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Analyzing Farmers' Cultivated-Land-Abandonment Behavior: Integrating the Theory of Planned Behavior and a Structural Equation Model

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Abstract: Based on the hypothesis of individual-bounded rationality, this study analyzes the mechanisms of farmers' cultivated land abandonment behavior, theoretically and empirically, by integrating the theory of planned behavior (TPB) and a structural equation model (SEM). On the basis of the TPB's logical analysis framework of farmers' abandonment behavior, combined with social psychology, behavioral economics, and a household behavior model, this study analyzes the influence of attitude on behavior, the subjective norm, and perceived behavioral control on farmers' abandonment actions, then verifies it via an SEM Model. The research shows that farmers' abandonment behavior accords with the theory of planned behavior. Farmers' recognition of the negative impacts of abandonment, the intervention of important other persons, and the obstacles encountered in the process of abandonment can effectively restrain farmers' abandonment behavior. Finally, by considering the determinants for farmers' abandonment decisions, this study proposes to curb abandonment practices through measures that include strengthening publicity about abandonment, creating a favorable atmosphere for farming, and improving tillage conditions.

Keywords: theory of planned behavior; cultivated land abandonment; farmer behavior mechanism; structural equation model

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1. Introduction

Abandonment of previously cultivated agricultural land is one of the dominant processes of change in the rural areas of Europe, North America, and some regions of Asia [1–4]. This practice is an ongoing trend and will continue into the next few decades [5]. In abandoned land with poor ecological location and serious soil erosion, the natural vegetation restoration rate is lower than the land degradation rate, and the ecosystem will gradually deteriorate and even collapse. Moreover, agricultural abandonment results in high pressure for natural food safety and a decline of local agricultural incomes and employment [6,7]. In mountainous or remote rural areas especially, the loss of agricultural income often aggravates the weak economic and social structures [8]. Therefore, the abandonment of cultivated land is generally perceived as a policy challenge [9].

In adopting policy interventions, knowledge of the mechanism of the abandonment of cultivated land is significant. As the primary units of economics and social activity in rural areas, farmers are the main stakeholders of cultivated land use. Clarifying the mechanisms of farmers' abandonment behavior is the key in curbing abandonment practices.

Current research on the mechanisms of farmers' abandonment behavior is mostly based on the assumption of complete rationality; i.e., farmers' abandonment behavior is analyzed on the premise of pursuing income maximization. However, according to a study by Simon in 1976, such a complete-rationality hypothesis of people's economic behavior may have little to do with their expected behavior [10]. In reality, the hypothesis of bounded rationality is more consistent with people's decision-making processes. This view is supported by studies on farmers' decision-making behavior that were carried out

by agricultural economists from the perspective of social psychology [11]. Therefore, when studying the mechanisms of farmers' abandonment behavior, farmers' various cultural, social, and psychological characteristics should be considered, as well as their motivation for income maximization.

As one of the most important theories about individual behavior, the theory of planned behavior (TPB), which is based on the bounded rationality hypothesis in social psychology, performs well in explaining and predicting human behavior [12]. As a successful application behavioristic psychology's bounded rationality hypothesis in economics, the TPB introduces a psychological analysis to the study of economic behavior and incorporates individuals' multidimensional behavioral motives, including revenue maximization, emotional satisfaction, and social recognition, in the interpretation and prediction of behavior, effectively addressing farmers' bounded rationality in their abandonment decision making. In this way, the TPB provides a thorough understanding of the formation of the mechanisms of farmers' abandonment behavior [13]. With Gannan Hills in China as an example, this paper studies the mechanisms of farmers' abandonment behavior in hilly and mountainous areas, based on the TPB, and verifies its findings via a structural equation model (SEM). By providing a theoretical and empirical basis for curbing abandonment practices, this paper plays a positive role in improving land use efficiency, maintaining national food security, and ensuring the supply of agricultural products [14,15].

2. Literature Review

Recent works have suggested that the marginalization of agriculture is driven not only by poor biophysical characteristics or a lack of demand for produce [16]. Abandonment of cultivated land as an economic resource typically occurs when the land has ceased to generate sufficient income flows and the available options (within the constraints of farmers' knowledge and capacities) for adjusting resource use, farming practices, or farm structuring have been exhausted [4]. Current studies tend to interpret farmers' abandonment behavior from an economic perspective, based on a complete-rationality hypothesis [17–19]. However, the law of profit maximization is not always correct [20]. Structural and psychological factors that affect farmers' perceptions and abilities also play decisive roles [21]. For instance, such factors include farmers' recognition of situations, their qualifications, existing agricultural schemes, and differential competitive advantages among rural regions [22]. In addition, agricultural land abandonment is linked to the loss of local agricultural practices and knowledge [23,24]. Therefore, in the analysis of farmers' abandonment behavior, irrational motives, such as farmers' cognition or their perceptions, should be taken into consideration, as well as economic factors. As Simon's report stated, in reality, people may pursue satisfactory social goals with richer connotations, rather than making optimal economic decisions [14]. Therefore, a transformation of assumptions about farmers' behavior, from complete rationality to bounded rationality, is more realistically in line with farmers' behavioral motivations [25].

In 1985, Ajzen put forward the theory of planned behavior [26]. By studying the logical relationship between behavioral cognition, behavioral intentions, and behavioral responses, this theory provides a specific analytical model and a paradigm to explain individual behavior, and it reveals the mechanisms and reasons for behavior [26]. The TPB a successful application of behavioristic psychology's bounded rationality hypothesis in economics. The publication of the theory of planned behavior by Ajzen marked its maturity [27]. Due to the close relationship between agricultural decision making and social psychology, the TPB is widely applied in agricultural research by agricultural economists and social psychologists, as verified in practice [15,28]. Farmers' abandonment behavior is essentially a type of planned decision making; therefore, this paper will construct a decision-making model on farmers' abandonment behavior under the framework of the TPB, and study the mechanisms of abandonment under the assumptions of bounded rationality.

3. Mechanism Analysis

3.1. Construction of Decision Model of Farmers' Abandonment Behavior, Based on the TPB

According to the TPB, the main components of behavior formation are as follows:

(1) Under adequate control conditions, behavioral intention (BI) has a decisive effect on behavior;
(2) An individual's behavioral intention is influenced by attitude to behavior (AB), subject norm (SN), and perceived behavioral control (PBC);
(3) AB, SN, and PBC are jointly affected by exogenous variables. Although they can be completely distinguished conceptually, they are related, due to a common basis of belief;
(4) As an accurate PBC reflects an actual control condition, it can predict the likelihood of abandonment to a certain extent, due to its direct effect on behavioral response (BR).

According to the TPB, farmers' decision making on abandonment follows the path of "cognitive judgment—intention choice—behavioral response" (Figure 1). As BI determines BR under adequate control conditions, this paper will analyze the influence of AB, SN, and PBC on abandonment behavior in sequence, based on the TPB.

