7.904)	0.167 ** (2.171)	0.558 *** (7.005)	0.810 *** (8.191)
95% CI	−0.258~ −0.040	0.045~ 0.350	0.023~ 0.218	−0.452~ −0.186	−1.458~ −0.647	1.192~ 1.978	0.016~ 0.317	0.402~ 0.715	0.616~ 1.004
VIF	—	1.086	1.13	1.293	4.749	4.544	1.094	1.775	1.121
Tolerance	—	0.921	0.885	0.774	0.211	0.22	0.914	0.563	0.892
N					321				
R ²					0.484				
Adjusted R ²					0.47				
F					F (8312) = 36.535, $p = 0.000$ ***				

Note: “*, **, ***” respectively indicate significance at the 10%, 5%, and 1% levels. Values in parentheses are t-values.

Table 7. Results of OLS on drivers of CA based on different types of farming households.

Type	OPFHs					NPFHs				
Independent variable	Constant term	X1	X4	X8	X10	X5	X6	X9	X10	X11
Regression coefficient	0.187 ** (2.065)	0.184 ** (1.970)	−0.269 *** (−4.445)	−0.269 *** (−4.445)	0.460 *** (5.661)	−1.002 *** (−3.199)	1.577 *** (5.217)	0.649 *** (4.893)	0.826 *** (4.558)	−0.181 *** (−2.718)
N			130					191		
R ²			0.570					0.512		
Adjusted-R ²			0.526					0.479		
F		F (12,117) = 15.436, $p = 0.000$ ***					F (12,178) = 18.230, $p = 0.000$ ***			

Note: “*, **, ***” respectively indicate significance at the 1%, 5%, and 10% levels. Values in parentheses are t-values.

4. Discussion

4.1. Comparisons with Previous Studies

The development of urbanization and industrialization is considered to be the most fundamental driving force behind CA. In most mountainous areas of China, rural–urban migration is still an irreversible process in the short term, and the problem of CA will continue. Compared with the plains, the problem of CA in mountainous areas is more serious and complex. One view is that because of the low levels of income from agriculture in mountainous areas and the large number of laborers going out to work, abandonment is a natural phenomenon, which verifies the “marginal theory of land use” and facilitates ecological recovery [47]. Another view is that CA will endanger industrial development and food security, and should be controlled and corrected [48]. Knowing how to find the critical point to distinguish whether the CA in mountainous areas is beneficial to ecological restoration or harmful to food security has become a major challenge within follow-up research.

Based on the study of CA by different types of farmers on different scales, research on CA from the household scale is mainly analyzed from the economic and social perspectives and household characteristics [49]. In terms of the comparison of drivers, on the economic side. Zheng et al. [1] emphasize land fragmentation; Pu [50] focuses on defarming and defooding. In terms of policy factors, Liu et al. [51] analyze migration and relocation policies; Chen et al. [52] explore the impact of capital going to the countryside. On ecological factors, Song et al. [53] and Crawford et al. [54] discuss the return of cropland to forests and biodiversity. In terms of research subjects, few studies have been conducted to analyze the differences and influencing factors of CA behaviors between OPFHs and NPFHs, especially for the two specific but large groups mentioned in the study of China.

In terms of the measures taken to govern CA, a series of measures have been taken around the world to combat or alleviate the problem of CA, such as the EU's FLA agricultural development policy that stimulates farmers to farm by strengthening financial support for backward regions, and the Japanese government's direct subsidy policy for mountainous and semi-mountainous areas. China has also proposed supporting measures such as comprehensive land improvement across the region, construction of high-standard cropland, and large-scale operation of agricultural machinery, aiming to boost farmers' motivation to work in agriculture. In addition, Chinese scholars have proposed various policy ideas through empirical studies, mainly related to the construction of agricultural infrastructure, the development of rural markets, ways of precisely subsidizing farmers for arable land conservation, ways of encouraging farmers to return to their hometowns to start their businesses, ways of establishing a sound penalty mechanism for abandoning arable land, and ways of improving the rural social security system, etc. [55,56].

