frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 20 June 2025
DOI 10.3389/fsufs.2025.1609478

OPEN ACCESS

EDITED BY
Imran Ul Haq,
University of Agriculture, Faisalabad, Pakistan

REVIEWED BY
Amit Kumar,
Nanjing University of Information Science and Technology, China
Sunny Sharma,
Lovely Professional University, India

*CORRESPONDENCE
Huashan Zhang
✉ nanjing2009@163.com
Shaojun Chen
✉ sjchen@hhu.edu.cn

RECEIVED 11 April 2025
ACCEPTED 02 June 2025
PUBLISHED 20 June 2025

CITATION
Zhang H, Huang J and Chen S (2025) Resettlement resilience and land transfer efficiency: farmers' perceptions of capital inflows in the context of ecological civilization.
Front. Sustain. Food Syst. 9:1609478.
doi: 10.3389/fsufs.2025.1609478

Resettlement resilience and land transfer efficiency: farmers' perceptions of capital inflows in the context of ecological civilization

Huashan Zhang[1,2]*, Jin Huang[2] and Shaojun Chen[1]*

[1]School of Public Administration, Hohai University, Nanjing, China, [2]China Renewable Energy Engineering Institute, Beijing, China

In the modern era, ecological migration is a voluntary migration strategy that offers multiple benefits, including poverty alleviation, economic development, resource optimization, environmental protection, and social harmony. Based on the survey data from 563 farmers in Guizhou Province, this study empirically examines the determinants influencing farmers' willingness to transfer land management rights in response to increasing capital inflow into rural areas using a Logistic binary regression model. The results show that farmers' risk perception toward rural capital investment emerges as the most critical factor shaping their land transfer decisions. Additionally, economic and institutional factors, including land transfer fees, the mode and timing of rent transfer, access to non-agricultural employment, the robustness of social security, and socio-economic development, play significant roles in facilitating or constraining land transfer willingness. Socioeconomic characteristics, such as education level, annual household income, and disposable income, are positive and significantly correlated with farmers' willingness to transfer land. These outcomes suggest that financially secure and better-informed farmers exhibit greater readiness to participate in structured land market mechanisms.

KEYWORDS

resettlement resilience, ecological civilization, land management right, socioeconomic characteristics, land circulation

1 Introduction

Ecological civilization emphasizes the integration of human intelligence and information resources to achieve a balanced relationship between economic development and environmental sustainability (Li, 2005). In China, this concept is considered as crucial as economic development itself. Poverty and fragile ecological environment are often interlinked (Li and Wang, 2013), mainly in the remote and rural areas of central and western China. The ecological environment in this region is the worst, and the incidence of poverty is the most extensive. The poverty problem is strong and unique characterized by harsh environments such as mountains, deserts and alpine zones, which exhibit both the highest poverty rates and the most fragile ecosystems (Wan et al., 2023). In the past 40 years of national ecological migration, poverty alleviation and development, the poor population in the western region has been greatly reduced, the local infrastructure construction has been continuously improved, and the production

and living standards of immigrants have been continuously improved. However, limited development opportunities in these areas have contributed to persistent regional poverty. To address this, the Chinese government has implemented ecological migration programs, especially targeting mountainous and ecologically vulnerable regions. Over the past four decades, these initiatives have significantly reduced poverty, improved infrastructure, and enhanced the livelihoods of relocated populations. However, challenges remain due to complex geographic, social, and human factors. Issues such as relative poverty, high rates of return to poverty, and socio-economic instability continue to pose risks (Wang et al., 2023; Ye, 2020). In response, in late 2015, the state proposed a new ecological migration poverty alleviation strategy, aimed at winning the battle against poverty and supporting sustainable development in the new era.

The ecological migration in the new era refers to the government-led, voluntary participation of rural residents, and the relocation of rural poor people living in areas with poor natural conditions, that is, areas where "one side of the soil and water cannot support one side of the people", to areas with better survival and development conditions employing ecological migration. By improving the production and living conditions of the resettlement area, adjusting the economic structure and expanding the channels of income increase, the production and living conditions of the migrants will be fundamentally improved, and a way of poverty alleviation will be achieved (Huang et al., 2020). The relocation objects of ecological migrants are mainly rural poor people who live in deep mountains, desertification, endemic diseases and other poor living environments, do not have basic development conditions, as well as a fragile ecological environment, restricted or prohibited development areas. In the new era, through innovative investment and financing models and organizational methods, improving relevant follow-up support policies and other measures, ecological migrants strive to move, stabilize, do something, and become rich to ensure that migrants can get rid of poverty as soon as possible and fundamentally solve their livelihood problems (Geng and An, 2020).

Ecological migration is a systematic project, which needs to be formulated with scientific planning. To ensure the full implementation of various measures, the core is to grasp the three key elements of "people, land and money," promote the optimization of rural population or agricultural population structure, reduce the proportion, establish a land use guarantee mechanism and a system conducive to the flow of various funds to rural agriculture, especially the scientific use of capital (Zhang and Xia, 2023). Practice shows that whether it is the new urbanization development path with the characteristics of urban and rural integration implemented in the economically developed areas in the east, or the construction of "four in the farm beautiful countryside" implemented in the economically underdeveloped areas in the west represented by Guizhou, for the development of agricultural and rural society, capital accumulation cannot be absent, and capital logic as an instrumental means is still in a dominant position. However, for the balanced development of rural society, rural construction needs to go beyond the logic of capital. This approach, driven by people's aspirations for a better life, enhances rural development by integrating capital and improving agricultural land transfer efficiency. It promotes larger-scale farming, increases farmers' incomes, and resolves the "low-level dilemma" in land transfer (Lu and Lu, 2022).

The academic community has conducted a lot of fruitful research on the concept of capital in the countryside and its impact. It usually refers to the participation of industrial and commercial capital in the development of agriculture, rural areas and farmers, including land consolidation and circulation, agricultural production and operation and new rural construction (Jiao and Zhou, 2016). In addition to policy support and active promotion of local governments, farmers "attitudes toward land transfer are also crucial. As the main body of participants in land transfer, farmers' awareness of the risk of farmland capitalization transfer will directly affect their willingness. In addition, farmers' traditional small-scale peasant consciousness and factor endowment differences, individual and family characteristics of farmers, also directly affect the willingness of land transfer (He, 2006).