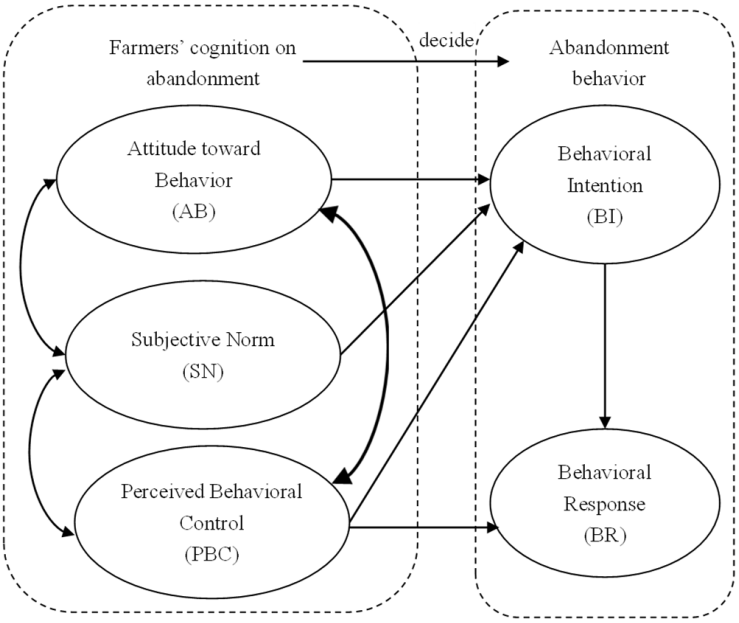


Figure 1. Decision model of farmers' abandonment behavior, based on the TPB.

3.2. Influence Mechanism of AB on Farmers' Abandonment Behavior

Attitude towards behavior (AB) refers to the positive or negative attitude of the actor toward a certain behavior. Farmers' perceptions of the "negative externality" of abandonment affect their abandonment behavior, resulting in varied areas of abandonment. In Figure 2, curve D represents the demand curve of abandoned cultivated land. MPC represents the marginal private cost of abandonment. MEC refers to the marginal external cost of abandonment. MSC denotes the marginal social cost. The MSC equals the marginal private cost plus the marginal external cost.

According to the externality theory of economics, point Q, determined by curve MPC and curve D, is farmers' intended area of abandonment. However, considering the marginal social cost, the ideal abandonment area should be Q_1, which may be much smaller than Q. According to the TPB, if farmers have a deep understanding of the negative externalities of abandonment, they may abandon as little farmland as possible. As reflected in Figure 2, point Q will always approach point Q_1.

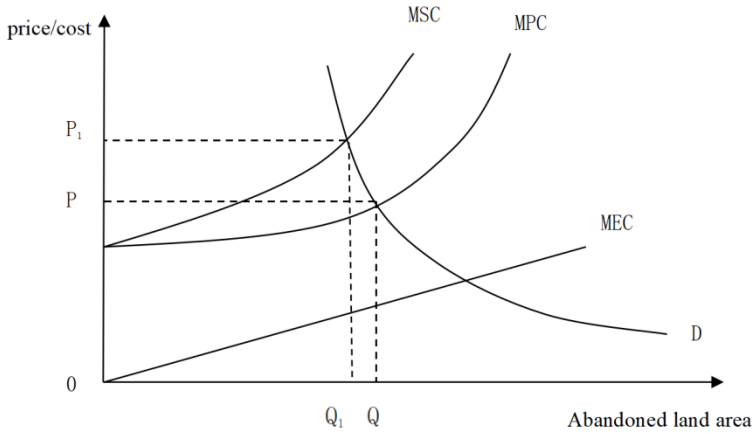


Figure 2. Influence of AB on abandonment.

3.3. Influence Mechanism of SN on Farmers' Abandonment Behavior

Subjective norm (SN) refers to the influence of external social pressure(s) on a person to carry out a specific behavior. Farmers' social pressures come mainly from family members, surrounding other persons of importance (e.g., villagers), and grass-roots governments (e.g., village committees). Family members may intervene in a farmer's abandonment behavior to ensure that the family demands for organic green food and grain self-sufficiency are met. For villagers, farmland surrounding their own contracted land acts as buffer and a protection barrier against external invasion; the abandonment of adjacent plots will increase the risk of animal intrusion and natural disasters, so villagers have a negative attitude about the abandonment of such adjacent plots. Grass-roots governments often intervene in farmers' abandonments of land by way of administrative instruction or the exercise of social responsibility. External social pressures produce negative incentives for farmers' abandonment behavior. If farmers' behavior is in line with external expectations, that would alleviate their external social pressure and encourage farmers to forego the abandonment of land.

3.4. Influence Mechanism of PBC on Farmers' Abandonment Behavior

Perceived behavioral control (PBC) refers to the promotion or hindrance of the implementation of a certain behavior, or to the perceived practical difficulties during an individual's implementation of behavior. PBC consists of controlling both beliefs and the perceived intensities of the controlling factors [29]. Controlling beliefs refer to farmers' abilities to control their livelihoods; in other words, whether they can maintain their livelihoods after abandonment. Therefore, this study adopted off-farm employment opportunities as an observable variable for controlling beliefs [30]. The perceived intensities of the controlling factors mainly refer to farmers' perceptions about cultivation conditions; therefore, this study selected tillage conditions and the agricultural labor force as the observation variables for the perceived intensities of the controlling factors [31,32]. In short, the PBC of abandonment behavior refers mainly to tillage conditions, the agricultural labor force, and non-agricultural employment opportunities.

3.4.1. Influence Mechanism of Tillage Conditions on Farmers' Abandonment Behavior

The Chinese system for household contract responsibility distributes cultivated land equally according to family population and land quality, resulting in varied tillage conditions[1] in different plots for different households. According to the principle of diminishing marginal income, the worse the tillage conditions, the greater the decline in the marginal income. Rational farmers will selectively invest in cultivated land on the basis of tillage conditions. Farmland with good tillage conditions will be preferentially cultivated.

In Figure 3, the horizontal axis represents the cultivated land area; the tillage conditions gradually deteriorate, from left to right. The vertical axis represents cultivated land yield.

Curves TR, AR, and MR represent, respectively, the total yield, the average yield, and the marginal yield of the cultivated land. Rational farmers will preferentially and intensively cultivate land with the best tillage conditions, between O and Q_1, as the marginal yields of these plots are increasing and they are higher than average. Next, farmers may cultivate the lands with the second-best tillage conditions, between Q_1 and Q. Compared with the lands between O and Q_1, the marginal income of these plots is less than the average income and decreases by a greater margin. However, as the marginal yields are greater than zero, the total land yield between Q_1 and Q is still increasing. Therefore, cultivating lands between Q_1 and Q is the second-best option for farmers, as those lands are still profitable; however, extensive management, a decreased multiple cropping index, or even complete abandonment may occur. Finally, the marginal yield of lands beyond point Q is less than zero, due to the poor tillage conditions. Rational farmers would abandon these plots, due to their poor economic value [33].

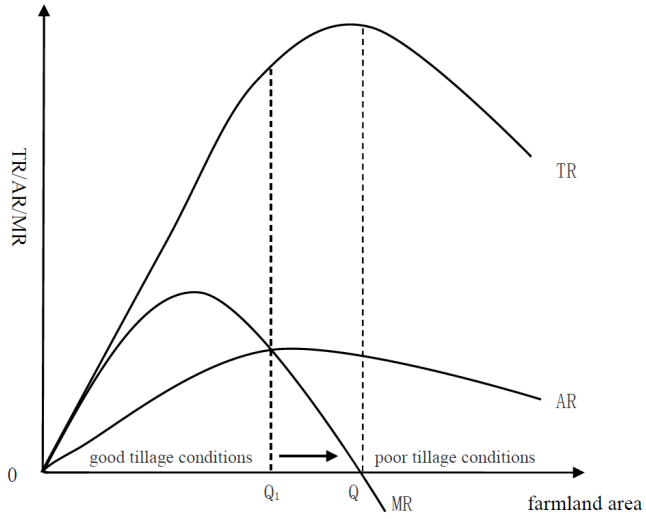


Figure 3. Influence of tillage conditions on cultivated land abandonment.