This paper argues that the heterogeneity of farming households leads to heterogeneity in cropland use, which is specifically manifested in the differences in CA behaviors between OPFHs and NPFHs, a perspective that supplements and extends existing research on CA. As noted in previous studies, most existing literature focuses on the CA behavior of "general farming households" or single-type groups and identifies universal driving factors such as land fragmentation and non-agricultural income. Our study aligns with these findings in terms of common influencing factors; for example, the degree of plot integrity (a key aspect of land fragmentation) is confirmed as a significant driver of CA for both OPFHs and NPFHs. However, our research differs substantially from existing studies in terms of heterogeneous driving mechanisms; existing studies rarely distinguish between OPFHs and NPFHs, nor do they explore group-specific drivers of CA. In contrast, we found that OPFHs' CA is uniquely influenced by the average age of the labor force and the proportion of the resident population in the total household registration population, reflecting the vulnerability of their labor supply and the constraints of family mobility after poverty alleviation. For NPFHs, CA is additionally driven by commuting time and per capita cropland area, which stems from their more flexible livelihood strategies and higher opportunity costs of agricultural labor. On this basis, we further emphasize that given the heterogeneity among farming households gives rise to heterogeneity in cropland use—a pattern manifested specifically through differences in CA behaviors—rational cropland utilization and classified governance of CA are essential. Such measures can not only improve the livelihoods of mountainous farming households and enhance their endogenous capacity for development but also effectively prevent OPFHs from falling back into poverty. Moreover, this targeted governance approach can provide a more refined theoretical reference for existing research on CA management.

4.2. Horizontal Comparison of Factors Influencing Farming Households' CA Behavior

CA is subject to the combined influence of multiple factors. Without taking policy and market environments into account, from the perspective of subject attributes, aging, intergenerational differences, and migration experiences will significantly increase the probability of CA, and the improvement of educational level has a more prominent impact on the middle-aged group. In terms of operating conditions, land fragmentation and a relatively large farming radius will raise the possibility of CA, while the improvement of the mechanization level and service substitution can significantly restrain CA. Natural terrain and resource endowments also play an important role; the abandonment rate of land in mountainous areas or plots with larger slopes is higher, presenting a stable pattern of "higher in the south and lower in the north, with marked characteristics in mountainous areas". From the perspective of income, cost, and price expectations, low net agricultural

income and high opportunity costs brought about by off-farm work and other activities will lead to CA. Meanwhile, the cultivation of cash crops and price fluctuations will also have differentiated impacts. In addition, differences in types result in distinct “abandonment-utilization” paths: farmers engaged in off-farm work or part-time farming are more prone to CA, whereas large-scale operation and specialized production can inhibit CA (Table 8).

Table 8. Comparative study on factors of farming households’ CA from a micro-perspective.

Factors	Representative Findings	References
Subject Attributes including Age, Education, Labor Force Structure, and Migration Experience	Aging, generational differences, and migration experience significantly increase the probability of CA; the impact of education improvement is more pronounced among the middle-aged generation.	[57]
Operational Conditions: Land Fragmentation, Cultivation Radius, Average Plot Area, and Mechanization Level	Fragmentation and large cultivation radius increase the likelihood of CA; mechanization and service substitution can significantly suppress it.	[58]
Natural Terrain and Resource Endowment: Altitude, Slope, Soil/Irrigation, and Topographic Potential	The abandonment rate of plots in mountainous areas or with high slopes is higher; the pattern of “higher in the south and lower in the north, and significant in mountainous areas” is stable.	[59,60]
Income-Cost and Price Expectations	Low agricultural net income and high opportunity cost (income from migrant work) lead to CA; cash crops/price fluctuations have differential impacts. Differentiation leads to different “abandonment-utilization” paths:	[61]
Type Differences: Farmer Differentiation/Functional Orientation	migrant-worker-type and part-time-farming-type farmers are more likely to CA; large-scale operation and specialization can suppress it.	[62]

4.3. Policy Revelations

Cropland is the foundation of food security, and CA has affected food and agricultural security. As the main body of cropland use, farming households shape and drive changes in CA. Farmers with different types and attributes exhibit distinct CA characteristics. The above studies show significant differences in CA behavior between OPFHs and NPFHs in mountainous areas, with diverse and interactive causes that urgently require multi-dimensional regulation. Given the differences in CA characteristics and driving factors between the two groups, targeted multi-dimensional strategy adjustments should be made, incorporating the requirements of rural revitalization and targeted poverty alleviation, and adhering to the “three-in-one” protection of cropland quantity, quality, and ecology.