Despite significant policy efforts to promote farmland transfer in rural China, the process faces substantial challenges, particularly due to farmers' risk perceptions. Existing research has predominantly focused on economic incentives and institutional frameworks, often neglecting the critical role of risk perception in influencing farmers' decisions to transfer land management rights. This oversight leaves a gap in understanding how perceived risks, such as uncertainties in land revenue, land use, and non-farm employment, affect these decisions. Recent studies have begun to address this, revealing that heightened risk perceptions significantly deter farmers from transferring their land. For instance, Wan et al. (2023) found that farmers' perceptions of risks related to land returns, land use, and non-farm employment notably inhibited their willingness to transfer farmland. Similarly, research by Wang et al. (2023) highlighted that risk perceptions, along with factors like land tenure security and farmers' characteristics, significantly influence intentions toward rural homestead transfer.

In the pursuit of sustainable development goals (SDGs 1, 8, 11, and 15), land transfer efficiency and resettlement resilience have become central to China's ecological civilization strategy. Land transfers in ecological resettlement zones reshape rural livelihoods by enabling more flexible land use and promoting livelihood diversification (Zhang, 2021). These changes are increasingly influenced by capital inflows, which support agricultural modernization, mechanization, and rural entrepreneurship (Tang and Li, 2020). Such investments improve land productivity and generate off-farm employment, aligning with SDG-1, 8. Resilience among resettled farmers, however, depends not only on material compensation but also on institutional support and social adaptation. Fan et al. (2018) note that robust governance and infrastructure access enhance the adaptive capacity of displaced populations, reinforcing long-term livelihood stability. Integrated rural revitalization strategies are equally important. As Liu and Li (2017) argue, bridging rural-urban divides through land and policy reforms sustains economic and ecological outcomes. Furthermore, rural areas that adapt to external drivers (capital and governance shifts) tend to remain resilient and avoid decline (Li et al., 2019). Thus, incorporating farmers' perceptions into land governance and capital investment frameworks enhances the

effectiveness of ecological resettlement, contributing to sustainable rural transformation.

Despite growing attention to rural land system reforms in China, critical research gaps remain. Notably, there is limited understanding of how farmers' risk perceptions regarding capital inflows influence their willingness to transfer land management rights. Existing studies often overlook the behavioral and perceptional dimensions of land transfer, particularly in ecologically sensitive and underdeveloped regions like Guizhou Province. Moreover, empirical analyses that quantify the efficiency of farmland capitalization using robust econometric models remain sparse. To address these gaps, this study aims to evaluate the efficiency of farmland capitalization transfer by analyzing and examining how farmers' perceived risks affect their land transfer decisions. Utilizing survey data from farmers in Guizhou Province and employing a Logistic binary regression model, the study intends to identify key risk factors affecting land transfer decisions. The ultimate goal is to provide evidence-based insights to support more efficient land transfer mechanisms, ensuring equitable distribution of benefits from rural land system reforms.

2 Materials and methods

2.1 Theoretical analysis framework

For rural residents, land has a variety of attributes, not only is it one of the main sources of income for the family, but also serves as a function of social security. In the process of examining the risk perception of capital to the countryside, farmers cannot only consider the economic value of land. The willingness to transfer land management rights reflects the psychological emotions of farmers' dynamic changes, and is not entirely an economic judgment based on "rational economic man". Due to the different factor endowments of individual farmers and the different regional environments, farmers' risk perception is easily affected by individual characteristics and risk nature (Nan and Zhu, 2020). From the point of view of the theory of compound ecosystems, the major problems of social operation are complex system problems composed of three major elements of economy, society and ecology (Ma and Wang, 1981). This study categorized the factors influencing farmers' land capitalization transfer during rural capital investment into five dimensions: individual, household, economic, social and ecological. It establishes an analytical framework to explore farmers' risk perception, land transfer willingness, and the efficiency and path dependence of land transfer processes (Figure 1).

2.1.1 Individual characteristics

The individual characteristics of farmers are defined by variables such as age, gender, education level and degree of non-agricultural occupation of farmers. Notably, younger, educated individuals with higher skills and better access to non-agricultural employment are more willing to transfer land due to lower land dependence. In contrast, older, less-educated farmers with stronger risk perception are less inclined to do so. The influence of gender on farmers' willingness to transfer land is that men are more inclined to transfer land than women, because in rural society, men's employability is generally stronger than women's, women's risk awareness is stronger, the land is the last life guarantee, and they are more inclined to retain land. The higher the degree of professional non-agriculturalization or part-time farmers, the lower the family's dependence on land, the more inclined to transfer land, and its impact on the transfer of land management rights is positively correlated.

2.1.2 Family characteristics

The characteristics of rural households are defined by variables such as the number of the non-agricultural labor force in rural households, the proportion of non-agricultural income in rural households, and the annual income of rural households. Generally, households with more non-agricultural labor and a higher proportion of non-agricultural income show a stronger willingness to capitalize on and transfer agricultural land, especially under conditions of low agricultural comparative efficiency. There is a positive correlation between the two, especially under the premise of stable non-agricultural income; the willingness of farmers to transfer land is stronger (Shen, 2012). Farmers' annual household income reflects the overall economic capacity of a family. Generally speaking, the higher the level of annual household income, the stronger the ability to bear risks. The increase in annual household income directly promotes the willingness of farmers to transfer land.

2.1.3 Economic characteristics

The economic characteristics are defined by variables such as the price of land rent and the time of rent payment. Under normal circumstances, farmers have a psychological prediction of the level of land transfer funds. When the price of farmland capital transfer rents is far from the psychological expectations of farmers, especially when the rent price is lower than expected, the willingness of farmers to transfer land is low, and the rent price is the main influencing factor. The stability of rent payment time is also a major economic risk for farmers to consider land capital transfers. If the lessee does not default on the transfer rent and can pay in full and on time according to the contract, it means that the risk is small and the willingness of farmers to transfer land is strong.