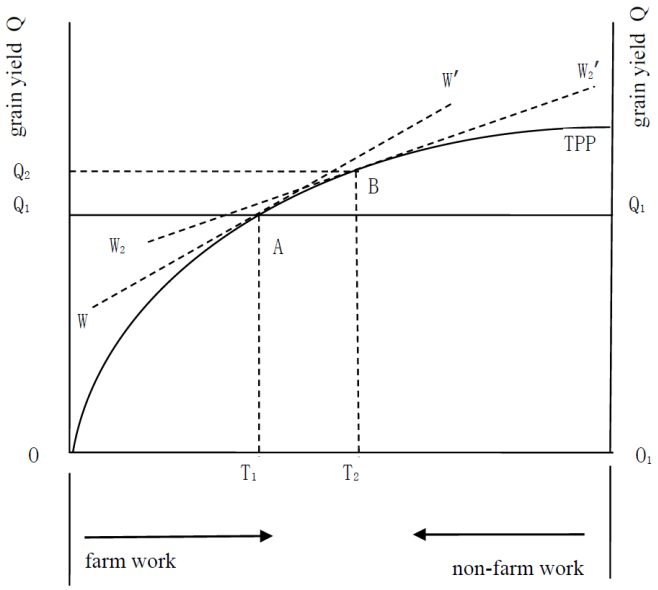
3.4.2. Influence Mechanism of Off-Farm Employment Opportunity on Farmers' Abandonment Behavior

Off-farm employment opportunities affect farmers' time allocations between farming work and off-farm work, based on comparative incomes. Therefore, in this section, farmers' non-agricultural employment wages are adopted to reflect farmers' non-agricultural employment opportunities. Farmers will allocate labor and cultivated land resources according to their expected incomes [34]. If non-agricultural employment opportunities exist, farmers will allocate their working time to off-farm employment with higher incomes. When the working time allocated by farmers to farming meets the labor demand of land cultivation, farmers' land will be fully cultivated instead of being abandoned. In contrast, when farmers allocate most of their working time to off-farm employment, resulting in the time allocated to farming failing to meet the labor demands of land cultivation, land will be gradually abandoned.

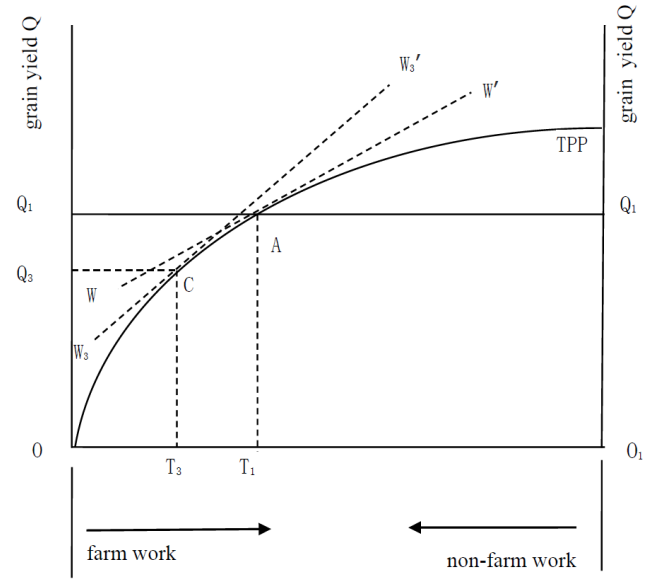
To simplify the model, this study makes the following assumptions: (1) Farmers' working time is allocated to farming or off-farm employment, and housework time, etc., is not taken into consideration; (2) Labor-saving inputs for the agricultural labor force, such as agricultural machinery and pesticides, are ignored; (3) Farmers are free to engage in agriculture or off-farm employment as they choose; and (4) cultivated land is homogeneous, with the same intensified utilization.

In Figure 4a, the horizontal axis represents the total working time available to farmers, in which the farming time increases from left to right and the off-farm working time increases from right to left. The grain production function is measured in kind, that is, by the total physical product curve TPP. Curve Q_1, parallel to the horizontal axis, represents

the grain output when the farmers' lands are fully cultivated, and the corresponding farming time is OT_1. Curve ww′ represents the market wage, which is equal to the value of the agricultural marginal physical product (MPP) when the farming time is OT_1. When the wage curve is $w_2w_{2'}$, the tangency point B between $w_2w_{2'}$ and TPP determines the farmers' optimal labor input (OT_2) in grain production; i.e., the maximum working time that the farmers are willing to allocate to farming. At point B, the farmers' opportunity costs of farming, represented by w, are equal to the MPP. As the OT_2 is greater than the farming time, OT_1, which is the time required by household land cultivation, the farmers' lands would be fully cultivated and abandonment would be avoided. However, in reality, a situation where the MPP value exceeds the labor market wage is rarely seen reality. The wage curve in Figure 4b is more universal in terms of real life.



(**a**)



(**b**)

Figure 4. (**a**) Influence of off-farm employment opportunities on farmers' abandonment behavior (lower wage). (**b**) Influence of off-farm employment opportunities on farmers' abandonment behavior (higher wage).

With wage increases, as shown in Figure 4b, the farmers' wage curve moves from $w_2w_{2'}$ to $w_3w_{3'}$. The tangent point C, between $w_3w_{3'}$ and TPP, determines the farmers' optimal labor input, OT_3, in grain production. On the right side of tangent point C, the slope of the wage curve $w_3w_{3'}$ is greater than that of the TPP curve, which indicates that farmers' opportunity costs of farming, w, are higher than the MPP; in that case, farmers will engage in off-farm employment [35]. This shows that when the farmers' wages rise to $w_3w_{3'}$, the farmers will spend time, OT_3, in farming, which is far from the time, OT_1, required by household land cultivation. In that case, land will be abandoned.

It should be noted that the curve ww' tangent to TPP represents the labor market wage level, which is equal to the agricultural marginal physical product (MPP). As the MPP varies, according to farmers' cultivated land area, the farmers' wage curve ww' is, accordingly, diverse; i.e., the farmers' farming opportunity costs vary with the land area. Off-farm employment opportunities affect farmers' time allocations between farm work and non-farm work, in terms of the opportunity costs of farming, thereby affecting farmers' abandonment behavior.

3.4.3. Influence of Agricultural Labor Quantity on Farmers' Abandonment Behavior

Agricultural labor shortages include passive and active situations. A passive labor shortage mainly results from old age, illness, disability, etc. An active labor shortage means that excess household labor or all household labor is allocated to off-farm employment, due to low agricultural comparative income, and an agricultural labor shortage follows, resulting in abandonment.

For a passive agricultural labor shortage, an inverse correlation exists between an abandoned area and the agricultural labor force on the whole. Abandonment can be avoided, so long as agricultural labor is replenished.

For an active agricultural labor shortage, the opportunity costs of farming for each family member act as the decisive role. To simplify the model, the following assumptions are made: (1) There is no scale effect or substitution effect of production factors; (2) Land input per unit is constant; (3) Tillage conditions are the same; and (4) The farmers can acquire farmland according to their family size, which ensures that land input increases with labor input increases and diminishing returns are delayed. In other words, there may exist a linear or nearly linear portion (i.e., a portion with constant marginal revenue) in the production function before the returns start to decline [36].