(1) Enhance income support to reduce active abandonment for NPFHs. NPFHs are less dependent on cropland, with livelihoods mainly relying on part-time and non-agricultural activities. In line with rural revitalization’s “industry prosperity” goal and targeted poverty alleviation’s focus on income increase, policy support should be strengthened in three aspects: First, improve non-agricultural employment guarantees. Integrate with rural revitalization industry projects (e.g., rural e-commerce, characteristic processing), carry out targeted skill training for NPFHs in service, manufacturing, and digital technologies, and establish government-enterprise cooperation mechanisms to expand stable non-agricultural employment channels, thereby reducing the need for CA due to low agricultural income. Second, optimize cropland transfer mechanisms. Rely on village collectives and cooperatives to standardize the transfer of cropland management rights, promote large-scale operation by professional teams, and ensure NPFHs obtain stable transfer income while liberating surplus labor. Third, implement “quantity-based monitoring” for cropland. Establish a dynamic monitoring system for cropland use, linked with rural revitalization

cropland protection policies, to timely warn and intervene in large-scale or long-term abandonment, ensuring the stability of cropland quantity.

(2) Consolidate poverty-alleviation achievements through quality improvement of cropland-dependent income for OPFHs. Their livelihoods are vulnerable, making rational cropland use critical for preventing a return to poverty. In line with targeted poverty alleviation's requirement of "consolidating achievements" and rural revitalization's "livelihood security", a multi-level protection mechanism should be built: First, strengthen technology and financial support. Provide OPFHs with preferential policies such as interest-free agricultural loans, agricultural insurance subsidies, and technical guidance on high-yield and eco-friendly planting (e.g., drought-resistant crops, organic fertilization), empowering agriculture through technology as advocated in rural revitalization. Second, upgrade cropland quality. Prioritize OPFHs' fragmented plots in high-standard cropland construction, improve irrigation and road facilities, reduce production costs through plot consolidation, and enhance cropland quality. Third, develop characteristic ecological agriculture. Support OPFHs in planting regional characteristic crops, establish "production-marketing integration" channels through consignment sales and brand building to increase agricultural added value, and promote eco-friendly practices such as crop rotation and green pest control to achieve ecological protection while stabilizing income, ensuring the effective use of cropland quality.

(3) Promote "three-in-one" cropland protection to optimize the utilization environment. Aiming at the core factor of cropland fragmentation affecting both groups, relevant departments should integrate rural revitalization policies to implement comprehensive improvement: In terms of quantity protection, carry out cross-regional cropland consolidation, merge fragmented plots, and strictly control non-agricultural conversion to maintain the total cropland area. In terms of quality improvement, accelerate the construction of high-standard cropland in mountainous areas, focus on improving soil fertility and anti-disaster capacity, and match with mechanized operation conditions to reduce production costs. In terms of ecological protection, combine cropland improvement with the "Grain for Green" project, retain ecological buffer zones in steep-slope cropland, promote water-saving irrigation and low-carbon fertilization technologies, and achieve ecological sustainability while ensuring production. By improving the cropland utilization environment from quantity, quality, and ecology, we can stabilize farmers' cropland income and consolidate food security.