2.1.4 Social characteristics

Social characteristics such as trust in the lessee, re-employment prospects, regional economic development conditions, and social security level significantly influence land transfer willingness. Higher trust in lawful and contract-abiding lessees under government oversight enhances farmers' willingness to transfer land. Generally, the economic and social development conditions in the area where the farmers are located are better, the social employment opportunities are more, and the social security system is more complete. After the transfer of land, the possibility of re-employment in the local area is relatively large, and the transfer of land does not mean the loss of old-age security. In this case, farmers are more willing to transfer land (Zhang and Wang, 2024).

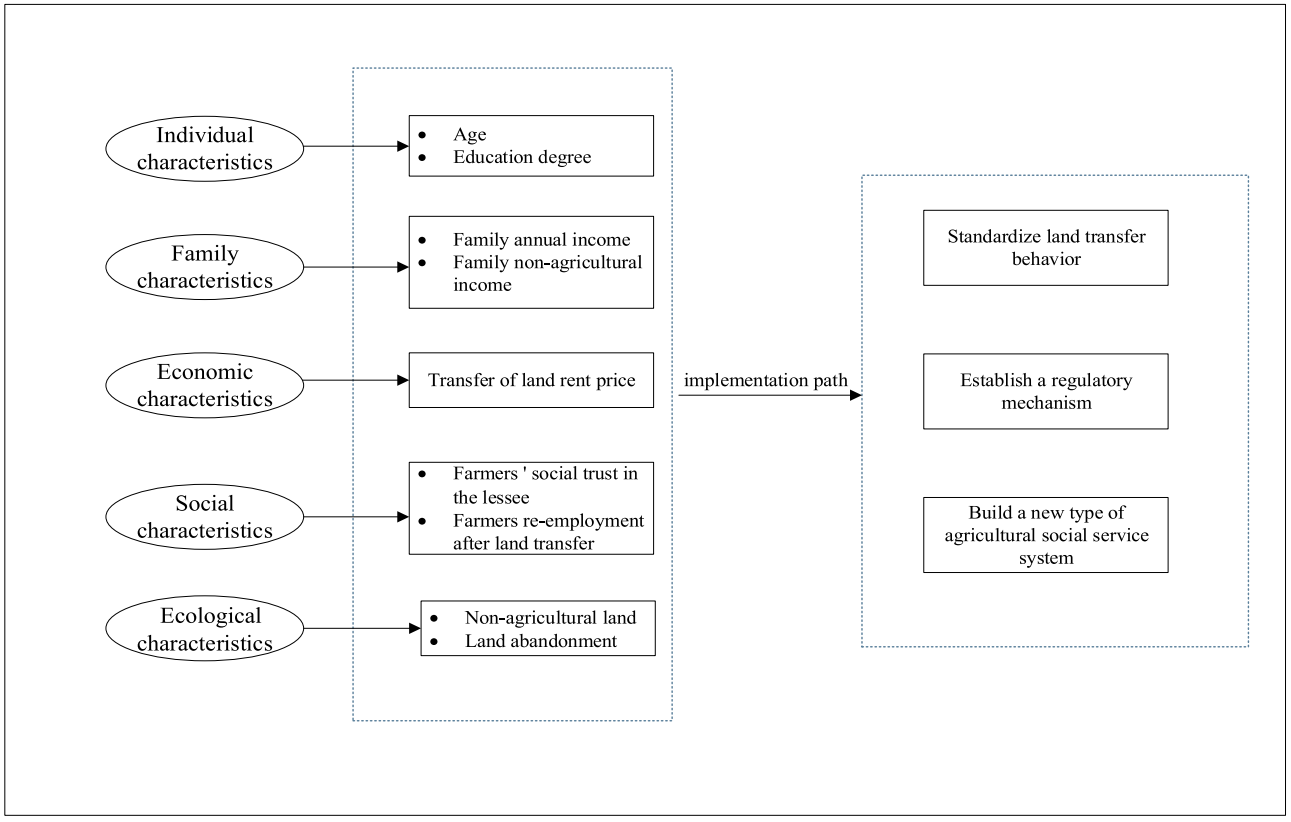

FIGURE 1
Framework for analyzing land transfer efficiency and path dependence.

2.1.5 Ecological characteristics

Ecological characteristics such as land non-agriculturalization and land abandonment pose significant risks for farmers reliant on traditional agriculture. Land holds multifunctional and cultural value, and its conversion to non-agricultural uses can undermine land governance and complicate future reclamation. High perceived risks, including post-contract abandonment, reduce farmers' willingness to transfer land. These perceptions, shaped by individual and environmental factors, influence the dynamics and outcomes of land capitalization and transfer in the context of rural industrial and commercial investment.

2.2 Empirical analysis

2.2.1 Data sources and sample characteristics

Guizhou Province is an underdeveloped area in southwestern China between latitudes 24°37′N to 29°13′N and longitudes 103°36′E to 109°35′E, characterized by extensive karst landform and severe rocky desertification (Figure 2). Over 92% of the province is mountainous or hilly, and are predominated karst terrain results in limited and low-quality arable land, with per capita farmland availability being significantly constrained. Additionally, the province faces substantial challenges in industrial development due to inadequate infrastructure and limited industrialization, forming the socio-economic backdrop for ecological migration. Given these constraints, Guizhou leverages its unique geographical and ecological conditions to foster specialized industries and capitalize on the advantages of latecomer catch-up. Strategic investment in modern agriculture, industry, and tourism services is essential for sustainable economic growth. Within this context, the capitalization and circulation of rural land have become essential mechanisms for enhancing land use efficiency, promoting agricultural modernization, and attracting external investment. These strategies also support broader goals of achieving economies of scale, fostering inclusive growth, and ensuring long-term ecological sustainability in line with national and global sustainability targets.

