

Article

Determinants of Local Communities' Willingness to Engage in the Non-Timber Forest Products Industry near Nature Reserves: Evidence from China

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Abstract

Nature reserves are among the regions with the richest forest and grass resources. They face dual pressures of protection and development. The non-timber forest products (NTFPs) industry combines ecological protection with economic development. This unique function provides a key solution to this contradiction. Drawing on the Theory of Planned Behavior (TPB), this study employs a structural equation model (SEM). We collected survey data from 361 farmers. These farmers live in communities surrounding Yunling Provincial Nature Reserve. We empirically examine how behavioral attitude, subjective norm, and perceived behavioral control influence their willingness to participate in the non-timber forest products (NTFPs) industry. The results show that subjective norm and perceived behavioral control significantly enhance participation willingness. Subjective norm emerges as the strongest predictor. In contrast, behavioral attitude has no significant effect. This suggests that external social pressure and perceived self-capability outweigh simple benefit expectations in shaping willingness. Accordingly, we recommend three measures. First, strengthen external support to translate attitudes into actual willingness. Second, leverage social networks to amplify subjective norms. Third, enhance farmers' endogenous capacity to consolidate their participation base. These measures can foster a win-win outcome for ecological protection and community income growth.

Keywords: non-timber forest products; participation willingness; theory of planned behavior; community participation; protection and development; sustainable forest management



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1. Introduction

The coordination between nature reserves and adjacent communities significantly influences conservation management [1]. Consequently, how to harmonize the relationship between nature reserves and surrounding communities to achieve a win-win outcome for both conservation and development has become a pressing issue [2]. China has effectively safeguarded biodiversity by establishing the world's largest system of nature reserves. However, the livelihoods of farmers residing near these reserves have not been adequately secured [3]. While ecological protection is essential, it may also impose restrictions on agricultural production and development in adjacent areas [4,5]. The establishment of nature reserves often limits access to environmental resources within their boundaries,

compelling residents to alter their traditional ways of life [6]. Nature reserves and surrounding communities constitute a closely interconnected organic whole; thus, the attitudes of local farmers toward reserve development are critical determinants of the long-term sustainability of conservation efforts [7]. When rural residents living near reserves can derive economic benefits, their support for conservation is maximized [8]. Therefore, understanding farmers' perceptions of ecological benefits and losses is vital for ensuring the sustainable development of nature reserves [9,10]. Domestically, the non-timber forest products (NTFPs) industry serves as a key approach to effectively promote rural revitalization in forested regions. It enables the full utilization of forest resources while advancing ecological conservation and stimulating local economic growth [11,12]. Internationally, the NTFPs industry plays a critical role in rural economic development, sustainability, and biodiversity conservation, serving as a vital source of livelihood for millions of people living in forest-fringe communities worldwide [13–15], and providing alternative income sources that help alleviate poverty in forest-dependent communities [16]. The NTFPs industry represents not only a business model aligned with modern forestry trends but also an industrial form contributing to sustainable development goals. Moreover, it serves as a key vehicle for realizing the “Two Mountains” philosophy within the broader framework of ecological civilization construction [17,18]. It encompasses activities such as under-forest cultivation, animal husbandry, the collection and processing of forest by-products, and the utilization of forest landscapes [19,20]. Thus, the high-quality development of the NTFPs industry holds significant strategic importance for ecological civilization, regional development, and livelihood security [21,22].

The NTFPs industry is a vital livelihood source for millions of forest-edge communities worldwide. In China's vast mountainous areas, the NTFPs industry has a long history. It meets subsistence needs and also enters markets through various trade channels. However, the establishment of nature reserves introduced strict regulations. These regulations prohibited logging, grazing, hunting, medicinal plant collection, and land reclamation. As a result, traditional income channels for surrounding farmers narrowed. Farmers were forced to change their livelihood methods. To ease this conflict, the National Forestry and Grassland Administration now encourages the rational use of forest resources. This is permitted provided that ecological protection requirements are met. According to the newly revised Regulations on Nature Reserves, nature reserves are divided into core protection areas and general control areas. Zoned management is applied. In general control areas, certain forest-related activities are permitted. These include ecotourism, scientific and educational activities, and moderate resource utilization.

In this context, a key question arises. Can the NTFPs industry serve as an effective alternative livelihood option? The answer depends crucially on the willingness of surrounding farmers to participate. This is the core issue of this study. Accordingly, the main objectives of this research are threefold.