4.4. Limitations and Future Directions

This study explores the differences in CA behavior and driving factors between OPFHs and NPFHs in Guizhou's mountainous areas, but some limitations need to be addressed in follow-up research. First, the research scope is limited to cross-sectional data analysis in specific counties of Guizhou, lacking long-term dynamic tracking of CA behavior. Guizhou's mountainous CA is affected by seasonal agricultural cycles, extreme weather, and periodic adjustments of provincial poverty alleviation policies, so short-term data cannot fully reflect the long-term evolution of abandonment behavior, especially the dynamic response of farmers' decision-making to policy changes (e.g., the impact of Guizhou's "rural revitalization industry fund" on non-agricultural income of NPFHs). Second, the analysis of interaction mechanisms between driving factors and regional characteristics is insufficient. The study identifies key factors such as cropland fragmentation and non-agricultural income, but fails to deeply discuss how Guizhou's unique karst terrain amplifies the negative impact of fragmentation on cropland utilization, which limits the explanation of the regional heterogeneity of CA in Guizhou. Third, the research perspective focuses on the micro household scale, with insufficient integration with

meso-level village governance and macro-level provincial policies. For example, the role of Guizhou's "village collective economic organizations" in coordinating cropland transfer, or the implementation effect of the province's "high-standard cropland construction special plan" in mountainous counties, has not been incorporated into the analysis framework, reducing the operability of policy recommendations.

Future research directions will focus on the following aspects. Introduce geospatial analysis methods to quantify the coupling effect between topographic factors (slope, altitude) and driving factors (e.g., cropland fragmentation $\times$ karst degree), and clarify the regional differentiation law of CA in Guizhou. Expand the research scale to integrate micro household surveys with meso data of village collectives and macro policy texts of Guizhou Province, and construct a "household-village-county" multi-scale analytical framework to discuss the interaction and coupling mechanism between the cropland use and the sustainable development of households in mountainous rural areas with heterogeneous farming households.

5. Conclusions

There are significant differences in CA behavior between farmers with different farming patterns in mountainous areas (OPFHs and NPFHs), which are mainly reflected in two aspects: farmer type and plot type. From the perspective of the farming households' structure, OPFHs are mainly engaged in agriculture, while NPFHs are deeply influenced by non-agricultural industries and part-time farming. In terms of abandoned plots, OPFHs are more dependent on cropland, while NPFHs have a lower dependence on cropland, showing the characteristics of a large number of abandoned plots, a large area, and simultaneous abandonment of paddy fields and drylands. In addition, with the increase in commuting distance, the proportion of CA of both types of farming households shows an upward trend. There are differences in the factors affecting the area of CA among different farmers in mountainous areas. The driving factors affecting the area of CA by OPFHs also include the average age of the labor force, the proportion of the resident population in the total household registration population, plot type, while the drivers affecting the area of CA by NPFHs also include per capita income, non-agricultural income, per capita cropland area, and commuting time. Through the research, we found that the differences in cropland use behavior and its driving factors between OPFHs and NPFHs show characteristics of diversity and interactivity, which should be adjusted through multi-dimensional regulation based on adhering to land transfer and moderate-scale operation. By comparing the research progress and the micro-scale driving factors of farmers with CA in other regions of China, we put forward countermeasures and suggestions based on the "three-in-one" protection of cropland.

