


## Article

# An Estimation of the Extent of Rent-Free Farmland Transfer and Its Driving Forces in Rural China: A Multilevel Logit Model Analysis

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**Abstract:** In recent years, the rent-free farmland transfer has become increasingly prominent in rural China. By employing multiple data sources, this study estimates the extent of rent-free land transfer from 1986 to 2015 and develops a multilevel logit model to identify its drivers. The results show that the extent of rent-free land transfer has been increasing, especially since 2002, and 30% to 50% of the land that has been transferred does not receive any rent, both in terms of the number of land parcels and the land area. There are obvious regional differences for the rent-free phenomenon in the process of land transfer, especially in mountainous areas, where the proportion is more than 70%. The cost-benefit analysis at the land parcel level shows that the average net income of rent-free land per mu that has been transferred (1 mu = 1/15 ha) is at a loss of 66 yuan, at 35 yuan. The rent-free land transfer is affected by factors at the levels of the land parcel, farmer and village. The land parcel size, quality level and irrigation condition are the key factors at the land parcel level; the ratio of the non-agricultural income in the family and land fragmentation are the key factors at the farmer level, and the inter-village gap is the key factor at the village level. The land parcel features account for approximately 40% of the variation in the rent-free land transfer. In sum, the increase in the labour cost is the direct reason for the rent-free land transfer, and land parcel features and the marginalization of mountainous areas are the preconditions for the rent-free land transfer. A rent-free land transfer is reasonable to some extent, but it is not an informal land transfer, and land rent does not play an effective role in allocating land resources. In this process, the idle or abandoned land resources in mountainous areas become relatively rich. The government should reasonably introduce urban capital and fully tap relatively rich land resources to realize the land capital appreciation and develop the local economy, and it should further regulate the land rental market and lay an emphasis on the integration of land resources, while moderating scale operations in mountainous areas.

**Keywords:** rent-free farmland transfer; informal land transfer; driving forces; multilevel logit model; rural China

## 1. Introduction

It is well known that China feeds more than 20% of the world's population with only 9% of the world's cultivated land [1]. China is far from self-sufficient in food production, and how to improve grain yield and farmland productivity is still the primary concern of the country [2]. But most Chinese farms are less than 10 mu. There is a clear need to expand the size of farms to take advantage of

mechanization. In reality, for nearly 20 years, the Chinese government has been taking a series of measures aimed at expanding the scale of agricultural land management. The Rural Land Contract Law (RLCL), passed in 2002, stipulates that when land contractual management rights are subcontracted, leased and transferred, both parties shall sign a written contract and stipulate the term, price and payment method and liability for breach of contract for the transfer in rural China. In 2014, the General Office of the State Council issued the opinions on guiding the healthy development of the rural land use rights transaction market, aimed at promoting the open, fair and standardized operation of the transfer and transaction for rural land use rights [3]. Thereafter, in July 2016, the Ministry of Agriculture issued the regulations on the operation of the rural land management rights transfer market, with a special emphasis on the norms for guaranteeing the transfer of land management rights, requiring the transfer parties to sign a written contract and stipulate the price, land use and contractual responsibility for violating land contract law [4,5]. This shows that China has actively promoted the standardized operation of the rural land rental market from the perspective of a top-level design.

However, informal land transfer is still prevalent in rural China [6,7]. A survey of 17 provinces shows that 70% of farmland transfers have not involved a signed transfer contract, 52% have not stipulated the transfer term and 39% have not paid rent; that is, they represent a rent-free land transfer [8]. Another study conducted in Jiangsu, Hubei, Heilongjiang and Guangxi Provinces suggests that more than 30% of farmland has been transferred without any rent [9]. Furthermore, there are significant differences in the proportion of rent-free land transfers in different terrains, among which approximately 40% is in plain areas and 60% in mountainous areas [10]. In 2015, the proportion of rent-free land transfers in typical mountainous areas exceeded 70%, such as in Chongqing City [10]. Nowadays, informal land transfer, especially rent-free land transfer, is particularly prominent, and it is an expression of the imperfect development and imperfection of the land rental market [11]. How large is the extent of land transfer without rent in rural China and why does the phenomenon of rent-free land transfer exist widely?

In the past, it has been reported that 50% of the output of the land tenancy system was usually used as the land rent before the 20th century [12]. From 1900 to 1920, the quota rent in physical form was adopted in most regions, and the land rent was 50% of the output. In the period of the Republic of China, the study on land rent in 22 provinces showed that land rent decreased with the decrease in the land quality grade; the minimum rent was not under 25% of the land output, and the maximum reached 69%. In the pre-liberation period, approximately 30% of the output was taken as the land rent in land leasing. In the historical period, land rent occupied a relatively high proportion and the phenomenon of rent-free land transfers was extremely rare [12,13]. Therefore, it is necessary to estimate the extent of rent-free land transfer and identify its drivers to understand the informality and development of the land rental market in rural China.

In fact, the phenomenon of rent-free land transfers has been explained from two aspects. First, the acquaintance-based rural society can explain the phenomenon, as some scholars have noted that about 70% of land transfers without rent occur between relatives or acquaintances [14]. To pursue the security of land contract rights, farmers usually transfer land out to relatives or acquaintances with little or no rent. If the acquaintance society can explain the rent-free land transfer, farmers have had a strong acquaintance society since ancient times in China [10,15]. Why was land transferred for a higher rent in some historical periods, even if the land was transferred to relatives? In the early 20th century, a survey in northern China showed that, although landlords gave priority to the lease of land to relatives, the land rent was not reduced. This shows that the acquaintance society cannot convincingly explain the phenomenon of rent-free land transfers [16]. Second, human rent can explain the phenomenon of rent-free transfers; that is, the hidden human rent replaces the monetary rent [14]. A survey on different agricultural regions and mountainous counties conducted by the Chinese Academy of Sciences found that 70% of land without rent was transferred between relatives or acquaintances and that there was human contact in daily life or during festivals. However, about 30% of land transfers without rent occur between unfamiliar smallholders, family farms and agribusinesses. Human rent can explain the

phenomenon of rent-free land transfer between relatives, but the phenomenon between strangers still cannot be explained. Therefore, the variation of rent-free land transfers can be explained by human rent only to a limited extent.