To analyze poverty alleviation and relocation planning in the context of ecological migration, the research group conducted surveys using questionnaires and structured interviews. Representative and typical samples were selected from Liupanshui City, Bijie City, Qianxinan Prefecture, and other regions to examine the current status and outcomes of land capitalization transfer across different regions of Guizhou Province. A total of 585 questionnaires were distributed, and 572 were recovered, with a recovery rate of 97.78 %. After statistical screening, there were 563 valid questionnaires after eliminating invalid questionnaires, and the effective sample ratio was 98.43 %. The sample covers 3 cities/states, 9 counties, 36 townships, and 563 peasant households. The basic situation of the sample households is detailed in Table 1.

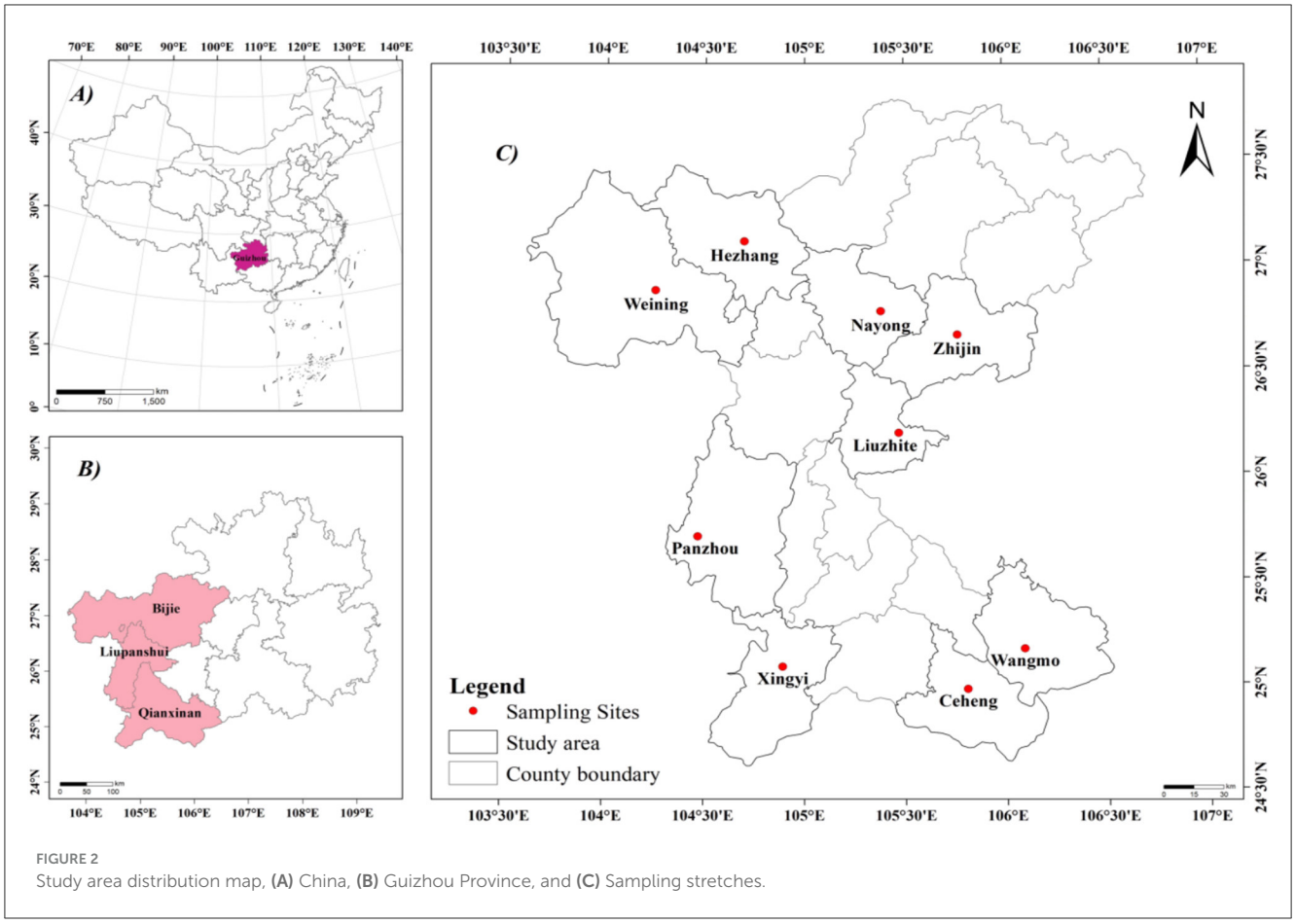

FIGURE 2
Study area distribution map, **(A)** China, **(B)** Guizhou Province, and **(C)** Sampling stretches.

The sample data indicate that men constitute 54.71 % and women 45.29 %. The population is predominantly middle-aged, with 35.17% aged 31–50 years and 20.07 % aged 51–60 years. Education levels are mainly primary and junior high schools (74.96%). Non-agricultural employment is prevalent, accounting for 63.94 % of occupations. Among rural households, 66.07 % have <3 non-agricultural laborers. Annual household income falls between 5,000 and 100,000 Chinese yuan (CNY) for 41.39% of respondents. Non-agricultural income is relatively high, with 64.83% of households earning <10,000 CNY (1 USD−7.2 CNY) annually from agriculture, reflecting a high proportion of non-agricultural employment in rural households.

2.3 Methodologies adopted

In order to empirically analyze the factors influencing the willingness of ecological immigrant farmers to transfer land in the process of capital inflows into rural areas under ecological civilization, a binary Logistic model is established. The dependent variable Y, represents whether the farmer is willing to transfer the land management right for agricultural land capitalization. The binary choice is defined as $Y = 1$ for farmers willing to transfer land, and $Y = 0$ for those unwilling to transfer land. Given that the dependent variable is binary, the model estimates the probability of the event occurring. Let P1 and P2 represent the probability of "transferring land" and "not transferring land", respectively. The explanatory variables denoted as X_1, X_2, X_3, ..., X_n, represent the influencing factors, respectively. The Logistic regression equation is expressed as:

$$Y = Ln\left(\frac{P1}{P2}\right) = b0 + b1\,X1 + b2\,X2 + b3\,X3 + \ldots bnXn \quad (1)$$

Where b_0 is the intercept term, and b_1, b_2, …, b_n are the coefficients corresponding to the explanatory variables X_1, X_2, … X_n, The sample variable description and descriptive statistics are detailed in Table 2.