In Figure 5, the vertical axis represents actual revenue, y, and the horizontal axis represents working time, t. Assume there are three laborers in the household and that their working hours are A, B, and C, respectively, on the horizontal axis. These three laborers have exactly the same labor productivity in terms of agricultural production, but they receive different wages in the off-farm labor market. Curve TPP represents the total agricultural physical product in Figure 5. The TPP curve is a straight line in Figure 5, indicating that the agricultural marginal labor productivity of the three laborers is constant and equal. On the other hand, these three laborers earn different wages in the labor market, so each person's labor wage multiplied by working time is that person's wage income (or the opportunity costs of farming). Curve OW represents the growth state of total household wages, or the total labor opportunity costs of farming.

Curve ww' in Figure 5 represents the labor opportunity cost line parallel to the curve, OW. It is tangent to curve TPP at point D. Obviously, the distance between curve TPP and curve OW is maximal at point D, so D represents the "profit maximization" level of a farmer's labor input. To gain more revenue, farmers intend to engage in agricultural production when MPP exceeds their opportunity cost of farming. In Figure 5, the difference between the slope, w, of the labor opportunity cost curve, ww', and the slope (MPP) of curve TPP is very important. If $w <$ MPP, engaging in agricultural production is more profitable; if $w >$ MPP, engaging in off-farm employment is more profitable. According to Figure 5a, $w <$ MPP for laborers A and B, while $w >$ MPP for laborer C. Therefore, to maximize household income, laborers A and B should engage in farming, while C engages in off-

farm employment. If two farmers satisfy the labor demand for household land cultivation, agricultural labor is sufficient for this household and, accordingly, abandonment is avoided.

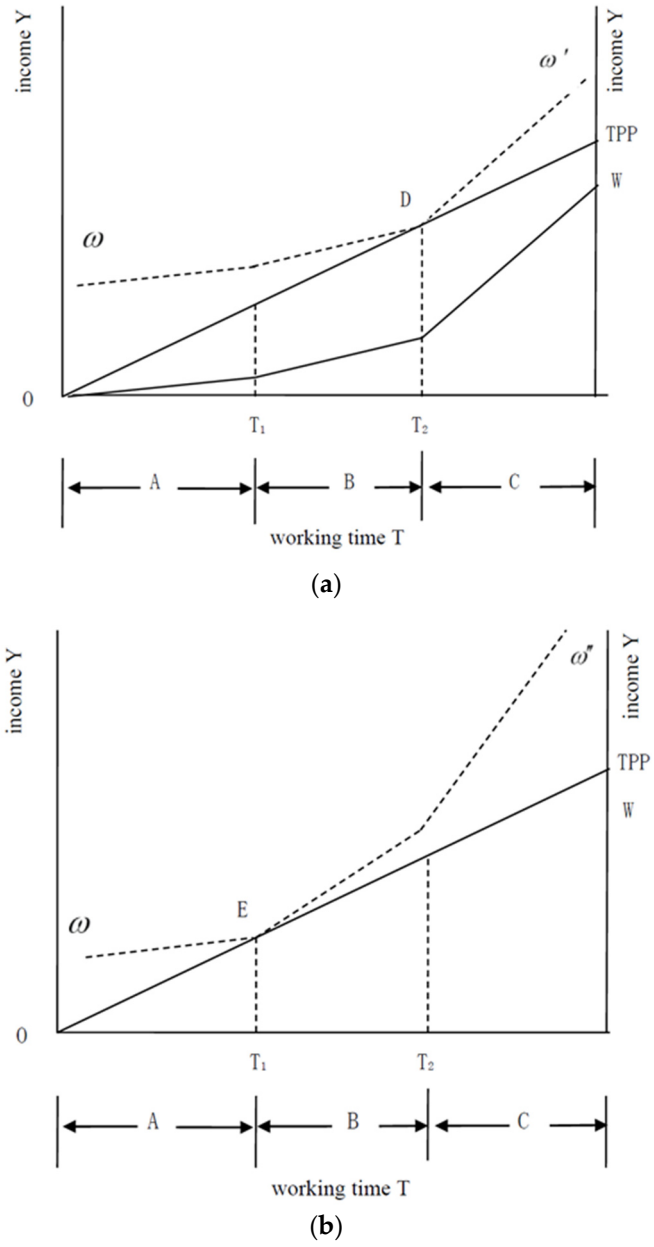


Figure 5. (**a**) Influence of household labor allocation on cultivated land abandonment (w_a < MPP, w_b < MPP, w_c > MPP). (**b**) Influence of household labor allocation on cultivated land abandonment (w_a < MPP, w_b > MPP, w_c > MPP).

If the grain price remains unchanged and wages rise, the labor opportunity cost curve, *ww'*, in Figure 5a moves to *ww''* in Figure 5b, which is tangent to TPP at point E. In this case, laborer A tends to engage in agricultural production, as w < MPP, and laborers B and C tend to engage in off-farm employment, as w > MPP. If two laborers are demanded for household land cultivation, cultivated land is at risk of abandonment, due to the labor shortage. If the grain price remains unchanged and the wages of all laborers rise to w > MPP, all household laborers will engage in off-farm employment and the land will be completely abandoned [31].

3.5. Observation Variables and Research Hypothesis

3.5.1. Observation Variables

Based on the TPB, five latent variables were selected: attitude to behavior (AB), subjective norm (SN), perceived behavioral control (PBC), behavioral intention (BI), and behavioral response (BR). As it is difficult to directly observe farmers' psychological characteristics according to the latent variables, they are described by multiple indicators from varied dimensions. Based on the above mechanism analysis, 15 items were determined as observation variables in this study (Table 1).

Table 1. Selection and definition of variables.

Latent Variable	Abbr.	Observation Variable Definition	Magnitude Definition
Attitude to behavior (AB)	AB1	Abandonment has no negative impact on economy	1 = totally disagree, 2 = somewhat disagree, 3 = general, 4 = somewhat agree, 5 = totally agree
	AB2	Abandonment has no negative impact on society	
	AB3	Abandonment has no negative impact on environment	
Subjective norm (SN)	SN1	Family does not interfere in abandonment	
	SN2	Villagers do not interfere in abandonment	
	SN3	Government does not interfere in abandonment	
Perceived behavioral control (PBC)	PBC1	Lack agricultural labor	
	PBC2	Off-farm employment opportunities are available	
	PBC3	Tillage conditions of cultivated land are poor	
Behavioral intention (BI)	BI1	I do not want to farm	
	BI2	I do not want my descendants to farm	
	BI3	I do not want to farm even with strengthened policy support	
Behavioral response (BR)	BR1	Cultivated land is extensively managed	
	BR2	Multiple cropping index decreased	
	BR3	Land is abandoned throughout the year	

3.5.2. Research Hypothesis

Based on the above mechanism analysis, combining the ideas of the TPB and the assignment of the observation variables, the following hypotheses were put forward.