Nowadays, the rent-free land transfer is a means of land use for farmers and is often influenced by multilevel factors such as land resource endowment, household characteristics, the macroeconomic situation and policy [17–19]. Therefore, it is necessary to analyse the causes of the rent-free phenomenon in the land transfer process from a systematic and multilevel perspective. In view of this, this study estimates the extent of land transfer without rent by employing different data sources, such as the Rural Permanent Observation Sites Survey (RPOS) from 1986 to 2015, the Chinese Household Income Project (CHIP) in 2013, sampling survey data of farmers in different agricultural regions and typical mountainous areas, and a multilevel logit model that is developed to identify the driving factors of rent-free land transfer, thereby providing scientific judgement for the development of the land rental market.

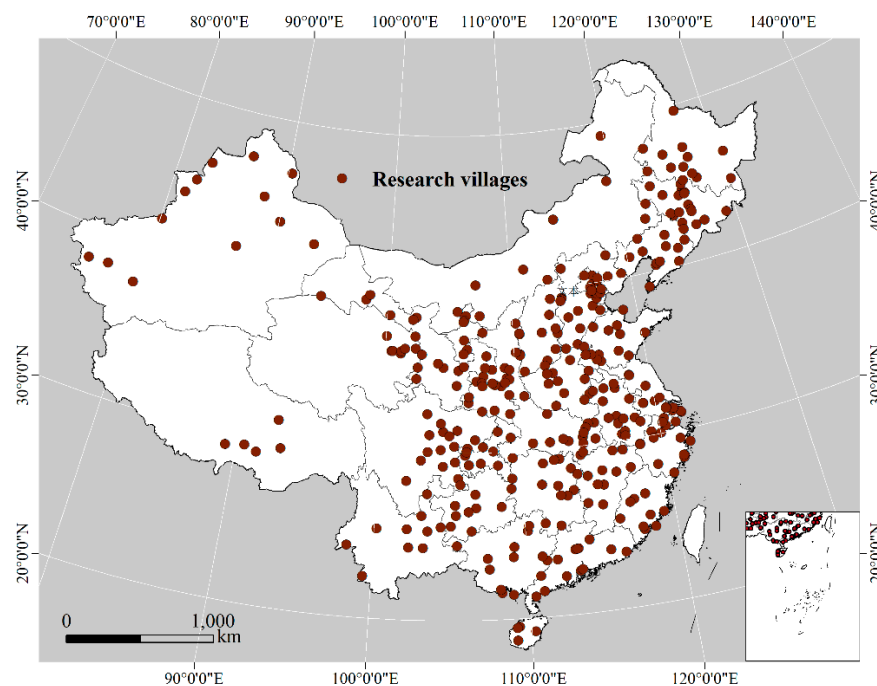
## 2. Materials and Methods

### 2.1. Data

#### 2.1.1. Rural Permanent Observation Sites Survey

These data come from the database of the RPOS (<http://www.rcrc.agri.cn/>), which is investigated and managed by the rural economic research centre of the Ministry of Agriculture [10]. Since 1986, a nationwide tracking survey of rural households has been carried out, and the database has three distinct characteristics.

First, the samples are widely distributed and deeply representative. The database has covered more than 360 villages (Figure 1), distributed in nearly 300 counties in 31 provinces in mainland China since 1986. The abovementioned villages are sampled according to the characteristics of the topography, economic development level, agricultural operation type and geographical location, and the rural samples from the whole country are highly representative. Second, the sample size is large enough. The survey conducted the sampling according to the population size and land scale of each region. The total of 602,926 effective households were surveyed from 1986 to 2015, representing an average annual of 20,000 households. Once the surveyed villages and farm households are confirmed, they are not replaced in principle. However, considering population migration or agricultural restructuring, some samples that are not representative are eventually replaced. Third, research indicators are relatively rich. The village questionnaire and household questionnaire are included in the database. The village questionnaire covers information on the village economic status, labour force employment, land transfer, collective assets, agricultural operation and social development. The household questionnaire covers information on family members, land management, geographical location, family assets, and family income and expenditure. Importantly, the household questionnaire also records the scale, rent, term and object of land transfers in detail, which provides data support for this study. The database is mainly used to estimate the extent of rent-free land transfers in rural China over the past 30 years.



**Figure 1.** Distribution of sample villages in the Rural Permanent Observation Sites

### 2.1.2. Chinese Household Income Project

This data set comes from the fifth round of the national household income survey released by the China Institute for Income Distribution (<http://www.ciidbnu.org/>) in May 2016, with the assistance of the National Bureau of Statistics [20]. The sample covers 234 counties distributed in 15 provinces, covering a total of 18,948 domestic households and 64,777 family members, including 11,013 rural households, 7175 urban households and 760 immigrant households. In this study, rural household samples include information on demographics, agricultural operations, income and expenditure, land transfer and other aspects, and the whereabouts, scale and rent of the land transfer are recorded in detail. The samples were cleared up before the analysis due to the artificial statistical bias in the original data. First, these households without cultivated land were excluded. Second, samples with negative indicators, such as the number of family members and ages, were excluded. Third, the samples missing important indicators were removed. In the end, 8051 effective samples were distributed in 14 provinces across the country, with significant differences in the resource endowment and economic development level. This set of data is mainly used to estimate the extent of rent-free land transfers in different provinces.

### 2.1.3. Survey Data of Different Agricultural Regions

In terms of the utility pattern of farmland, this paper divides agriculture into four types, including urban agriculture, intensive agriculture, plain field agriculture and mountain agriculture. Urban agriculture refers to the modern agriculture that arises in the suburbs of large-sized cities to serve the needs of urban development, such as leisure and sightseeing agriculture. This paper selects the Daxing, Shunyi and Tongzhou Districts of Beijing City as representative of urban agriculture because these areas have been known as the vegetable basket of Beijing. The value of farmland utilization is relatively prominent in these areas, and it can represent the use of cultivated land around cities. Intensive agriculture refers to the increase in labour and production materials and the use of advanced technical means and management methods to increase the output per unit of farmland, such as greenhouse vegetables. Shouguang City, Qingzhou City and Changle County of Shandong Province are selected as representative of intensive agriculture because these areas are mainly engaged in cultivating greenhouse vegetables and fruits. Plain field agriculture refers to the agriculture of staple

grain crops grown in plain areas, such as the Jiangnan Plain and the North China Plain. Jianli County and Honghu City in Hubei Province are selected because both are located in the Jiangnan Plain and belong to the major grain producing areas; thus, they can represent the land use patterns of the major grain-producing areas in the plain areas. Mountain agriculture refers to farming in mountainous areas, such as corn, sweet potatoes and rice. Wulong District and Youyang County of Chongqing City are selected because both are typical mountainous areas in the southwest and can represent the land use pattern in mountainous areas.