Author Contributions: The co-authors together contributed to the completion of this article. Y.F. and D.F. conceived and designed this study; Y.F. and D.F. analyzed the data; J.L. validated the data; all the authors wrote the first drafts of this manuscript and alternatively commented and revised the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Natural Science Foundation of China (Grant No.42261044) and Guizhou University of Finance and Economics Innovation Exploration and Academic New Talent Project (2024XSXMA04).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are available from the authors upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Zheng, L.Y.; Jin, S.Q.; Su, L.F. Of nothing comes nothing: The impact of agricultural comparative return on cropland abandonment. *J. Rural Stud.* **2025**, *119*, 103759. [\[CrossRef\]](#)
2. Zuo, M.; Liu, G.; Jing, C.; Zhang, R.; Wang, X.; Mao, W.; Shen, L.; Dai, K.; Wu, X. Spatiotemporal Patterns and Driving Factors of Cropland Abandonment in Metropolitan Suburbs: A Case Study of Chengdu Directly Administered Zone, Tianfu New Area, Sichuan Province, China. *Land* **2025**, *14*, 1311. [\[CrossRef\]](#)
3. Patrick, M.; Florian, S.; Alexander, V.P.; Daniel, M.; Tobias, K. Drivers, constraints and trade-offs associated with recultivating abandoned cropland in Russia, Ukraine and Kazakhstan. *Glob. Environ. Change Hum. Policy Dimens.* **2016**, *37*, 1–15.
4. Li, J.; Feng, Y.; Gu, L. Telecoupling Effects among Provinces of Cultivated Land Grain Production in the Last 30 Years: Evidence from China. *Agriculture* **2024**, *14*, 1121. [\[CrossRef\]](#)
5. Liu, Y.S.; Li, X.H.; Guo, Y.Z. Exploring land system reform for demographic transition in rural China. *Land Use Policy* **2024**, *147*, 107355. [\[CrossRef\]](#)
6. Ma, L.; Long, H.; Tang, L.; Tu, S.; Zhang, Y.; Qu, Y. Analysis of the spatial variations of determinants of agricultural production efficiency in China. *Comput. Electron. Agric.* **2021**, *180*, 105890. [\[CrossRef\]](#)
7. Liang, X.Y.; Li, Y.B.; Zhou, Y.L. Study on the abandonment of sloping farmland in Fengjie County, Three Gorges Reservoir Area, a mountainous area in China. *Land Use Policy* **2020**, *97*, 104760. [\[CrossRef\]](#)
8. Hong, B.; Wang, J.; Xiao, J.; Yuan, Q.; Ren, P. Spatiotemporal Patterns and Determinants of Cropland Abandonment in Mountainous Regions of China: A Case Study of Sichuan Province. *Land* **2025**, *14*, 647. [\[CrossRef\]](#)
9. Li, X.; Ma, L.; Liu, X. Identification, Mechanism and Countermeasures of Cropland Abandonment in Northeast Guangdong Province. *Land* **2025**, *14*, 246. [\[CrossRef\]](#)
10. Guo, A.; Yue, W.; Yang, J.; Xue, B.; Xiao, W.; Li, M.; He, T.; Zhang, M.; Jin, X.; Zhou, Q. Cropland abandonment in China: Patterns, drivers, and implications for food security. *J. Clean. Prod.* **2023**, *418*, 138154. [\[CrossRef\]](#)
11. Chen, H.; Tan, Y.; Xiao, W.; Xu, S.; Xia, H.; Ding, G.; Xia, H. Spatiotemporal variation in determinants of cropland abandonment across Yangtze River Economic Belt, China. *Catena* **2024**, *245*, 108326. [\[CrossRef\]](#)
12. Tu, Y.; Wu, S.; Chen, B.; Weng, Q.; Bai, Y.; Yang, J.; Yu, L.; Xu, B. A 30 m Annual Cropland Dataset of China from 1986 to 2021. *Earth Syst. Sci. Data* **2024**, *16*, 2297–2318. [\[CrossRef\]](#)