H1. *In farmers' cultivated land abandonment behavior, farmers' attitude to behavior (AB) has a positive effect on behavior intention (BI);*

H2. *In farmers' cultivated land abandonment behavior, farmers' subjective norm (SN) has a positive effect on behavior intention (BI);*

H3. *In farmers' cultivated land abandonment behavior, farmers' perceived behavioral control (PBC) has a positive effect on behavior intention (BI);*

H4. *In farmers' cultivated land abandonment behavior, farmers' perceived behavioral control (PBC) has a positive effect on behavior response (BR);*

H5. *In farmers' cultivated land abandonment behavior, farmers' attitude to behavior (AB), subjective norm (SN) and perceived behavioral control (PBC) are pairwise correlated;*

H6. *In farmers' cultivated land abandonment behavior, farmers' behavior intention (BI) has a positive effect on behavior response (BR).*

4. Mechanism Verification

4.1. Research Methods

A structural equation model (SEM) that integrates factor analysis and path analysis can effectively deal with the structural relationship among multiple variables and overcome the collinearity among independent variables. An SEM is a verification method. It is difficult to measure the latent variables directly, such as AB in this study, so it is necessary to explain and evaluate them through the observation variables. Moreover, the observation variables

of the same latent variable may be highly correlated, so the SEM, which is suitable for handling multivariable structural relations, should be adopted for empirical analysis. The SEM is composed of a measurement model and a structural model. It can be expressed as follows.

$$\eta = \Lambda\eta + \Gamma\delta + \gamma \quad (1)$$

where η and δ represent endogenous and exogenous latent variable vectors, respectively, Λ and Γ are the coefficient matrices between latent variables, and γ is the residual matrix of the structural equation. The SEM is adopted in this paper to verify the applicability of the TPB in farmers' abandonment behavior.

4.2. Data Sources and Sample Characteristics

The study area was Ganzhou City, also known as Gannan. It is located in the south part of Jiangxi Province in Southeast China. Ganzhou City is located between 24°29′~27°09′ north latitude and 113°54′~116°38′ east longitude. Ganzhou City has a humid monsoon climate in the subtropical hilly and mountainous areas, with a mild climate, rich heat, abundant rainfall, and a long frost-free period. The average altitude of Ganzhou City is between 300~500 m, and the terrain is mainly mountainous and hilly. the hilly area is 24,053 square kilometers, accounting for 61% of the total land area, and the mountain area is 8620 square kilometers, accounting for 21.89% of the total land area of the city. According to the 2019 survey, the proportion of farmers with abandoned farmland in Ganzhou was as high as 36.69%, and the abandonment rate reached 17.5%. At the same time, the outflow trend of the rural labor force in Ganzhou City was obvious. The sown area and the degree of intensive utilization of cultivated land declined to different degrees.

The data used in this analysis were derived from a field survey carried out by a research group in Ganzhou City from July 2019 to August 2019. In order to improve the design of the questionnaire and ensure the accuracy of the data, the research group carried out a pre-survey analysis before the formal survey and conducted relevant training for the investigators. First, considering the land, its location, and the agricultural economic development level comprehensively, the research group selected five counties as sample areas: Xingguo County in the north of Ganzhou City, Shicheng County in the northeast, Huichang County in the southeast, Longnan County in the south, and Chongyi County in the west. Then, four townships were randomly selected from each sample county; three villages were randomly selected from each township; and approximately 10 to 11 households were randomly selected as respondents from each village. The survey was conducted via face-to-face interviews with heads of households or with major decision makers on agricultural production. A total of 650 questionnaires were distributed in the formal survey; 637 responses were collected. After removing incomplete information and invalid answers, a total of 616 valid responses were obtained. The basic information about the respondents and the descriptive statistics of variables are shown in Tables 2 and 3.

Table 2. Basic characteristics of samples.

Statistical Indicators	Classification	Sample Number	Proportion
gender	Male	581	94.32%
	Female	35	5.68%
age	≤45 years old	86	13.96%
	46~50 ≤ 45 years old	88	14.29%
	51~55 ≤ 45 years old	130	21.10%
	56~60 years old	90	14.61%
	61~65 years old	86	13.96%
	>65 years old	136	22.08%
marriage	Married	603	97.89%
	Unmarried	13	2.11%

Table 2. *Cont.*

Statistical Indicators	Classification	Sample Number	Proportion
education	unschooled	39	6.33%
	primary school	235	38.15%
	middle school	234	37.99%
	high school or vocational high school	82	13.31%
	college or above	26	4.22%
Family size	≤3 persons	236	38.31%
	4 to 5 persons	202	32.79%
	>5 persons	178	28.90%
Household contracted land scale	≤1 mu	54	8.77%
	1~2 mu (excluding 1 mu)	132	21.43%
	2~3 mu (excluding 2 mu)	133	21.59%
	3~5 mu (excluding 3 mu)	195	31.66%
	>5 mu	102	16.56%
Annual household income	≤ CNY 20,000	150	24.35%
	~CNY 20,000 to CNY 50,000 (excluding CNY 20,000)	161	26.14%
	~CNY 50,000 to CNY 100,000 (excluding CNY 50,000)	178	28.90%
	>CNY 100,000	127	20.62%

Table 3. Descriptive statistics of variables.

Latent Variable	Observation Variable	Abbr.	Mean	S.D.
Attitude to Behavior AB	Abandonment has no negative impact on economy	AB1	3.19	1.78
	Abandonment has no negative impact on society	AB2	3.31	1.50
	Abandonment has no negative impact on environment	AB3	2.97	1.74
Subjective Norm SN	Family does not interfere in abandonment	SN1	2.81	0.94
	Villagers do not interfere in abandonment	SN2	2.89	1.49
	Government does not interfere in abandonment	SN3	1.99	0.81
Perceived behavioral Control PBC	Lack agricultural labor	PBC1	2.35	1.36
	Off-farm employment opportunities are available	PBC2	2.29	1.13
	Tillage conditions of cultivated land are poor	PBC3	2.04	1.37
Behavioral Intention BI	I do not want to farm	BI1	3.25	0.72
	I do not want my descendants to farm	BI2	3.54	0.92
	I do not want to farm even with strengthened policy support	BI3	1.80	1.14
Behavioral Response BR	Cultivated land is extensively managed	BR1	1.98	1.31
	Multiple cropping index decreased	BR2	2.91	1.23
	Land is abandoned throughout the year	BR3	2.41	1.27

4.3. Reliability and Validity Test

In order to ensure the quality of the scale items, it was necessary to test the scale's reliability and validity (Table 4). A reliability evaluation includes an evaluation of consistency. It was used to measure the degree to which the questionnaire reflected the actual situation. Cronbach's α coefficient was adopted for testing. It is generally considered that Cronbach's α coefficient below 0.65 is not credible; between 0.65 and 0.70 is acceptable; between 0.7 and 0.8 is quite good; and between 0.8 and 0.9 is very good. The test results showed that the Cronbach's α coefficients for all of the latent variables were close to or over 0.8, indicating that the consistency and stability of the scale data were good.

Table 4. Results of reliability and validity tests and factor analysis.

Paths	Standard Factor Loading	CR Value	Cronbach's α Coefficient	KMO Value	Bartlett Test of Sphericity
AB1 < —AB	0.732	17.960 ***	0.802	0.707	593.637 (p = 0.000)
AB2 < —AB	0.654	16.110 ***			
AB3 < —AB	0.853	——			
SN1 < —SN	0.861	17.562 ***	0.789	0.656	784.478 (p = 0.000)
SN2 < —SN	0.846	17.446 ***			
SN3 < —SN	0.672	——			
PBC1 < —PBC	0.816	28.092 ***	0.895	0.699	1234.732 (p = 0.000)
PBC2 < —PBC	0.717	22.701 ***			
PBC3 < —PBC	0.937	——			
BI1 < —BI	0.574	——	0.830	0.651	945.608 (p = 0.000)
BI2 < —BI	0.874	15.851 ***			
BI3 < —BI	0.951	16.554 ***			
BR1 < —BR	0.703	——	0.831	0.639	841.527 (p = 0.000)
BR2 < —BR	0.767	17.269 ***			
BR3 < —BR	0.954	22.554 ***			

Note: *** indicates significant at 1% level; the CR value is the T value.