From July to October 2018, the research team conducted a field survey in Beijing, Shandong, Hubei and Chongqing, involving 1025 households distributed in 84 villages from 10 counties (Table 1). The contents of the questionnaire include information on agricultural operation, labour mobility, land transfer, income and expenditure, among which detailed land transfer information includes the scale, rent, payment method, time limit, daily exchange and liability for a breach of contract. This data is used to estimate the extent of rent-free land transfers in different agricultural regions.

**Table 1.** Basic information of households in case study areas.

Agricultural Type	Case Regions	Village	Household	Effective Households	Effective Rate (%)
urban agriculture	Daxing, Tongzhou and Shunyi District	23	234	204	87.18
intensive agriculture	Shouguang, Qingzhou, Changle City	19	202	172	85.15
plain field agriculture	Jianli County and Honghu City	24	287	257	89.55
mountain agriculture	Wulong District and Youyang County	18	302	272	90.07
total sample	-	84	1025	905	88.29

Note: The data was from the field investigation and compiled by the author.

#### 2.1.4. Survey Data of Typical Mountainous Areas

These data come from a field survey of typical mountainous areas conducted by the Chinese Academy of Sciences and Southwest University. The field investigations on farm households were conducted in July 2014 and October 2018. In 2014, the group surveyed Yongchuan District and Zhongxian County of Chongqing City, selecting towns with a relatively high proportion of land transfer as the unit and then randomly extracting 2–3 villages in each township and 10–30 households from each village. The householders are mainly respondents, and other members in the family provided assistance, with a total of 291 farm households. Using the same sampling method, the total number of questionnaires collected from farmers in Wulong District and Youyang County of Chongqing City in 2018 was 302. The proportions of land transfer and land abandonment in the four counties are relatively high, which is deeply representative of mountainous areas.

There are significant differences in the two sets of questionnaires. In 2014, the questionnaire focused on land use, family livelihood and ecological environment, but the survey in 2018 was rich in land parcel features, demography, geographical location, agricultural operations, land transfer, income and expenditure. Importantly, the scale of the land parcel and rent, payment method and liability for a breach of contract were included. The samples were sorted to avoid the possibility of a statistical bias before an empirical analysis. First, the samples without farmland were removed. Second, the samples whose effective labour force is larger than the total population in the family were excluded. Third,

the samples with 0 or 100% agricultural or non-agricultural income, except when the family owns a part-time business, were excluded. Finally, the samples missing important indicators were excluded. There were 262 and 272 valid samples in 2014 and 2018, and the effective rate of the questionnaires was 90% and 90.1%, respectively. The data of the two periods are used to reveal the extent of rent-free land transfer in mountainous areas. In addition, the data in 2018 is used to identify the influencing factors of rent-free land transfers.

## 2.2. Methods

### 2.2.1. Calculation of the Proportion of Rent-Free Land Transfer

The proportion of rent-free land transfer indicates the ratio of the land size that has been transferred and has not received any rent in the total land size that has been transferred. This study estimates the extent of the rent-free land transfer from the perspectives of the number of households, land parcels and land area.

#### (1) Proportion of rent-free land transfer based on the number of farm households.

This ratio refers to the number of households that transferred out land without rent from the total number of households that transferred out land. The formula is as follows:

$$r_1 = N_{0,fm} / N_{t,fm} \quad (1)$$

where  $r_1$  represents the proportion of rent-free land transfer calculated by the number of farm households,  $N_{0,fm}$  represents the number of farmers who transferred out land without rent, and  $N_{t,fm}$  represents the total number of farmers who transferred out land.

#### (2) Proportion of rent-free land transfer based on the land area.

The ratio refers to the land area that has been transferred out and that has not received any rent divided by the total land area that has been transferred. The formula is as follows:

$$r_2 = S_0 / S_t \quad (2)$$

where  $r_2$  represents the proportion of rent-free land transfer calculated according to the land area,  $S_0$  is the area of transferred land without rent, and  $S_t$  is the total area of the transferred land.

#### (3) Proportion of rent-free land transfer based on the number of land parcels.

The ratio refers to the number of land parcels transferred without rent divided by the total number of land parcels that are transferred. The formula is as follows:

$$r_3 = N_0 / N_t \quad (3)$$

where  $r_3$  represents the proportion of rent-free land transfer calculated by the number of land parcels,  $N_0$  represents the number of land parcels transferred without rent, and  $N_t$  represents the total number of land parcels transferred out.

### 2.2.2. Calculation of Net Income from Farmland

The net income from farmland is equal to the sum of the net income of all kinds of crops planted on the land per unit area. The net income of crops can be calculated by subtracting the cost of each input from the total output value of agricultural products [15,21,22]. The formula is as follows:

$$\pi = R - I_l - I_s - I_p - I_w - I_{f1} - I_i - I_h - I_{f2} - I_o \quad (4)$$



where  $\pi$  is the average net income of the cultivated land per mu,  $R$  represents the average output value per mu, including the main output value and the by-product value, and  $l$  represents the labour cost per mu, including discounts on the household labour and employment cost. The number of labourers refers to the number of days that family members and employees devoted to agricultural production and is measured by the average labour standard of 8 h. The average labour standard is estimated by the following methods [23]. (1) Labourers who can adapt to a moderate labour intensity are 18 to 50 years old for men and 18 to 45 years old for women. (2) Labourers outside the abovementioned age groups can often participate in labour, and their labour capacity and intensity are equivalent to those of the average labour force. If the labour capacity and intensity are insufficient, the coefficient conversion should be handled in terms of the actual situation. (3) Employees are treated as an average labour force. The number of labourers per mu is equal to the total labour hours of the average labour force divided by 8 h, and the wages of the labourers are reversed by the wages of the employees and then back to obtain the average labour cost per mu.  $I_s$ ,  $I_p$ ,  $I_w$ ,  $I_{f1}$ ,  $I_i$ ,  $I_h$ ,  $I_{f2}$  and  $I_o$  represent the costs for seeds, insecticides, herbicide, fertilizer, irrigation and ploughing, harvesting, mulching and other related costs, which are calculated based on the actual investment in the process of crop cultivation, in units of yuan per mu.