13. Yang, L.; Liang, Y.; Tu, X. Identification and Spatial Pattern Analysis of Abandoned Farmland in Jiangxi Province of China Based on GF-1 Satellite Image and Object-Oriented Technology. *Front. Environ. Sci.* **2024**, *12*, 1423868. [\[CrossRef\]](#)
14. Ding, G.; Ding, M.; Xie, K.; Li, J. Driving Mechanisms of Cropland Abandonment from the Perspectives of Household and Topography in the Poyang Lake Region, China. *Land* **2022**, *11*, 939. [\[CrossRef\]](#)
15. Wang, J.; Wang, J.; Xiong, J.; Sun, M.; Ma, Y. Spatial-Temporal Characterization of Cropland Abandonment and Its Driving Mechanisms in the Karst Plateau in Eastern Yunnan, China, 2001–2020. *PLoS ONE* **2024**, *19*, e0307148. [\[CrossRef\]](#)
16. He, Y.; Xie, H.; Peng, C. Analyzing the Behavioural Mechanism of Farmland Abandonment in the Hilly Mountainous Areas in China from the Perspective of Farming Household Diversity. *Land Use Policy* **2020**, *99*, 104826. [\[CrossRef\]](#)
17. Wang, W.X.; Lan, Y.Q.; Wang, X. Impact of livelihood capital endowment on poverty alleviation of households under rural land consolidation. *Land Use Policy* **2021**, *109*, 105608. [\[CrossRef\]](#)
18. Zhang, D.L.; Wang, W.X.; Zhou, W.; Zhang, X.L.; Zuo, J. The effect on poverty alleviation and income increase of rural land consolidation in different models: A China study. *Land Use Policy* **2020**, *99*, 104989. [\[CrossRef\]](#)
19. Liu, Y.S.; Guo, Y.Z.; Zhou, Y. Poverty alleviation in rural China: Policy changes, future challenges and policy implications. *China Agric. Econ. Rev.* **2018**, *10*, 241–259. [\[CrossRef\]](#)
20. Guo, Y.Z.; Liu, Y.S. Poverty alleviation through land assetization and its implications for rural revitalization in China. *Land Use Policy* **2021**, *105*, 105418. [\[CrossRef\]](#)
21. Zhao, X.Y.; Liu, J.H.; Wang, W.J.; Lan, H.X.; Ma, P.Y.; Du, Y.X. Livelihood sustainability and livelihood intervention of out-of-poverty farming households in poor mountainous areas: A case of Longnan mountainous area. *Prog. Geogr.* **2020**, *39*, 982–995. [\[CrossRef\]](#)
22. Zhou, Y.; Guo, Y.Z.; Liu, Y.S.; Wu, W.X.; Li, Y.R. Targeted poverty alleviation and land policy innovation: Some practice and policy implications from China. *Land Use Policy* **2018**, *74*, 53–65. [\[CrossRef\]](#)
23. Liu, Y.S. Introduction to land use and rural sustainability in China. *Land Use Policy* **2018**, *74*, 1–4. [\[CrossRef\]](#)
24. Liu, Y.S.; Ou, C.; Liu, Y.Q.; Cao, Z.; Robinson, G.M.; Li, X. Unequal impacts of global urban-rural settlement construction on cropland and production over the past three decades. *Sci. Bull.* **2025**, *70*, 1699–1709. [\[CrossRef\]](#) [\[PubMed\]](#)
25. Chen, Z.; Yan, H.; Yang, C. A study on the impact of extreme weather on the poverty vulnerability of farming households—Evidence from six counties in the Hubei and Yunnan provinces of China. *Front. Environ. Sci.* **2022**, *10*, 942857. [\[CrossRef\]](#)
26. Xu, S.C.; Xiao, W.; Yu, C.; Chen, H.; Tan, Y.Z. Mapping Cropland Abandonment in Mountainous Areas in China Using the Google Earth Engine Platform. *Remote Sens.* **2023**, *15*, 1145. [\[CrossRef\]](#)