Validity testing measures the accuracy and authenticity of the questionnaire's expression of its established goals. Validity testing is usually done by factor analysis. Table 4 shows that the Kaiser-Meyer-Olkin (KMO) values of all of the latent variables were above the threshold value of 0.6. The significance level of the Bartlett sphericity test was 0.000 < 0.001, indicating that the sample data were suitable for factor analysis. In the factor analysis, the load of each observation index in its respective principal component was between 0.561 and 0.954, all of which were greater than the recommended value of 0.5 [37], indicating that the structural validity of the scale items was good. In addition, the covariance ratio (CR) values of the loading coefficients of all of the observation variables were greater than 2 and significant at a 99% confidence level, indicating that the loading coefficients between the latent variables and the observable variables were significant. The scale data passed the reliability and validity tests, and were suitable for further study.

4.4. Model Fitting and Fitness Test

Based on this study's hypotheses, measurement indicators, and test results, an SEM was constructed that included the latent variables of BR, BI, AB, SN, and PBC (Figure 6). Amos 23.0 was used to test the fitness of the SEM. Considering the reasonable co-variation relationship between the variables, six groups of co-variation relationships (e1 and e2, e2 and e7, e2 and e8, e3 and e9, e7 and e8, and e13 and e14) were added, based on the model's preliminary results, and the chi-square value of the model was reduced without violating the theoretical assumptions. Absolute fit indices, incremental fit indices, and parsimonious fit indices were used to assess the fitness of the model [38]. The results are shown in Table 5. All of the fit indices were better than or within the range of acceptable values. The results indicated that the model was properly set for SEM analysis (Table 5).

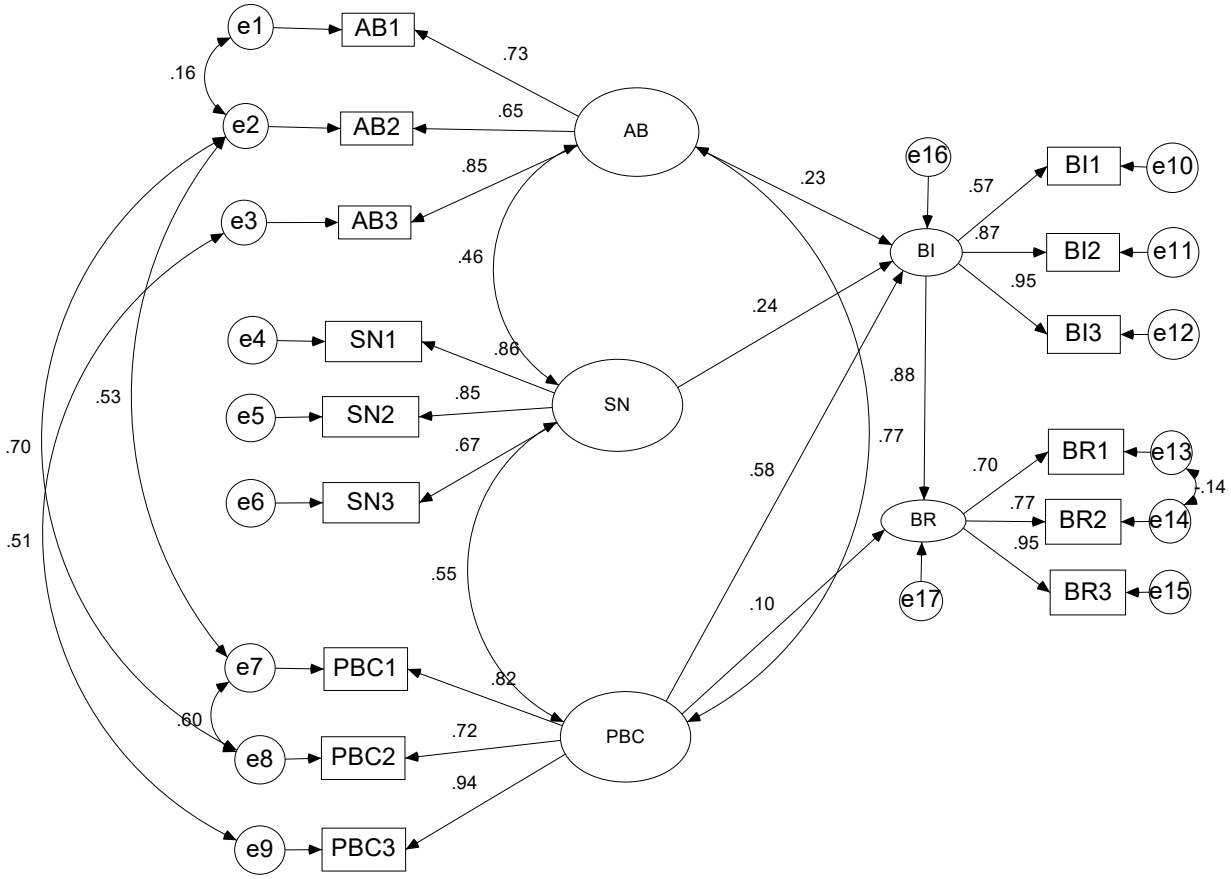


Figure 6. Structural equation model (SEM) on farmers' cultivated land abandonment behavior and its estimation results (Note: → denotes causality among latent variables, from dependent variable to result variable; ↔ denotes correlation among latent variables; e1–e17 denote the residual error of the observation variables in the measurement model and the measurement error in structural model.).

Table 5. Key performance indices of model.

Type of Indices	Abbr.	Acceptable Fit Values	Fit Values	Result
Absolute fit indices				
Goodness-of-fit index	GFI	>0.90	0.914	Accept
Adjusted goodness-of-fit index	AGFI	>0.80	0.864	Accept
Incremental fit indices				
Normed fit index	NFI	>0.90	0.936	Accept
Relative fit index	RFI	>0.90	0.912	Accept
Incremental fit index	IFI	>0.90	0.946	Accept
Tacker–Lewis index	TLI	>0.90	0.925	Accept
Comparative fit index	CFI	>0.90	0.945	Accept
Parsimonious fit indices				
Parsimony goodness-of-fit index	PGFI	>0.50	0.579	Accept
Parsimony-adjusted normed fit index	PNFI	>0.50	0.678	Accept
Parsimony-adjusted comparative fit index	PCFI	>0.5	0.684	Accept
Consistent Akaike information criterion	CAIC	CAIC of the default model was less than that of the saturated model and the independence model	826.294 < 890.790 826.264 < 7971.612	Accept

4.5. Hypothesis Test and Discussion

The results of the critical ration test indicated values of 5.213, 7.198, 10.503, 1.880, 10.602, 8.196, 9.659, and 12.391 for AB→BI, SN→BI, PBC→BI, PBC→BR, BI→BR, AB↔SN, SN↔PBC, and AB↔PBC, respectively. These values were greater than the required significance level, and were significant at 0.01 and 0.06 levels, according to the p-value test results. The estimated results of the SEM for each observed and latent variable are presented in Table 6.

Table 6. Estimation results of the SEM.