In this study, family income, non-farm income, and age were converted from continuous to categorical variables to capture potential non-linear and threshold effects in farmers' land transfer decisions. This transformation enhanced model interpretability, aligned with policy-relevant income and age groupings, and mitigated issues related to data skewness and outliers. Additionally, it improved model stability and fit by reducing multi-collinearity and facilitating convergence during logistic regression estimation.

3 Results

To ensure the authenticity and reliability of the research findings, logistic regression analysis was conducted using SPSS

10.3389/fsufs.2025.1609478

TABLE 1 Basic characteristics of survey samples ($N = 563$).

Serial number	Respondent attribute information		Frequency/person/household	Frequency/%
1.1	Gender	Male	308	54.71
1.2		Female	255	45.29
2.1	Age/years	21-30	66	11.72
2.2		31-50	198	35.17
2.3		51-60	113	20.07
2.4		61-65	92	16.34
2.5		65	94	16.70
3.1	Culture	Illiterate	90	15.99
3.2		Primary school	238	42.27
3.3		Junior high school	184	32.68
3.4		High school	102	18.12
3.5		University and above	39	6.93
4.1	Occupation	Farming	104	18.47
4.2		Non-farming	305	54.17
4.3		Part-time business	154	27.35
5.1	Non-agricultural labor force/household	2	197	34.99
5.2		3	175	31.08
5.3		4	137	24.33
5.4		5	54	9.59
6.1	Total annual household income/ten thousand yuan	5	124	22.02
6.2		>5–10	233	41.39
6.3		>10–15	135	23.98
6.4		–	71	12.61
7.1	Agricultural annual income/ten thousand yuan	≤1	365	64.83
7.2		1–3	118	20.96
7.3		≥3	80	14.21

on a dataset of 563 samples. To assess multi-collinearity among explanatory variables, variance inflation factors (VIFs) were examined. All VIF values were below 4, indicating no multi-collinearity issues. A stepwise backwards regression method was employed for variable selection. The analysis revealed that variables such as age, occupation, household annual income, non-agricultural income, land rental price, social trust in the lessee, re-employment opportunities after land transfer, social security level, degree of land non-agriculturalization, and land abandonment significantly influence farmers' willingness to transfer land. These factors collectively constitute key determinants in constructing an efficient land transfer framework. Detailed regression results are presented in Table 3.

The results of the binary logistic regression model reveal that several variables significantly influence farmers' willingness to transfer land. Among individual characteristics, education level ($B = 0.667$, $p < 0.05$) and age ($B = 0.694$, $p = 0.068$) positively affect land transfer willingness, indicating that older and more educated farmers are more likely to participate in land transfers. Within family-level factors, annual household income ($B = 1.326$, $p < 0.10$) and non-agricultural income ($B = 2.361$, $p < 0.10$) significantly enhance willingness, reflecting the role of income diversification and financial security. In terms of economic factors, land rent price ($B = 0.965$, $p = 0.05$) shows a strong positive association, suggesting that higher rental returns incentivize land circulation. For social dimensions, trust in lessees ($B = 0.627$, $p < 0.10$) and re-employment opportunities post-transfer ($B = 2.674$, $p < 0.10$) are important determinants, underscoring the relevance of institutional trust and employment security. The level of social security also exhibits a modest positive effect ($B = 1.062$, $p = 0.26$). Ecological characteristics have a notable inverse impact: both non-agricultural land conversion ($B = -2.365$, $p < 0.05$) and land abandonment ($B = -1.806$, $p < 0.01$) significantly reduce the likelihood of land transfer, indicating that ecological degradation and informal land-use changes discourage formal land market participation.

In the process of land capitalization transfer, the influence of farmers' age and education level on their willingness to transfer land is significant at 90 % and 95 % confidence intervals, respectively, and there is a positive correlation. It shows that farmers with younger individuals have a stronger ability to accept new things and have certain professional skills. The smaller the dependence on land, the stronger the willingness to transfer land; on the contrary, older farmers, based on the consideration of land security function, worry that land transfer will be greatly affected by market factors, thus restricting the expectation of obtaining stable and sustainable income from land. The higher the education level of farmers, the more opportunities for non-agricultural employment. They do not take the income from land as the main source of income, and are more willing to transfer land. As far as occupational distribution is concerned, there are also differences in the attitude of farmers who are simply engaged in agricultural production, not engaged in agricultural production, and both of them. During the case interview, it was learned that part-time farmers also tend to use land as a safeguard measure and are not willing to transfer land easily.

In the process of capital going to the countryside, the influence of annual income and non-agricultural income of farmers on their willingness to transfer land is significant in the 95 % confidence interval, indicating that the higher the annual income of the family, especially the larger the proportion of non-agricultural income, it has a positive effect on the willingness to transfer land (Wang et al., 2011). Families with higher non-agricultural income usually have better educational backgrounds and non-agricultural skills, stronger employability, and are more inclined to optimize resource allocation through land transfer to better engage in non-agricultural occupations. With the increase of family annual income and non-agricultural income, the function of land as social security to obtain economic income is gradually weakened, and

10.3389/fsufs.2025.1609478

TABLE 2 Model explanatory variable selection and descriptive statistics.