27. Zhao, Y.L.; Zhang, M.; Li, X.B.; Dong, S.Z.; Huang, D.K. Farmland marginalization and policy implications in mountainous areas: A case study of Renhuai City, Guizhou. *J. Resour. Ecol.* **2016**, *7*, 61–67. [\[CrossRef\]](#)
28. Luo, X.; Tong, Z.; Xie, Y.; An, R.; Yang, Z.; Liu, Y. Land Use Change under Population Migration and Its Implications for Human–Land Relationship. *Land* **2022**, *11*, 934. [\[CrossRef\]](#)
29. Dang, A.N.; Kawasaki, A. A review of methodological integration in land-use Change models. *Int. J. Agric. Environ. Inf. Syst.* **2016**, *7*, 1–25. [\[CrossRef\]](#)
30. Chen, Q.; Xie, H.; Zhai, Q. Management Policy of Farmers’ CA Behavior Based on Evolutionary Game and Simulation Analysis. *Land* **2022**, *11*, 336. [\[CrossRef\]](#)
31. Terres, J.-M.; Scacchiafichi, L.N.; Wania, A.; Ambar, M.; Anguiano, E.; Buckwell, A.; Coppola, A.; Gocht, A.; Källström, H.N.; Pointereau, P.; et al. Farmland abandonment in Europe: Identification of drivers and indicators, and development of a composite indicator of risk. *Land Use Policy* **2015**, *49*, 20–34. [\[CrossRef\]](#)
32. Zhang, Y.; Li, X.B.; Song, W. Determinants of cropland abandonment at the parcel, household and village levels in mountain areas of China: A multi-level analysis. *Land Use Policy* **2014**, *41*, 186–192. [\[CrossRef\]](#)
33. Li, F.Q.; Xie, H.L.; Zhou, Z.H. Factors Influencing Farmland Abandonment at the Village Scale: Qualitative Comparative Analysis (QCA). *J. Resour. Ecol.* **2021**, *12*, 241–253. [\[CrossRef\]](#)
34. Paul, E. The relation of Marx’s humanist political economy to ideas of ‘divinity’ and humanity found in Plato and Aristotle. *Int. Rev. Econ.* **2016**, *1*, 31–49.
35. Goncharko, O.Y. Dialectic after Plato and Aristotle. *Hist. Philos. Log.* **2022**, *43*, 96–101. [\[CrossRef\]](#)
36. Neri, S.; Rodolfo, S. Defense versus Opulence? An Appraisal of the Malthus-Ricardo 1815 Controversy on the Corn Laws. *Hist. Polit. Econ.* **2015**, *47*, 151–184.
37. Johanna, H.; Maria, H. Knowledge rationales in human geography: Economic, policy, empowerment, and methodological. *Norsk. Geogr. Tidsskr.* **2017**, *71*, 269–287.
38. Wu, C.J. The core of study of geography: Man-land relationship areal system. *Econ. Geogr.* **1991**, *11*, 1–6.
39. Wang, J.; Chen, Y.; Liu, Z.; Liu, X.; Li, X. An in-depth multiscale analysis of farmland abandonment and recultivation dynamics in the Yangtze River Delta, China: A landscape ecology perspective empowered by google earth engine. *Environ. Sustain. Indic.* **2024**, *24*, 100541. [\[CrossRef\]](#)
40. Bi, G.H.; Yang, Q.Y. The spatial production of rural settlements as rural homestays in the context of rural revitalization: Evidence from a rural tourism experiment in a Chinese village. *Land Use Policy* **2023**, *128*, 106600. [\[CrossRef\]](#)
41. Tu, S.W. The Organic Integration of Poverty Alleviation and Rural Revitalization Strategies: Goal Orientation, Key Areas and Measures. *Chin. Rural. Econ.* **2020**, *8*, 2–12.
42. Chen, L.L.; Meadows, M.E.; Liu, Y.; Lin, Y.L. Examining pathways linking rural labour outflows to the abandonment of arable land in China. *Popul. Space Place* **2021**, *28*, e2519. [\[CrossRef\]](#)
43. Cheng, Y.; Hu, Y.; Zeng, W.Z.; Liu, Z.B. Farmer Heterogeneity and Land Transfer Decisions Based on the Dual Perspectives of Economic Endowment and Land Endowment. *Land* **2022**, *11*, 353. [\[CrossRef\]](#)
44. Ghazali, S.; Zibaei, M.; Azadi, H. Impact of livelihood strategies and capitals on rangeland sustainability and nomads’ poverty: A counterfactual analysis in Southwest Iran. *Ecol. Econ.* **2023**, *206*, 107738. [\[CrossRef\]](#)
45. Coulibaly, B.; Li, S. Impact of Agricultural Land Loss on Rural Livelihoods in Peri-Urban Areas: Empirical Evidence from Sebougou, Mali. *Land* **2020**, *9*, 470. [\[CrossRef\]](#)
46. Shi, T.; Li, X.; Xin, L.; Xu, X. Analysis of Farmland Abandonment at Parcel Level: A Case Study in the Mountainous Area of China. *Sustainability* **2016**, *8*, 988. [\[CrossRef\]](#)
47. Yan, J.; Yang, Z.; Li, Z.; Li, X.; Xin, L.; Sun, L. Drivers of Cropland Abandonment in Mountainous Areas: A Household Decision Model on Farming Scale in Southwest China. *Land Use Policy* **2016**, *57*, 459–469. [\[CrossRef\]](#)
48. Yang, H.; Huang, K.; Deng, X.; Xu, D. Livelihood Capital and Land Transfer of Different Types of Farmers: Evidence from Panel Data in Sichuan Province, China. *Land* **2021**, *10*, 532. [\[CrossRef\]](#)
49. Baek, S.; Yoon, H.; Hahm, Y. Assessment of spatial interactions in farmland abandonment: A case study of Gwangyang City, Jeollanam-do Province, South Korea. *Habitat Int.* **2022**, *129*, 102670. [\[CrossRef\]](#)
50. Pu, L.M. Impact of cropland use changes based on non-agriculturalization, non-grainization and abandonment on grain potential production in Northeast China. *Sci. Rep.-UK* **2025**, *15*, 23596. [\[CrossRef\]](#)
51. Liu, J.M.; Zhou, X.; Hou, X.H. Does a Migrant Relocation Program Aggravate Cropland Abandonment? A Case Study on Pingli County, China. *Land* **2025**, *14*, 518. [\[CrossRef\]](#)
52. Chen, M.; Han, Q.; Zhang, C.; Chen, J. Valuing the effect of Capital goes to countryside on cropland abandonment: Evidence from rural China. *Habitat Int.* **2025**, *156*, 103299. [\[CrossRef\]](#)
53. Song, H.; Li, X.; Xin, L.; Dong, S.; Wang, X. Conflicts between ecological and agricultural production functions: The impact of the Grain for Green Program and wildlife damage on cropland abandonment in China’s mountainous areas. *Land Use Policy* **2025**, *153*, 107552. [\[CrossRef\]](#)