### 2.2.3. Empirical Analysis of the Determinants of Rent-Free Land Transfer

Household land use behaviours are usually affected by many factors, such as the land resource endowment, family characteristics and regional economic development, which are subordinated to different levels of land parcels, farmers and villages [18]. The data have the characteristics of intra-group homogeneity and inter-group heterogeneity, which does not accord with the assumptions of the sample independence, normal distribution and homoscedasticity of the traditional statistical model. The multilevel model decomposes the random error term in the traditional model to the level corresponding to the data hierarchical structure, so that the individual random error meets the abovementioned assumption and is an effective method for processing the multilevel data [19,24]. Based on the above reasoning, this paper proposes the following research hypothesis:

- (1) Rent-free land transfer as a land use behavior for farmers is not only affected by the land quality, land scale, and irrigation condition but may also be affected by the characteristics of the farm households and regional economic development.
- (2) The characteristics of the land parcel is the most important factor that affects the rent-free land transfer.
- (3) The proportion of the land with a higher quality and larger scale to be transferred in the rent-free form is lower.

Therefore, it is necessary to develop a multilevel logit model to simulate and identify the key factors that affect rent-free land transfer for farmers. For the sake of simplification, this study analyses only the situation of land that has been transferred out, and the dependent variable is whether the farmland is transferred out for rent. When rent is not obtained, the value is 1, and when the opposite is true, the value is 0. The multilevel logit model is set as follows:

$$\log \left( \frac{p_{ijk}}{1-p_{ijk}} \right) = \gamma_{000} + \sum_{n=1}^N \alpha_{n00} X_{nijk} + \sum_{p=1}^P \beta_{p00} Y_{pjk} + \sum_{q=1}^Q \delta_{00q} Z_{qk} + r_0 + \mu_{00} \quad (5)$$

where  $p$  is the probability that the dependent variable is equal to 1, and  $1 - p$  is the probability that the dependent variable is equal to 0. The subscripts  $i$ ,  $j$  and  $k$  represent the codes of the land parcel, farmer and village, respectively.  $\gamma_{000}$  is the fixed intercept;  $r_0$  and  $\mu_{00}$  represent the random intercepts at the levels of the farmer and the village, which are consistent with the hypothesis of a random distribution and mean value of 0.  $X$ ,  $Y$ ,  $Z$  and  $\alpha$ ,  $\beta$ ,  $\delta$  represent the independent variables and parameters to be estimated at the levels of the land parcel, farmer and village, respectively. Table 2 presents the

definitions and descriptive statistics of the variables required for the model. The cross-level correlation coefficient is mainly used to measure the interaction between different levels, and in most studies, it is used to evaluate the interpretation degree of the overall variation of the dependent variables at different levels [22].

$$\rho_2 = \frac{Var(r_0)}{Var(r_0) + Var(\mu_{00}) + \pi^2/3} \quad (6)$$

$$\rho_3 = \frac{Var(\mu_{00})}{Var(r_0) + Var(\mu_{00}) + \pi^2/3} \quad (7)$$

where  $\rho_2$  and  $\rho_3$  represent the cross-correlation coefficient of the farmers and the villages.  $Var(r_0)$  and  $Var(\mu_{00})$  represent the variance of the random intercept of the farmer level and the village level, and  $\pi^2/3$  is the residual of the land parcel level.

**Table 2.** Variable definitions and descriptive statistics.

Variable	Definition	Mean	S. D
<b>Dependent variable</b>			
Whether rent-free transfer out farmland	Rent-free land transfer = 1, otherwise = 0	0.69	0.45
<b>Land parcel level (N = 325)</b>			
Land parcel area	The actual planting area of the land parcel (mu)	1.71	3.41
Distance to homestead	Distance between the land parcel and homestead (m)	779	821
Quality level	First-class = 5, second-class = 4, third-class = 3, fourth-class = 2, fifth and other class = 1	3.23	0.87
Irrigation condition	Surface water = 3, only groundwater = 2, no = 1	1.99	0.7
Is connected with transferee's land parcel	Connected = 1, not connected = 0	0.73	0.45
<b>Household level (N = 241)</b>			
Householder's age	Actual age of the householder (years old)	58.99	12.32
Householder's gender	Male = 1, female = 0	0.91	0.29
Householder's education level	Education years of householders (years)	7.48	3.15
Ratio of farmers' non-agricultural income	Ratio of farmers' non-agricultural income to total income	0.62	0.37
Dependency ratio	Number of people not participating in the labor divide by number of people participating in labor	0.86	1.02
Land fragmentation	Total number of planted plots divided by total area of cultivated land	0.68	0.43
Amount of household productive assets	Total value of productive assets (yuan)	9711	38,608
<b>Village level (N = 26)</b>			
Ratio of the number of farmers that transferred out land to transferred into	Number of households transferred out land divided by number of households transferred into land	1.56	1.77
Distance from the village to the centre of the county	The shortest distance between the village and the centre county (km)	24.53	12.19
Net income per capita in village	Annual net income per capita in the village (yuan per year)	11,168	5276



Table 2 shows the characteristics of the land parcels, household and village. First, concerning the land parcel features, the average area of land parcels is 1.71 mu; 62% of the land parcels are smaller than 1 mu and fewer than 2% of the land parcels are larger than 10 mu. The average distance of the land parcel to home is 779 metres, among which 61% are under 500 metres away from home, and about 20% are more than 1000 metres away. The average quality grade of the land parcels is third class, and the land parcels of the first class, second class, third class, fourth class, and fifth class and other classes account for 24%, 25%, 20%, 16% and 15%, respectively. The number of land parcels that can be irrigated with surface water account for 11%, and more than 70% are irrigated without water. Second, concerning the farmers' characteristics, the householders are close to 60 years old, on average, and most have not graduated from junior high school. The dependency ratio is 0.86; that is, one labourer in the family needs to support 0.86 non-labourers. Third, for the village characteristics, the ratio of the number of households that transferred out land to the number of households that transferred into land in the village (1.56) is greater than 1, indicating that the increasing cultivated land is concentrated in fewer households. In addition, the distance between the village and the county centre is generally close to 25 km.

### 3. Extent and Characteristics of Rent-Free Land Transfer

#### 3.1. Extent of Rent-Free Land Transfer in Rural China

Figure 2 shows the extent of rent-free land transfer in the whole country from 1986 to 2015. The results show that the proportion of rent-free land transfer was small, generally less than 10%, for both the statistics from the number of farmers and the land area before 1991. After 1991, the proportion rapidly increased, and it reached 48.7% based on the number of farmers in 2002. Since then, the proportion has ranged from 40% to 50%, reaching a maximum of 52.6% in 2015. Meanwhile, according to the statistics of the land area, the proportion of rent-free land transfer has similar characteristics; that is, the proportion was low at the early stages and then showed a rapid rising trend. It was in the range of 30% to 40% after 2002 and rose to 43.2% in 2015.