Variable type	Variable name	Variable definition	Mean value	Standard deviation
Dependent variable	Willingness of land transfer	Unwilling = 0; Willing = 1	0.69	0.31
Explanatory variables	***1. Individual characteristics***			
	Gender (X_1)	Male = 1; Female = 2	0.91	0.33
	Age (X_2)	≤30 years = 1; 31–50 years old = 2; 51–60 years old = 3; 61–65 years old = 4; >65 years = 5	3.16	1.02
	Education degree (X_3)	Illiterate = 1; primary school = 2; junior high school = 3; high school = 4; university and above = 5	2.65	0.89
	Occupation (X_4)	Farming = 1; non-farming = 2; part-time business = 3	1.90	0.74
	2. Family characteristics			
	Non-agricultural labor force (X_5)	≤2 people = 1; 3 people = 2; 4 people = 3; ≥5 people = 4	2.26	0.65
	Family annual income (X_6)	≤5 million yuan = 1; >5–10 million yuan = 2; >10–15 million yuan = 3; >15 million yuan = 4	3.28	0.78
	Family non-agricultural income (X_7)	≤1 million yuan = 1; >1–3 million yuan; ≥3 million yuan = 3	3.09	1.10
	3. Economic characteristics			
	Transfer of land rent price (X_8)	High = 1; General = 2; Low = 3	2.60	0.55
	Rent payment time (X_9)	Fixed = 1; Not fixed = 2	2.20	0.82
	4. Social characteristics			
	Farmers' social trust in the lessee (X_{10})	High = 1; General = 2; Low = 3	2.14	0.76
	Farmers re-employment after land transfer (X_{11})	Easy = 1; General = 2; Difficult = 3	1.97	1.02
	Regional economic development conditions (X_{12})	High = 1; General = 2; Poor = 3	1.85	0.94
	Social security level of farmers (X_{13})	High = 1; General = 2; Poor = 3	2.06	0.85
	5. Ecological characteristics			
	Non-agricultural land (X_{14})	High = 1; General = 2; Low = 3	2.19	0.60
	Land abandonment (X_{15})	High = 1; General = 2; Low = 3	2.33	1.18

farmers are less dependent on land, and are more willing to transfer land out to obtain higher economic benefits.

The rent price of land capitalization circulation directly affects the willingness of farmers, both of which are significant in the 99 % confidence interval, indicating that the rent price of land circulation is the economic benefit directly obtained by farmers. The higher the rent price, the more income farmers obtain through land circulation, so they are more willing to participate in land circulation. High rent prices can make up for the loss of farmers' abandonment of land management and provide additional economic compensation, which makes land transfer more attractive to farmers. At the same time, the transfer of land capitalization makes the value of land clearer and market-oriented. When the rent price of land transfer is high, the capital value of land is fully reflected, and farmers are more willing to transfer land as an asset to obtain higher economic returns. This process of capitalization also makes the land transfer market more active and further promotes the willingness of farmers to transfer.

In the process of capital going to the countryside, the influence of farmers' social trust in the lessee and the convenience of farmers' re-employment after land transfer on their willingness to transfer land is significant at 95 % confidence interval, and the influence of farmers' social security level on their willingness to transfer land is significant at 90 % confidence interval. It shows that the degree of social trust can reduce risk perception, and social trust can reduce farmers' concerns about possible risks in the process of land transfer. In the rural "acquaintance society", farmers are more inclined to transfer land to familiar and trusted people. This trust relationship can reduce the uncertainty after land transfer (Lou and Hong, 2024). At the same time, the degree of social trust can promote the transaction, and social trust can help to establish a stable land transfer relationship and promote land transfer transactions. In the case of high social trust, farmers are more willing to sign long-term contracts with lessees, thereby increasing the willingness to land transfer.

In the process of capital going to the countryside, the influence of farmers' cognition of land non-agriculturalization degree and the land abandonment degree on their willingness to transfer land is significant at 95 % and 99 % confidence intervals, respectively, showing a negative correlation. The research shows that with the popularization of the concept of ecological civilization, farmers' understanding of the ecological value of

TABLE 3 Model regression to ensure the authenticity and reliability.

Variable name	*B*	Wald	d*f*	Sig.	Exp (*B*)
1. Individual characteristics					
Gender (X_1)	0.726	3.422	1	0.062	0.264
Age (X_2)	0.694*	1.167	1	0.068	0.885
Education degree (X_3)	0.667**	8.623	1	0.143	0.195
Occupation (X_4)	1.637	6.987	1	0.225	1.682
2. Family characteristics					
Non-agricultural labor force (X_5)	2.368	3.032	1	0.126	0.659
Family annual income (X_6)	1.326**	2.690	1	0.095	2.364
Family non-agricultural income (X_7)	2.361**	0.964	1	0.167	0.962
3. Economic characteristics					
Transfer of land rent price (X_8)	0.965***	3.526	1	0.052	1.368
Rent payment time (X_9)	3.320	3.765	1	0.741	0.693
4. Social characteristics					
Farmers' social trust in the lessee (X_{10})	0.627**	1.528	1	0.092	0.367
Farmers re-employment after land transfer (X_{11})	2.674**	0.950	1	0.187	1.952
Regional economic development conditions (X_{12})	2.954	1.563	1	0.387	2.549
Social security level of farmers (X_{13})	1.062*	0.589	1	0.256	1.628
5. Ecological characteristics					
non-agricultural land (X_{14})	−2.365**	2.094	1	0.026	0.659
land abandonment (X_{15})	−1.806***	3.280	1	0.008	0.367

Where *, **, *** are significant at 10 % ($p < 0.10$), 5 % ($p < 0.05$), and 1 % ($p < 0.01$) confidence levels, respectively. B denotes the regression coefficient, Wald is Wald chi-square test statistic, df is degrees of freedom, Sig. is significance or p-value, and Exp(B) indicates exponentiated coefficient.

land has gradually increased. They realized that land transfer is not only an economic behavior, but also an important means of ecological protection. When the land is in good ecological condition, farmers are more willing to transfer the land to the main body capable of ecological management. After land transfer, it is often possible to achieve a large-scale operation. The lessee is more able to use water-saving irrigation, ecological restoration and other technologies for ecological management. This large-scale and ecological management method can improve the ecological function of land and bring stable economic benefits to farmers. At the same time, after the land transfer, its ecological function can be guaranteed through long-term planning and management (Jintao et al., 2024). Farmers realize that through the transfer of land, they can not only obtain short-term economic benefits, but also provide protection for the long-term ecological health of the land.