54. Crawford, C.L.; Wiebe, C.A.; Yin, H.; Radeloff, V.C.; Wilcove, D.S. Biodiversity consequences of cropland abandonment. *Nat. Sustain.* **2024**, *7*, 1596–1607. [[CrossRef](#)]
55. Li, S.F.; Li, X.B. Global understanding of farmland abandonment: A review and prospects. *J. Geogr. Sci.* **2017**, *27*, 1123–1150. [[CrossRef](#)]
56. Luo, X.; Zhang, Z.; Lu, X.H. Topographic heterogeneity, rural labour transfer and cultivated land use: An empirical study of plain and low-hill areas in China. *Pap. Reg. Sci.* **2019**, *98*, 2157–2178. [[CrossRef](#)]
57. Wang, G.; Liao, H.P.; Wen, T. Causes Differentiation Mechanism and Regulation of Farmland Abandonment in Villages of Nanchuan District, Chongqing. *Acta Geogr. Sin.* **2024**, *79*, 1824–1841. [[CrossRef](#)]
58. Tang, H.; Liang, L.-J.; He, H.-F.; Liu, Y.-Q. Impact of Agricultural Socialized Services and Cultivated Land Fragmentation on Farmland Abandonment. *J. Nat. Resour.* **2024**, *39*, 2171–2187. [[CrossRef](#)]
59. Hong, C.Q.; Prishchepov, A.V.; Bavorova, M. Cropland Abandonment in Mountainous China: Patterns and Determinants at Multiple Scales and Policy Implications. *Land Use Policy* **2024**, *145*, 107292. [[CrossRef](#)]
60. Li, S.; Li, X.; Xin, L.; Tan, M.; Wang, X.; Wang, R.; Jiang, M.; Wang, Y. Extent and Distribution of Cropland Abandonment in Chinese Mountainous Areas. *Resour. Sci.* **2017**, *39*, 1801–1811. [[CrossRef](#)]
61. Zhou, T.; Koomen, E.; Ke, X.L. Determinants of Farmland Abandonment on the Urban-Rural Fringe. *Environ. Manag.* **2020**, *65*, 369–384. [[CrossRef](#)]
62. Xie, H.; Ouyang, Z.; Liu, W.; He, Y. Impact of Farmer Differentiation on Farmland Abandonment: Evidence from Fujian's Hilly Mountains, China. *J. Rural Stud.* **2025**, *113*, 103494. [[CrossRef](#)]

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