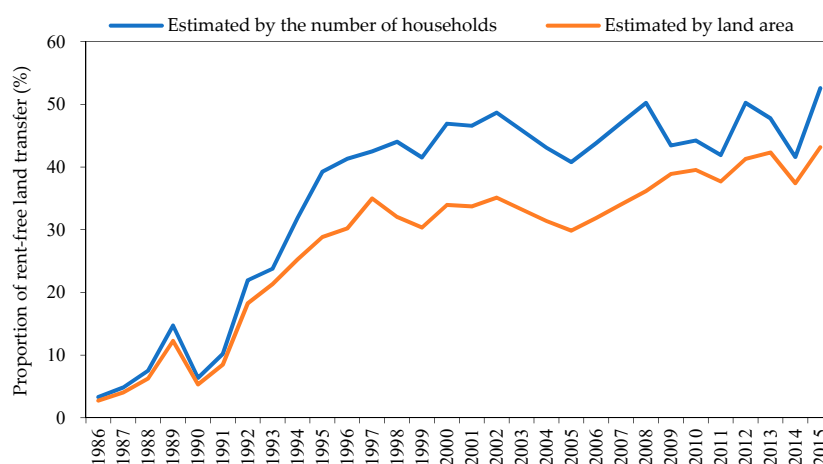
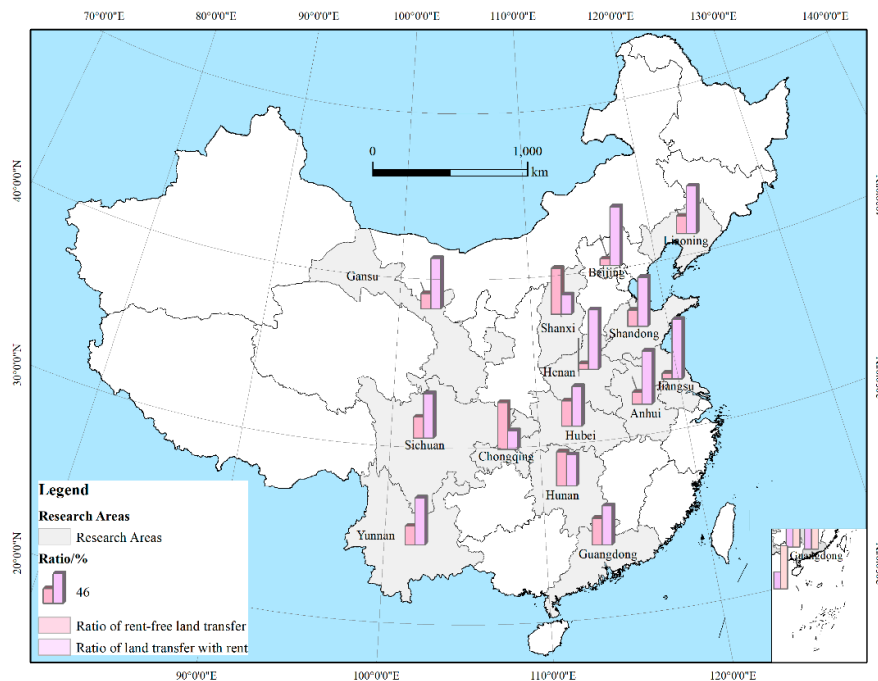


Figure 2. Proportion of rent-free land transfer from 1986 to 2015.

Figure 3 shows the proportion of rent-free land transfer in 14 provinces based on CHIP in 2013. According to statistics of the land area, 38.7% of the farmland that has been transferred is rent-free. Specifically, there is a significant difference in the proportion of rent-free land transfer among different provinces. The proportion in mountainous provinces, such as Chongqing City, Shanxi and Hunan Provinces, are generally higher, representing more than 70% in Chongqing and Shanxi. In contrast, the proportion in plain provinces, such as Henan, Jiangsu and Shandong, are relatively low and generally less than 20%, representing less than 10% in Henan and Jiangsu. In addition, the proportion of most provinces is between 20% and 50%.

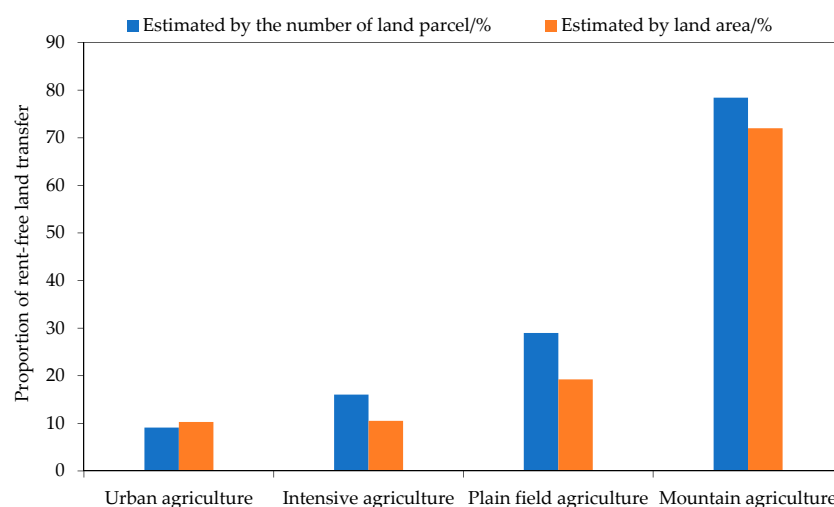
The rent-free phenomenon in the land transfer process has been relatively common in recent years, especially after 2002. The proportion of rent-free land transfer is between 20% and 50%, regardless of the statistics from the number of households or land area. Generally, the proportion is relatively low in plain provinces, while it is generally higher in mountainous provinces, and the proportion in some provinces has exceeded 70%.



**Figure 3.** Proportion of rent-free land transfer in different provinces (estimated by land area).

### 3.2. Extent of Rent-Free Land Transfer in Different Agricultural Regions

Figure 4 shows the proportion of rent-free land transfer in different agricultural regions. The results show there are significant differences in the proportions of rent-free land transfer in different agricultural regions. According to the statistics of the land parcel area, the proportions of rent-free land transfer in urban agriculture, intensive agriculture, plain field agriculture and mountain agriculture are 10.3%, 10.5%, 19.3% and 73%, respectively. Meanwhile, the proportion in the four regions corresponds to 9.11%, 16.1%, 29% and 78.4% according to the number of land parcels, respectively. The proportion in mountain agricultural areas is the highest, with close to 80%.