Paths	Standardized Path Coefficient	Standardized Error	Critical Ration	Hypothesis Test
BI < —AB	0.234 ***	0.013	5.213	H1 accepted
BI < —SN	0.244 ***	0.026	7.198	H2 accepted
BI < —PBC	0.580 ***	0.018	10.503	H3 accepted
BR < —PBC	0.104 * (p = 0.060)	0.040	1.880	H4 accepted
BR < —BI	0.877 ***	0.185	10.602	H5 accepted
AB < – > SN	0.463 ***	0.046	8.196	
SN < – > PBC	0.547 ***	0.040	9.659	H6 accepted
AB < – > PBC	0.771 ***	0.118	12.391	

Note: ***, * indicate significant at 1% and 10% level, respectively.

According to the model's results, as shown in Table 6 and the path diagram presented in Figure 6, the action logic of farmers' land abandonment behavior conforms to the TPB. Hypotheses H1 to H6 were verified, as detailed below.

AB is an important factor affecting farmers' abandonment behavior intention. Its path coefficient was 0.234 (Table 6, Figure 6), and significant at the 1% level. The factor loadings of its three observation variables were 0.732, 0.654, and 0.853, respectively (Table 4). This showed that farmers' principal concern is whether abandonment influences the environment negatively. Compared with directly observable environmental impacts, the negative impact of abandonment on economy and society affects farmer households through the price system or supply and demand mechanisms, etc., by way of a macroeconomic operation system. Farmers usually know about the negative impact of abandonment on the economy and society via information media, such as news programs with a lag. Therefore, farmers have a deeper understanding of the negative impact of abandonment on the environment than of its impact on the economy and society.

The path coefficient of SN was 0.244 (Table 6, Figure 6), and significant at the 1% level. The factor loadings of its three observation variables were 0.861, 0.846, and 0.672, respectively (Table 4). This showed that farmers' abandonment behavior is affected by external pressure. Moreover, the influence of family and villagers' intervention on abandonment is greater than that of government's intervention. This indicated that the credibility and trust of grassroots governments in rural communities needs to be strengthened. Compared with government regulations, a community code of conduct formed spontaneously by farmers is more recognized by the farmers. Such a code's role in informal institutional constraints suggests that it is particularly important to create a generally recognized cultivation environment in rural communities.

The path coefficient of PBC was 0.580 (Table 6, Figure 6), which was greater than the sum of the path coefficients of AB and SN to BI. It was significant at the 1% level. Meanwhile, as can be seen from Table 7, PBC had direct effects on both BI and BR, which were significant at the level of 1% and 10%, respectively. In addition, the total effect of PBC on BR was greater than the sum of the total effects of AB and SN on BR. This showed that among the three latent variables of farmers' cognition on abandonment, PBC had the greatest influence. Farmers' abandonment decisions depend largely on the objective constraints that have a direct impact on land cultivation and the farmers' ability to control objective conditions, which reflect farmers' extremely pragmatic and cautious attitude with respect to key issues involving their own interests.

Table 7. Standardized direct effect, indirect effect, and total effect of each latent variable to BR.

Effect	AB	SN	PBC	BI
Direct	——	——	0.104 (p = 0.056)	0.877 (p = 0.015)
Indirect	0.205 (p = 0.012)	0.214 (p = 0.012)	0.509 (p = 0.007)	——
Total	0.205 (p = 0.014)	0.214 (p = 0.012)	0.613 (p = 0.007)	0.877 (p = 0.014)

The path coefficient of BI was 0.877 and significant at the 1% level (Table 6, Figure 6), and its standardized total effect on BR was the greatest. These results indicated that BI not only has a mediating effect between farmers' cognition of abandonment and BR, but also directly contributes to farmers' abandonment behavior. AB, SN, and PBC are significantly pairwise correlated in varying degrees (Table 6, Figure 6). This is because they are jointly affected by exogenous variables. For example, farmers with political status may have more social resources, off-farm employment opportunities, and deeper understandings of the negative impacts of abandonment. Meanwhile, they are more likely to be interfered with in making abandonment decisions, due to their special status. In general, attention should be paid to the correlation between the latent variables of farmers' recognition and the relevant regulatory policies regarding abandonment needs, so they can be effectively coordinated and connected to enhance the effects of policy implementation.

5. Conclusions and Policy Recommendations

5.1. Conclusions

The abandonment of cultivated land is a comprehensive decision made by farmers via an overall balancing of cultivated land conditions, non-agricultural income, and labor conditions, combined with their cognition and external interventions. The decision reflects farmers' bounded rationality in land-use decision making. Farmers attitude to behavior (AB), subject norm (SN), and perceived behavioral control (PBC) positively affect their abandonment behavioral intentions, and such intentions play a decisive role in their abandonment behavioral responses. In addition, farmers' AB, SN, and PBC were pairwise correlated.

Regarding AB, farmer has a deeper understanding of the negative impact of abandonment on the environment, rather than on the economy and society. The more farmers know about the negative impacts of abandonment, the lower the likelihood of abandonment. SN mainly refers to the interference of family, villagers, and government in abandonment behavior. In terms of farmers' cognition, the intervention by government in abandonment behavior is stronger than that of family and villagers. However, in terms of effect, the interventions by family and villagers are more significant than that of government. The PBC of farmers' abandonment behavior is mainly focused on tillage conditions, the agricultural labor force, and non-agricultural employment opportunities. PBC is the most influential latent variable among the three latent variables of farmers' cognition.

5.2. Policy Recommendations

Based on the findings of this study, it is recommended that publicity about the rational use of cultivated land be strengthened, and that farmers' awareness of the social, economic, and environmental impacts of land abandonment be improved. It is also recommended that a favorable atmosphere be created atmosphere for farming in rural communities, with support services for agricultural production and operation. Farmers' trust in grass-roots government needs to be enhanced to improve government's performance in implementing the management of the abandonment of cultivated land and improving agricultural services. In terms of perceived behavioral control, tillage conditions need to be improved by means of leveling land, improving mechanization, etc., to enhance agricultural revenue. In addition, local off-farm employment opportunities for the rural labor force need to be increased so that farmers can balance cultivation with off-farm work to avoid abandonment. Ultimately, land transfer is carried out by households that lack agricultural labor.

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Conflicts of Interest: The author declares no conflict of interest.

Notes

[1] Tillage conditions include irrigation and commuting conditions, land quality, and wildlife invasion.