- (1) At the theoretical level, this study introduces the Theory of Planned Behavior (TPB). It aims to clarify the key psychological antecedents of farmers' willingness to participate in the NTFPs industry.
- (2) At the empirical level, this study uses the structural equation model (SEM). The model quantifies the effect size and path differences of each influencing factor. It also clarifies their relative importance.
- (3) At the practical level, based on the research findings, this study will provide scientific support. This support is intended for the precise design of community co-management policies in the protected area.

2. Materials and Methods

2.1. Study Area

Yunling Provincial Nature Reserve is located in Yunnan Province. It lies in the south-east of Lanping County, Nujiang Prefecture. It sits on the east bank of the Lancang River. Its total area is 75,894.00 hectares. The reserve was established by the Yunnan Provincial People's Government in 2003. The reserve lies within the Hengduan Mountains biodiversity hotspot. Its natural ecosystems are dominated by mid-mountain humid evergreen broad-leaved forests, with pronounced altitudinal zonation ranging from subtropical valley vegetation to alpine meadows. Its surrounding communities cover 6 townships or sub-districts. According to statistics, the reserve contains 15 village committees. It includes 60 natural villages. There are 2448 households and 8971 people. Currently, local households rely on multiple income sources, including crop cultivation, livestock husbandry, collection of forest products (wild edible fungi and medicinal herbs), and seasonal wage labor outside the community. In terms of natural resources with potential economic value, the region supports various marketable non-timber forest products, including wild edible fungi and medicinal herbs. Additionally, the reserve's forest ecosystems and altitudinal vegetation gradients provide conditions suitable for ecotourism and nature education activities within designated general control areas.

Since its establishment in 2003, Yunling Provincial Nature Reserve has secured funding from multiple sources. This funding has helped progressively improve the infrastructure of the reserve and its surrounding communities. The reserve has also implemented the "Community Resource Co-management Village" project. This project is funded by the Yunnan Green Environment Development Foundation. Nevertheless, a contradiction remains pronounced. It exists between the available natural resources within the reserve and the population it must support. The pressure on resource and environmental carrying capacity is intensifying. Meanwhile, the community economy remains relatively underdeveloped. This severely constrains community development.

In the early stage following the reserve's establishment, the primary objective was the protection of resources and species, pursued by restricting local communities' utilization of resources within the reserve. This management approach tended to be closed and coercive in nature. However, after the reserve became operational, community residents who had depended on these natural resources for their livelihoods, affected by multiple factors, made considerable sacrifices, yet their production and living difficulties were not effectively resolved, and their living standards gradually fell behind the regional average. With continued population growth and local economic development, tensions between the community and the reserve have become increasingly pronounced.

Against this backdrop, simply imposing resource use restrictions cannot achieve long-term win-win outcomes. Promoting the sustainable development of the NTFPs industry offers a viable pathway. This pathway helps surrounding communities diversify economic activities. It enables residents to acquire stable income. This helps ease human-nature conflicts within the reserve. This forms the practical motivation for this study. The study investigates farmers' willingness to participate in the NTFPs industry.

2.2. Data Sources and Sampling Method

The data for this study were collected through on-site questionnaire surveys conducted in Lanping County, Yunnan Province, in January and April 2026. According to statistics from the Yunling Nature Reserve Administration, the survey covered 15 village committees and 60 villagers' groups around Yunling Provincial Nature Reserve, involving a total of 2448 households. Convenience sampling was adopted, with each household serving as the sampling unit. The sample size was determined based on Yamane's for-

mula ($n = N / (1 + N \times e^2)$), using a 95% confidence level and an allowable error of $\pm 5\%$; substituting $N = 2448$ households [23], the minimum theoretical sample size was calculated to be 344 households. In addition, the core scale contained 19 measurement items, yielding a sample-size-to-item ratio of approximately 19:1, which met the standards of multivariate statistical analysis and provided sufficient data support for examining variable relationships in the subsequent model.

In this study, a total of 400 questionnaires were distributed, from which 361 valid questionnaires were retrieved, yielding an effective recovery rate of 90.25%. To ensure smooth progress, all members of the research team had experience in conducting on-site farmer surveys, and the reserve management bureau and local village committee provided coordination for door-to-door visits, which effectively increased the success rate of questionnaire collection. The survey was conducted through face-to-face interviews and proxy-assisted completion, with researchers using simple and understandable local language and standardizing the interpretation of questionnaire items to minimize understanding errors. Upon collection, each questionnaire was thoroughly reviewed, and for samples with missing key variables or obvious patterned responses, a second door-to-door visit was conducted to supplement information, ensuring the reliability of the research data.