**Figure 4.** Proportion of rent-free land transfer in different agriculture regions.

### 3.3. Extent of Rent-Free Land Transfer in Different Topographic Types

Table 3 shows the proportion of rent-free land transfer in plain, hilly areas and in mountainous areas. 50% of farmers in rural China did not receive any rent in the process of transferring out farmland, according to the statistics of the number of households. In different topographic areas, the proportion of farmers who participate in land transfer without rent in plain areas is less than 40%, and the proportion of the land rent amounting to 0 to 500 yuan accounts for more than 40%. The proportion of farmers participating in rent-free land transfers in hilly areas and mountainous areas are relatively high, both close to 60%. In hilly areas, the proportion of land rent amounting to more than 500 yuan per mu is relatively low, with land rent between 500 and 1000 yuan representing only 4.1% and that greater than 1000 yuan representing 1.36%. The proportion of rent-free land transfers differs greatly by terrain, and the proportion is the highest in mountainous areas.

**Table 3.** Regional differences in the land rent (LR) received by the leasers (by households).

Topographic Type	Number of Households	LR = 0		0 < LR ≤ 500 Yuan		500 < LR ≤ 1000 Yuan		LR > 1000 Yuan	
		Number of Households	Ratio %	Number of Households	Ratio %	Number of Households	Ratio %	Number of Households	Ratio %
plain area	5782	2163	37.41	2457	42.49	794	13.73	368	6.36
hilly area	5402	3077	56.96	1227	22.71	672	12.44	426	7.88
mountain area	7917	4554	57.52	2929	36.99	326	4.12	108	1.36
national level	19,397	10,009	51.60	6640	34.23	1680	8.66	927	4.78

### 3.4. Extent of Rent-Free Land Transfer in Typical Mountainous Areas

Table 4 presents the rent statistics of land transfer in typical mountainous areas, such as counties in Chongqing. The proportion of rent-free land transfers in four typical mountainous counties is 79.1%, according to the number of land parcels. Specifically, the proportions in Yongchuan District and Zhongxian, Wulong and Youyang Counties are 56.4%, 93.6%, 81.9% and 85.6%, respectively; the proportion is the highest in Zhongxian, exceeding 90%.

**Table 4.** Statistics of the land rent (LR) received by the leasers in mountainous counties (by land parcels).

County	Number of Land Parcel	LR = 0		0 < LR ≤ 500 Yuan		500 < LR ≤ 1000 Yuan		LR > 1000 Yuan	
		Number of Land Parcels	Ratio %	Number of Land Parcels	Ratio %	Number of Land Parcels	Ratio %	Number of Land Parcels	Ratio %
Yongchuan	243	137	56.38	71	29.22	19	7.82	16	6.58
Zhongxian	281	263	93.59	11	3.91	5	1.78	2	0.72
Wulong	127	104	81.89	23	18.11	0	0.00	0	0.00
Youyang	173	148	85.55	14	8.09	6	3.47	5	2.89
Overall	824	652	79.13	119	14.44	30	3.64	23	2.79

In sum, the proportion of rent-free land transfers in rural China has been on the rise in recent years. There are obvious differences in the proportions of rent-free land transfers among areas with different agricultural types and terrains. Rent-free land transfer mainly occurs in mountainous areas, with a proportion of 80%.

## 4. Determinants of Rent-Free Land Transfer in Rural China

### 4.1. Cost-Benefit Analysis for Land Parcels in Rural Areas

Table 5 shows the average cost-benefit per mu of rent-free and rent-paying land parcels. The average output value per mu of the transferred land parcel without rent is relatively small; there is a difference of 118.9 yuan between the two kinds of land parcels, passing the significance test at the

10% level. In terms of other factor costs, the costs of labour, seeds, pesticides, fertilizers, irrigation and land replanting, and harvesting did not pass the 10% significance test, except for the herbicide and film cost. Specifically, the labour cost accounts for a relatively high proportion of the operation cost for the two kinds of land parcels, among which the labour cost for rent-free land parcels accounts for 62%. From the perspective of the net income per mu, the average net incomes of the rent-free and rent-paying land parcels per mu are −65.7 and 34.6 yuan, representing a difference of 100.3 yuan and passing the significance level test at the 5% level. In general, rent-free land parcels suffered losses, while rent-paying land parcels were still profitable.

**Table 5.** Cost-benefit analysis of the transferred plots with rent and without rent.

Variable	Rent-Paying Land Parcels (N = 101)	Rent-Free Land Parcels (N = 224)	Difference	T Value	p Value
Average output value per mu/yuan	984.88	866.03	118.85	1.66 *	0.09
Average cost per mu/yuan					
Labour	536.46	533.92	2.54	0.06	0.95
Seed	98.86	99.7	−0.84	−0.06	0.95
Insecticide	36.63	31.83	4.79	0.37	0.71
Herbicide	17.76	26.29	−8.54	−2.14 **	0.03
Fertilizer	197.73	198.02	−0.29	−0.01	0.99
Irrigation and land replanting	43.60	30.57	13.04	1.32	0.18
Harvesting	4.68	2.11	2.57	0.69	0.49
Film	9.72	5.77	3.96	1.67 *	0.09
Other cost	4.86	3.56	1.31	0.98	0.33
Average net income per mu/yuan	34.57	−65.73	100.31	2.17 **	0.03

Note: \* and \*\* indicate a significance at the 10% and 5% levels.

#### 4.2. Empirical Results of the Multilevel Logit Model

This study first adopts the variance inflation factor (VIF) to test the collinearity between independent variables. The results show that the maximum VIF value of a single variable is 1.41, and that the average VIF of the overall variable is 1.23, which is far less than the critical point of 10, indicating that there is no serious collinearity problem between the variables. Table 6 shows the empirical results of different multilevel logit models. Model 1, which does not include any independent variables, is in the first column. Model 2, which only includes the independent variables at the land parcel level, is in the second column. The robustness estimation results of model 3, including the land parcel- and household-level independent variables, and of model 4, including the land parcel-, household- and village-level independent variables, are shown in columns 3 to 5, respectively. The dependent variable is the land transfer with or without rent; it is assigned a value of 1 if the land is transferred without rent; otherwise, it is assigned a value of 0.