References

1. Lasanta, T.; Arnáez, J.; Pascual, N.; Ruiz-Flaño, P.; Errea, M.; Lana-Renault, N. Space–time process and drivers of land abandonment in Europe. *Catena* **2017**, *149*, 810–823. [CrossRef]
2. Van Vliet, J.; de Groot, H.; Rietveld, P.; Verburg, P.H. Manifestations and underlying drivers of agricultural land use change in Europe. *Landsc. Urban Plan.* **2015**, *133*, 24–36. [CrossRef]
3. Munroe, D.K.; van Berkel, D.B.; Verburg, P.H.; Olson, J.L. Alternative trajectories of land abandonment: Causes, consequences and research challenges. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 471–476. [CrossRef]
4. MacDonald, D.; Crabtree, J.R.; Wiesinger, G.; Dax, T.; Stamou, N.; Fleury, P.; Gutierrez, L.J.; Gibon, A. Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. *J. Environ. Manag.* **2000**, *59*, 47–69. [CrossRef]
5. Van der Zanden, E.H.; Verburg, P.H.; Schulp, C.J.; Verkerk, P.J. Trade-offs of European agricultural abandonment. *Land Use Policy* **2017**, *62*, 290–301. [CrossRef]
6. Chen, Q.R.; Xie, H.L. Research Progress and Discoveries Related to Cultivated Land Abandonment. *J. Resour. Ecol.* **2021**, *12*, 165–174. (In Chinese)
7. Xie, H.L.; Wen, Y.Y.; Choi, Y.; Zhang, X.M. Global trends on food security research: A bibliometric analysis. *Land* **2021**, *10*, 119. [CrossRef]
8. Wang, Y.H.; Li, X.B.; Xin, L.J.; Tan, M.H. Farmland marginalization and its drivers in mountainous areas of China. *Sci. Total Environ.* **2020**, *719*, 135132. [CrossRef]
9. Corbelle-Rico, E.; Sánchez-Fernández, P.; López-Iglesias, E.; Lago-Pẽnas, S.; Da-Rocha, J.M. Putting land to work: An evaluation of the economic effects of recultivating abandoned farmland. *Land Use Policy* **2022**, *112*, 105808. [CrossRef]
10. Simon, H.A. *Administrative Behavior—A Study of Decision-Making Process in Administrative Organization*, 3rd ed.; Macmillan Publishing: New York, NY, USA, 1976.
11. Burton, R.J.F. Reconceptualising the 'behavioral approach' in agricultural studies: A socio-psychological perspective. *J. Rural. Stud.* **2004**, *20*, 371. [CrossRef]
12. Yan, Y. A Review on the Origins and Development of the Theory of Planned Behavior. *Chin. J. Commun.* **2014**, *36*, 113–129. (In Chinese)
13. Chen, Q.R.; Xie, H.L. *Study on the Mechanism of Farmers' Cultivated Land Abandonment Behavior*; Economical Management Publishing House: Beijing, China, 2020. (In Chinese)
14. Chen, Q.R.; Xie, H.L. Temporal-spatial differentiation and optimization analysis of cultivated land green utilization efficiency in China. *Land* **2019**, *8*, 158. [CrossRef]
15. Xie, H.L.; Chen, Q.R.; Wang, W.; He, Y.F. Analyzing the green efficiency of arable land use in China. *Technol. Forecast. Soc. Chang.* **2018**, *133*, 15–28. [CrossRef]
16. Zhao, Y.L.; Zhang, M.; Li, X.B.; Dong, S.Z.; Huang, D.K. Farmland Marginalization and Policy Implications in Mountainous Areas: A Case Study of Renhuai City, Guizhou. *J. Resour. Ecol.* **2016**, *7*, 61–67.
17. Li, S.F.; Li, X.B. Global understanding of farmland abandonment: A review and prospects. *J. Geogr. Sci.* **2017**, *27*, 1123–1150. [CrossRef]
18. Lambin, E.F.; Meyfroidt, P. Land use transitions: Socio-ecological feedback versus socio-economic change. *Land Use Policy* **2010**, *27*, 108–118. [CrossRef]
19. Prishchepov, A.V.; Müller, D.; Dubinin, M.; Baumann, M.; Radeloff, V. Determinants of agricultural land abandonment in post-Soviet European Russia. *Land Use Policy* **2013**, *30*, 873–884. [CrossRef]
20. He, Y.F.; Xie, H.L.; Peng, C.Z. Analyzing the behavioural mechanism of farmland abandonment in the hilly mountainous areas in China from the perspective of farming household diversity. *Land Use Policy* **2020**, *99*, 104826. [CrossRef]
21. Xie, H.L.; Huang, Y.Q. Influencing factors of farmers' adoption of pro-environmental agricultural technologies in China: Meta-analysis. *Land Use Policy* **2021**, *109*, 105622. [CrossRef]
22. Castillo, C.P.; Jacobs-Crisioni, C.; Diogo, V.; Lavalle, C. Modelling agricultural land abandonment in a fine spatial resolution multi-level land-use model: An application for the EU. *Environ. Model. Softw.* **2021**, *136*, 104946.
23. Gellrich, M.; Baur, P.; Koch, B.; Zimmermann, N.E. Agricultural land abandonment and natural forest re-growth in the Swiss mountains: A spatially explicit economic analysis. *Agric. Ecosyst. Environ.* **2007**, *118*, 93–108. [CrossRef]
24. Baldock, D.; Beaufoy, G.; Brouwer, F.; Godeschalk, F. *Farming at the Margins: Abandonment or Redeployment of Agricultural Land in Europe*; Institute for European Environmental Policy: London, UK; The Hague, The Netherlands, 1996.

25. Xie, H.L.; Jin, S.T. Evolutionary game analysis of fallow farmland behaviors of different types of farmers and local governments. *Land Use Policy* **2019**, *88*, 104122. [CrossRef]
26. Ajzen, I. From Intentions to Actions: A Theory of Planned Behavior. In *Action Control: From Cognition to Behavior*; Springer: Berlin/Heidelberg, Germany, 1985; pp. 11–39.
27. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]
28. Yang, X.; Zhou, X.H.; Deng, X.Z. Modeling farmers' adoption of low-carbon agricultural technology in Jianghan Plain, China: An examination of the theory of planned behavior. *Technol. Forecast. Soc. Chang.* **2022**, *180*, 121726. [CrossRef]
29. Chen, H.Z.; Liu, X. New development of the Theory of Planned Behavior theory and its variable connotation. *Sci. Educ. Artic. Collect.* **2008**, *10*, 286. (In Chinese)
30. Xie, H.L.; Huang, Y.Q. Impact of non-agricultural employment and land transfer on farmland abandonment behaviors of farmer: A case study in Fujian-Jiangxi-Hunan Mountainous Areas. *J. Nat. Resour.* **2022**, *37*, 408–423. (In Chinese) [CrossRef]
31. Xie, H.L.; Lu, H. Impact of land fragmentation and non-agricultural labor supply on circulation of agricultural land management rights. *Land Use Policy* **2017**, *68*, 355–364. [CrossRef]
32. Xie, H.L.; Huang, Y.Q.; Chen, Q.R.; Zhang, Y.W.; Wu, Q. Prospects for agricultural sustainable intensification: A review of research. *Land* **2019**, *8*, 157. [CrossRef]
33. Ding, G.P.; Liu, C.W.; Huang, L.M. A theoretical analysis and empirical research of marginalization of agricultural land in hilly-mountainous area under farmer-benefiting policy: A case study of Tongcheng County in Hubei Province. *Geogr. Res.* **2009**, *28*, 109–117. (In Chinese)
34. Schultz, T.W. *Transforming Traditional Agriculture*; Yale University Press: New Haven, CT, USA, 1964.
35. Ellis, F. *Peasant Economics: Farm Households and Agrarian Development*; Cambridge University Press: Cambridge, UK, 1988.
36. Low, A. *Agricultural Development in Southern Africa: Farm Household Theory & the Food Crisis*; James Currey: London, UK, 1986.
37. Yu, Z.N. *The Fallow Behavior of Farmers in Heavy Metal Polluted Region*; Zhejiang University: Zhejiang, China, 2019. (In Chinese)
38. Cheng, J.; Cheng, J.M.; Fei, L.C.; Xu, Y.T.; Zhou, Y.H. Modeling of farmer household psychological decision-making in farmland transfer. *Resour. Sci.* **2017**, *39*, 818–826. (In Chinese)