4 Discussion

The construction of ecological civilization is a long-term plan related to the wellbeing of the people. Poverty is not only a product of the fragile ecological environment, but also aggravates the vulnerability of the ecological environment (Li and Xu, 2014). The historical practice of ecological poverty alleviation and development shows that the coordinated development of "talent, land and capital" is one of the effective strategies to achieve poverty alleviation (SDG-1). Under the macro background of vigorously implementing ecological civilization, capital going to the countryside has been proven to be a powerful measure to attract talent, revitalize land and solve the sustainable development of rural society (Shi and Tong, 2023). The scale and benefit of land transfer are directly affected by the willingness of farmers to transfer land management rights. This willingness is not uniform and is shaped by a range of individual, household, economic, social and ecological factors. The key determinants include farmers age, level of education, family income, family non-agricultural income, and transfer of land rent prices (Zhang, 2021; Fan et al., 2018). Moreover, social trust in the lessee, the availability of re-employment opportunities, post-transfer, and the quality of social security systems significantly affect farmers' decision-making (Li et al., 2019; Tang and Li, 2020). The degree of land non-agricultural use, along with the extent of land abandonment, also plays a critical role in determining the extent and efficiency of land capitalization. Empirical analysis, including logistic regression modeling, has confirmed the statistical significance of these factors in shaping land transfer behavior and outcomes (Zhang, 2021). The results provide a valuable policy and practical enlightenment for advancing China ecological civilization strategy, and give full play to the depth and breadth of the influence of talents, land, and capital to achieve rural revitalization and sustainable land system reform.

First, through systematic theoretical analysis and empirical tests, it is fully explained that there are certain risks, especially hidden risks, in the formulation of social policies, the supervision of the implementation process and the solution of follow-up problems. These are the most concerned for farmers. Therefore, we should systematically sort out the various problems of agricultural land transfer in the process of capital going to the countryside, and focus on standardizing the transfer of rural land capitalization. To construct the path dependence of land transfer efficiency, the focus is to improve the relevant supporting policies of national and local rural land transfer, establish special financial institutions to provide policy and financial services for the capital transfer of agricultural land, and build a new type of agricultural social service system. With the improvement of the external environment of such capital in the countryside, the lessee will change the development concept, improve the comprehensive quality of farmers, and create a new type of professional farmers.

Secondly, the transfer of farmland capitalization is a systematic behavior. Through empirical tests, it is found that farmers' psychological expectations of the rent price of the transferred land, farmers' social trust in the lessee, the degree of land

non-agriculturalization and the degree of land abandonment significantly affect farmers' willingness to transfer land. Therefore, we should establish a strict urban industrial and commercial capital in the countryside, intervene in the access and supervision mechanism of rural social construction and development, strengthen the management of land capitalization transfer rent, and strictly prevent large-scale land non-agriculturalization and hoarding (Chen et al., 2018). Establish a standardized land transfer market, improve farmers' trust in social capital, form a diversified financial mechanism, reduce the pressure on farmers to bear the risk of land transfer, and protect farmers' rights and interests in an all-round and multi-level manner. Fei (2008) stated that the credit of the rural society is not the emphasis on the contract, but on the familiarity with the rules of an act to the reliability without thinking (Fei, 2008). Therefore, farmers' recognition of industrial and commercial capital, as well as the understanding and recognition of expected floating interests, the observance of contracts, the tacit understanding of local society according to "etiquette" and "habit", and the elimination of doubts and conflicts can truly achieve mutual benefit. At the same time, enterprises with capital going to the countryside also need to actively change their development concepts, create enterprises with profit-making space going to the countryside to drive farmers to get rich and innovate the scientific and technological thinking of combining "agriculture" and "capital" (He and Yang, 2018).

Third, factors such as farmers' age, education level, family household economic income, and the level of social security coverage exhibit a significant positive correlation with their willingness to transfer land. This suggests that the determinant of land transfer willingness extends beyond individual and household characteristics, encompassing broader dimensions of social governance, institutional trust, and socio-economic development. By accelerating the level of regional economic and social development, establishing and improving the social security system, strengthening the vocational skills training of farmers, improving the level of non-agricultural professional technology, whether from the economic function of land or the social security function, and ultimately reduce the dependence of farmers on land. On the one hand, we should vigorously develop rural vocational skills education, cultivate a group of new professional farmers with strong market awareness, and understanding of management, and technology, and become the leaders and practical talents of rural development (Zhang, 2022). On the other hand, through the combination of public service institutions and rural cooperative economic organizations, we should build a new type of agricultural socialized service system, improve the minimum living security system, do a good job in rural social assistance, build a multi-level rural old-age security system, and take multiple measures to relieve the worries of farmers' land capitalization transfer.

Despite providing valuable insights into the determinants influencing farmers' willingness to transfer land management rights, this study has three key limitations. First, the focus on Guizhou Province limits the applicability of the findings to other regions with different social, economic, or environmental conditions. Second, the cross-sectional survey design captures only a snapshot in time, making it difficult to assess causality or changes in behavior. Third, while binary logistic regression identifies key predictors, it may oversimplify the complex and varied nature of farmers' decisions. Additionally, self-reported data may be subject to recall bias or social desirability bias, which could influence the accuracy of responses regarding sensitive topics such as risk perception and land transfer intentions. Future research should consider longitudinal data collection, comparative multi-regional studies, and mixed-method approaches to better capture dynamic and context-dependent decision-making processes.

5 Conclusions and ways forward

This study provides empirical evidence that farmers' willingness to transfer land management rights in the context of capital inflows is shaped by a constellation of socio-economic, institutional, and perceptual factors. Risk perception plays a decisive role in shaping farmers' decisions, with greater apprehension about external capital investments leading to hesitancy in land transfers. Economic incentives such as transparent compensation mechanisms, predictable rent structures, and post-transfer land use aligned with SDGs (SDG-1, 8, and 11) positively influence farmers decisions. Additionally, structural drivers such as non-agricultural employment, social security availability, and broader regional development play a vital role by reducing farmers' dependency on agricultural income and enhancing livelihood resilience. Socioeconomic factors such as education level, household income, and disposable income further reinforce this trend, indicating that well-informed and financially secure farmers are more likely to perceive land transfers as an economically advantageous decision rather than a risk-prone venture. These insights underscore the necessity of establishing robust, transparent, and economically viable land transfer frameworks that align with farmers' concerns while fostering sustainable rural development.