**Table 6.** Empirical results of the multilevel logit model in determinants of rent-free land transfer.

Variable	Model 1		Model 2		Model 3		Model 4	
	$\beta$	Odds Ratio	$\beta$	Odds Ratio	$\beta$	Odds Ratio	$\beta$	Odds Ratio
<b>Fixed effect</b>								
Intercept term	−4.664 ***	0.009 ***	5.194	180.336	25.054	76.110	−20.932	0.001
Land parcel area			−0.441 **	0.643 **	−0.582 **	0.558 **	−0.312 **	0.345 **
Distance to homestead			0.001	1.001	0.001	1.000	0.001	1.001
Quality level			−1.075 *	0.206 *	−1.122 *	0.325 *	−1.951 *	0.142 *
Irrigation condition			−1.578 **	0.341 *	−0.711	0.491	−0.861 *	0.902 *
Is connected with transferee's land parcel			−3.142 **	0.043 **	−3.443 **	0.031 *	−1.167	0.311
Householder's age					−0.446	0.639	−0.433	0.648
Square of householder's age					0.003	1.003	0.004	1.004
Householder's gender					−0.799	0.449	−1.548	0.212
Householder's education level					−1.077 **	0.341 ***	−0.408	0.664
Ratio of farmers' non-agricultural income					4.454 **	8.976 **	5.520 *	9.670 *
Dependency ratio					0.688	1.991	−1.047	0.351
Land fragmentation					2.385 *	10.866 *	2.004 *	0.134 *
Log (amount of productive assets)					−0.347 *	0.706 *	0.197	1.218
Ratio of the number of farmers that transferred out land to transferred into							−0.135	0.873
Distance from the village to the centre of the county							−0.049	0.951
Log (net income per capita in village)							2.105	8.211
<b>Regional dummy variable</b>								
Youyang County							1.076 **	2.180 **
<b>Random effect</b>								
<b>Household level</b>								
$Var(r_0)$	2.293 *		2.066 **		2.120 **		2.091 **	
$\rho_2$	0.249		0.239		0.248		0.247	
<b>Village level</b>								
$Var(\mu_{00})$	3.255 **		3.278 ***		3.130 ***		3.054 ***	
$\rho_3$	0.368		0.379		0.366		0.362	
Area under ROC curve	0.732		0.777		0.887		0.971	

Note: \*, \*\* and \*\*\* indicate a significance at the 10%, 5% and 1% levels;  $Var(r_0)$  and  $Var(\mu_{00})$  represent the variance of the random intercept at the household and village levels.  $\rho_2$  and  $\rho_3$  represent the cross-correlation coefficients of the household and village levels.

Model 1 is also called the zero model and is mainly used to test whether the variation from the high level is significant. The explanation degree of each level on the variation of the dependent variable can be estimated by the cross-level correlation coefficient. The results show that the variance of  $Var(\mu_{00})$  at the village level is significant at the 1% significance level, indicating that there is a significant difference in the probability ratio among villages. Meanwhile, the variance  $Var(r_0)$  at the household level is significant at the 10% significance level, indicating that there is also a significant difference among households concerning the decision of whether to transfer out land without rent. According to the cross-level correlation coefficients  $\rho_2$  and  $\rho_3$ , the two levels of households and villages are calculated to explain 24.9% and 36.8% of the dependent variables, and the land parcel level explains the remaining 38.3%. Thus, the land parcel and village features are the key to understanding the difference in farmers'

decisions on whether to transfer out their land without rent, with the land parcel level explaining approximately 40%.

Models 2–4 incrementally add higher levels of independent variables. In terms of the size, direction, significance level and odds ratio of the same independent variable coefficients among the models, the overall robustness of the model and the existence of a model setting bias can be judged. Models 2 and 4 show that the independent variables at the land parcel level play a slightly different role in each model, but that the direction of the influence is basically consistent. The comparison among the abovementioned models shows that the multilevel logit model has a high credibility in empirical analysis. The impact of the variables at all levels on farmers' land transfer with or without rent is analysed as follows.

At the land parcel level, the coefficient of the land parcel area is significantly negative at the significance level of 5%, indicating that if other conditions remain unchanged, the larger the land parcel is, the smaller the probability of a rent-free land transfer. The odds ratio coefficient indicates that when the size of the land parcel increases by one standard deviation, the probability of a rent-free land transfer decreases by 34.5%. The coefficient of the land quality grade is significantly negative at the 10% significance level, which indicates that the probability of a rent-free land transfer is decreasing with the improvement in the land quality. The odds ratio is 0.142; that is, when the land quality improves by one grade, the probability of a rent-free land transfer decreases by 14.2%. In addition, the coefficient of the irrigation condition is equal to  $-0.861$  and is significant at the 10% level. Taking a land parcel without water irrigation as the control, the probability of a rent-free land transfer for a land parcel irrigated only by groundwater decreases by 90.2%. Although other variables have an impact on whether farmers transfer out land with zero rent, the coefficients are not significant. The land parcel hierarchy analysis shows that the probability of a rent-free land transfer is lower for land parcels with a larger scale, high quality grade and better irrigation conditions, and vice versa.

At the household level, the coefficient of the proportion of non-agricultural income is significantly positive at the 10% level, indicating that the higher the proportion of non-agricultural income is, the more farmers tend to transfer land without rent. The possible explanation for this is that farmers have a stable non-agricultural income that exceeds their agricultural income, and because they face high transaction costs in the land transfer process, they choose to lend their land to other farmers without collecting rent. In addition, the coefficient land fragmentation is significantly positive at the 10% level, and its odds ratio is 0.134, which indicates that the probability of transferring out land without rent will increase by 13.4% as land fragmentation increases by one standard deviation [23]. Similarly, other variables still have an impact on whether farmers transfer their land without rent, but their coefficients are not significant.

At the village level, Wulong District was used as the control group, and the coefficient of Youyang County was positive and significant at the 5% level, indicating that the proportion of rent-free land transfer in Youyang County was higher than the average of Wulong District. In addition, variables such as the distance from the village to the county centre and the net income per capita in the village were not significant.

In sum, the land parcel size, quality grade and irrigation condition are the key factors at the land parcel level that determine whether the land parcel is transferred rent-free. At the household level, the proportion of non-agricultural income and land fragmentation are the key factors affecting a rent-free land transfer. At the village level, the regional differences and geographical location are important factors. Concerning the variation of the dependent variables, the two levels of the land parcel and village features explain more than 75%, with the land parcel feature explaining the greatest part of the variation, accounting for approximately 40%.



## 5. Conclusions and Discussions

### 5.1. Conclusions

By employing data from the RPOS from 1986 to 2015, the CHIP in 2013, and sample investigations of different agricultural regions and typical mountainous counties, this paper systematically estimates the extent of rent-free land transfer according to the land area, number of households and land parcels. In addition, a multilevel logit model was developed to identify the factors influencing rent-free land transfers. The main conclusions are as follows.

First, the rent-free phenomenon in the process of land transfer has become more prominent, especially after 2002. Rent-free land transfer represented between 20% and 50% of the transferred land regardless of the number of households and the land area. Meanwhile, there are obvious regional differences in the extent of rent-free land transfers. Generally speaking, the proportion of rent-free transfer in plain provinces is relatively low, and that in mountainous provinces is relatively high, among which the proportions in Chongqing and Shanxi have exceeded 70%. The surveys in typical mountainous counties show that the rent-free land transfer in Wulong District, Zhongxian and Youyang County in Chongqing represented more than 80%, and that the rent-free land transfer in Zhongxian exceeded 90%.

Second, rent-free land transfer is a manifestation of land use behaviour and is affected by multilevel factors, such as land parcel-, household- and village characteristics. The land parcel size, quality level and irrigation condition are the key influencing factors at the land parcel level; the ratio of the household non-agricultural income and land fragmentation are the key factors at the household level, and inter-village difference is the key factor at the village level. The features of the land parcel and village level can explain more than 75% of the variation in rent-free land transfers, and land parcel features explain the largest proportion of the variation, accounting for nearly 40%.

Third, the plots transferred out without rent are generally in a state of loss, losing 66 yuan per mu, whereas the net income per mu is 35 yuan. The reason for this is that the total output value of rent-free transfer land is comparatively lower, with an average output value of 118.85 yuan per mu, while the proportion of the labour cost is comparatively higher, accounting for 62%, which compresses the land operation profit. Because of the adjustment in the national grain price protection policy, the grain price has been gradually lowered in recent years, leading to the gradual lowering of the ceiling of agricultural production. Meanwhile, the rapid increase in non-agricultural wages was transmitted to agriculture, resulting in the continuous rise of the agricultural production cost, especially after the Lewis turning point in 2003. The adjustment in the grain price and the continuous increase in the labour cost are the direct reasons for the prominent phenomenon of rent-free land transfers, while land parcel features, such as the land size, quality level and irrigation condition, as well as the marginalization of mountainous areas, are the preconditions for rent-free land transfers.

### 5.2. Discussions

The level of agricultural mechanization in mountainous areas is relatively low, and the net income of cultivated land is rapidly decreasing. According to a survey on land abandonment in 142 mountainous counties conducted by the Chinese Academy of Sciences in rural China, 78% of the villages experienced land abandonment [23]. The statistics based on county samples show that the rate of land abandonment in mountainous areas was 14.3% in 2015 [23,24]. In addition, the rate of land abandonment in typical mountainous counties, such as Wulong District and Shizhu County of Chongqing City, were more than 20% in 2014, according to remote sensing monitoring and household sampling surveys [24–26]. Studies have reported that land transfer can, to some extent, alleviate land abandonment. Rent-free land transfer is determined rationally, but there are also uncertainties. Most land transfer transactions do not sign a formal transfer contract, and the transfer terms are relatively arbitrary, so rent-free land transfer is an informal land rental market [27,28].

The current land system in China makes it difficult to realize land transfers and large-scale agricultural operations because of the high transaction costs. It has been reported that farmers who have more than 50 mu of farmland in China account for only 1%, and that more than 80% of farmers have less than 10 of the cultivated land. In 2015, the average number of land parcels per family farm was 34. To form a moderate family farm, one needs to conduct land transfer transactions with nearly 47 smallholders on average. According to the survey of the National Nutrition and Food Security Strategy Research from the Chinese Academy of Sciences, each household in Shandong Province needs to rent land with 59 smallholders on average, and it takes more than half a year to complete these transactions. Moreover, most farmers still have the intention to expand the cultivated land area. It can be inferred from this that the situation in hilly and mountainous areas is more serious. At present, local governments are also gradually aware of the restrictions of farmland fragmentation on the development of large-scale operations, and grass-roots organizations have begun to explore corresponding ways to promote a large-scale farmland operation, such as the reform of “turning palm field into one field” in Huaiyuan County, Anhui Province.

Furthermore, this study only takes mountainous areas as an example to identify the factors influencing rent-free land transfers, and finds that the negative net income of land is the direct cause for rent-free land transfers. However, the net income of cultivated land without rent is not less than zero, such as for urban agriculture and intensive agriculture. There may be other reasons in addition to the low income of agriculture. It is worth noting that the rural social security system is not sound and that farmers cannot escape their cultivated land for social security [29]. Even if they out-migrate for work, they do not feel confident in carrying out land transfers, so they prefer to rent the land to relatives or acquaintances in the rent-free form. It must be noted that the mode of rent-free land transfer does not play an effective role in allocating agricultural land resources, and it inhibits the value of cultivated land assets, resulting in losses for both parties. For the leaser, the land rent is too low to yield a higher income from cultivated land. For the person receiving the lease, due to the uncertainty of the land transfer term, farmers reduce their willingness to invest and are unable to improve the efficiency of farmland use. Therefore, the government should standardize the land rental market, pay attention to the integration of land resources and promote large-scale agricultural operations.

In recent years, China has made great adjustments in agricultural subsidies. The temporary purchase price of maize was adjusted, with the unit price reduced from 1.12 yuan to 1 yuan in 2014, a drop of 11%. In 2016, China merged the direct grain subsidy, seed subsidy and comprehensive subsidy into support and protection subsidies. The government began to support the moderate scale operation of agriculture and reduce the financial burden. Under the background of rising labour costs, the adjustment of agricultural subsidy will further reduce profits, which will increase the extent of rent-free transfers and the abandonment of land in mountainous areas. In the future, the extensive management of land, rent-free land transfers and land abandonment in plains will become prominent, and the government must pay attention to the food production reduction and food security risk and improve the agricultural productivity through targeted subsidies to medium size farmers owning more than 3 ha and up to 10 ha. Furthermore, the idle or abandoned land resources in mountainous areas become relatively rich in the process of rent-free farmland transfers, and the government should make full use of relatively rich land resources to realize a land capital appreciation and develop the local economy in mountainous areas.

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