To promote equitable and sustainable land transfer systems, and support resettlement resilience within an ecological civilization framework, several strategic interventions are recommended. This includes introducing legal safeguards, strengthening risk communication, improving rural employment opportunities and fortifying social security provisions, and investing in educational initiatives to elevate financial literacy and decision making capacity among farmers. Equally important is the ecological stewardship of post-transfer land use to align land governance with long-term environmental sustainability. These integrated multidimensional strategies will support the evolution of resilient, transparent, and inclusive land transfer frameworks, which will further advance the goals of rural revitalization and ecological civilization.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

HZ: Conceptualization, Data curation, Formal analysis, Software, Writing – original draft. JH: Conceptualization, Investigation, Resources, Writing – review & editing. SC: Funding

acquisition, Investigation, Supervision, Validation, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

References

Chen, Z., Guo, J., and Ou, M. (2018). Research on the impact of farmers ' risk perception on land transfer willingness in the process of capital going to the countryside. . *Nanjing Agricult. Univ. (Social Science Edition)*, 18, 129–137.

Fan, P., Chen, J., and John, R. (2018). Urbanisation, resettlement, and the resilience of farmers in China. *Sustainability*, 10, 4571.

Fei, X. (2008). *Local China*. Beijing: People 's Publishing House.

Geng, Y. M, H., An, S. (2020). Visualization analysis of ecological migration in China. *J. Southwest Univ. (Natural Science Edition)*, 42, 151–161.

He, Y., and Yang, B. (2018). The "non-discrete" connection between rural capital and farmland transfer: the path choice of rural revitalization. *J. Southwest Jiaotong Univ. (Social Science Edition)*, 19, 97–104.

He, Z. (2006). Farmers' concurrent business and its impact on rural land transfer—an analytical framework. *J. Shanghai Univ. Fin. Econ.* 8, 72–78. doi: 10.3969/j.issn.1009-0150.2006.02.010

Huang, Y., Tan, Y., and Wu, X. (2020). Research on poverty alleviation relocation and its follow-up support in China. *Explor. Econ. Issues* 27–33.

Jiao, C., and Zhou, F. (2016). 'Capital to the Countryside' and village reconstruction. *Chin. Soc. Sci.* 205–206.

Jintao, Ren, Y., and Pan, B. (2024). The status quo, problems and countermeasures of social capital participation in ecological protection and restoration-Taking the national ecological civilization pilot area (Guizhou) as an example. *China's Land Resour. Econ.* 37, 30–37.

Li, L. (2005). The scientific connotation and theoretical significance of ecological civilization. *Res. Mao Zedong Deng Xiaoping Theor.* 47–51.

Li, P., and Wang, X. (2013). Immigration, poverty alleviation and ecological civilization construction—investigation report on ecological migration in Ningxia. *Ningxia Soc. Sci.* 52–60. doi: 10.3969/j.issn.1002-0292.2013.03.011

Li, X., and Xu, K. (2014). The strategic choice of poverty alleviation in contiguous destitute areas. *J. Nanjing Forest. Univ. (Humanities and Social Sciences Edition)* 61–68. doi: 10.3969/j.issn.1671-1165.2014.02.009

Li, Y., Westlund, H., and Liu, Y. (2019). Why some rural areas decline while some others not: an overview of rural evolution in the world. *J. Rural Stud.* 68, 135–143. doi: 10.1016/j.jrurstud.2019.03.003

Liu, Y., and Li, Y. (2017). Revitalize the world's countryside. *Nature* 548, 275–277. doi: 10.1038/548275a

Lou, L., and Hong, M. (2024). Research on the impact of relationship strength on the choice of farmland transfer contract-Empirical evidence from 1108 farmers in 4 counties (cities) of Guizhou Province. *Econ. Long. Lat.* 41, 41–52.

Lu, M., and Lu, L. (2022). Research on the coordination mechanism of social capital participating in farmland transfer under the strategy of rural revitalization. *Rural Econ. Sci. Technol.* 33, 58–61.

Ma, S., and Wang, R. (1981). Social-economic-natural complex ecosystem. *Ecology* 4, 1–9.

Nan, G., and Zhu, P. (2020). Analysis of the influencing factors of endowment effect in agricultural land transfer-based on the survey data of two counties in Jiangsu Province. *Econ. Lat. Long.* 37, 54–61.

Shen, C. (2012). Influencing factors and interaction of the willingness to transfer the right to use homestead in Danyang. *Resour. Environ. Yangtze River Basin* 21, 552–556.

Shi, W., and Tong, T. T. (2023). Main risks and prevention of industrial and commercial capital going to the countryside under rural revitalization. *J. Northwest Univ. National. (Philosophy and Social Sciences Edition)* 97–110.

Tang, Z., and Li, H. (2020). Capital Inflows, Land Transfer and Agricultural Modernization. *China Agricult. Econ. Rev.* 12, 456–474.

Wan, Y., Zhang, X., and Li, X. (2023). Farmers' risk perception and willingness to transfer farmland: evidence from rural China. *PLoS ONE*, 18:e0289981.

Wang, Y., Li, J., and Chen, W. (2023). Risk perception, land tenure security, and farmers' willingness to transfer rural homesteads in China. *Land*, 12:714.

Wang, Z., Yang, Q., and Zhang, B. (2011). Analysis of farmers ' willingness to withdraw from land and its influencing factors in the reform of household registration system. *China's Rural Econ.* 49–61.

Ye, J. (2020). The path of poverty governance in China has shifted from government-led absolute poverty eradication to social policies for relative poverty governance. *Soc. Dev. Res.* 7, 28–38.

Zhang, H., and Xia, X. (2023). Exploration on the market-oriented linkage reform of rural land elements under the background of rural revitalization. *J. Hunan Agricult. Univ. (Social Science Edition)*, 24, 1–7.

Zhang, L. (2021). Understanding land transfer and farmer livelihoods in China's ecological resettlement areas. *Land Use Policy* 103:105316.

Zhang, Z., and Wang, R. (2024). Does social security participation contribute to rural land transfer? Mediating effect based on labor transfer. *J. Northeastern Univ. (Social Science Edition)*, 26, 54–62.

Zhang, M. (2022). Research on the development path of rural vocational education under the background of rural revitalization. *Agricult. Econ.* 119–121.