2.3. Theoretical Foundation

2.3.1. Theory of Planned Behavior

The TPB is the most widely recognized attitude–behavior framework in social psychology. The theory originated from Fishbein’s Multiattribute Attitude Theory [24]. In 1985, Ajzen formally proposed the TPB as a classic social–psychological framework for explaining individual decision-making in specific contexts [25]. According to this theory, an individual’s behavior is determined by their behavioral intention, which is in turn shaped by three key constructs: behavioral attitude (BA), subjective norm (SN), and perceived behavioral control (PBC) [26]. In 1995, Taylor [27] further decomposed these three influencing factors into multiple sub-dimensions, addressing the operational and interpretive limitations of the original TPB framework. This extension offered clear advantages in explaining individuals’ behavioral motivations and intentions, and has been widely applied across the humanities and social sciences [28].

2.3.2. Application of the TPB in the Study of Farmers’ Behaviors

The TPB has been widely applied since its inception. It has been used in diverse domains. These include pro-environmental behavior [29,30], business management [31,32], and educational administration [33,34]. Existing studies focus on farmer participation behavior. They show a threefold effect of the TPB on farmers’ willingness toward “non-grain conversion”. First, BA tends to act as a barrier. Second, the direction of SNs varies by livelihood type. Third, PBC exerts an enhancing influence [35,36]. The theory also exhibits strong explanatory power and applicability in studies of farmland abandonment [37], rural land transactions [38], and land transfer [39]. In international academia, the TPB has become a core paradigm. It explains farmers’ pro-environmental agricultural behaviors. Representative applications include several studies. These studies examine European farmers’ adoption of ecological agriculture [40]. They also cover Indian farmers’ safety perceptions of pesticide use [41]. They further explore the motivations behind New Zealand farmers’ low-carbon agricultural practices [42]. Further research has incorporated external variables. These include policy satisfaction and perceived costs. They are added into the “attitude-intention-behavior” chain. This improves explanatory power. The existing literature generally identifies a consistent structural characteristic. First, subjective norms

exert weaker effects. Second, attitude serves as the central mediator. Third, perceived behavioral control and cost barriers jointly account for the intention–behavior gap [43–45]. In recent years, the TPB has also attracted attention in research on farmer behavior within nature reserves [46,47]. One study used micro-level data from 378 farmers. These farmers were located in three national nature reserves. The reserves are in Yunnan and Hunan provinces. The study confirmed several findings. BA, SN, and PBC exert significant positive direct effects on farmers’ environmental protection willingness. They also indirectly influence environmental protection behaviors. This happens through the mediating variable of willingness [48]. The literature reviewed above clearly demonstrates a key point. The TPB has formed a mature research paradigm for studying farmer willingness. It provides solid theoretical support for the present study.

2.3.3. Proof of the Applicability of the Theoretical Model

The TPB shows high applicability in explaining the willingness of communities surrounding nature reserves to engage in the NTFPs industry. First, the willingness to participate in the NTFPs industry reflects a rational decision-making process, in which residents evaluate the potential benefits, costs, and risks associated with the industry before deciding, corresponding to the BA dimension [49]. Second, rural communities function as close-knit social groups, where the opinions of neighbors and village officials strongly guide individual willingness, corresponding to the SN dimension [50]. Third, participation in the NTFPs industry involves tangible constraints, including capital investment, technological thresholds, and labor allocation, and residents make a subjective assessment of whether they possess the necessary conditions to overcome these barriers, which directly shapes their willingness and corresponds to the PBC dimension [51]. In summary, the TPB provides an appropriate theoretical framework for the present study, please refer to Figure A1 in Appendix A for details.

2.4. Research Hypotheses

2.4.1. Behavioral Attitude (BA)

Behavioral attitude refers to an individual’s cognition and evaluation of performing a specific behavior, reflecting the positive or negative feelings associated with the decision to engage in that behavior [52]. Accordingly, Hypothesis 1 is proposed:

H1: *Behavioral attitude influences farmers’ willingness to participate in the NTFPs industry.*

2.4.2. Subjective Norm (SN)

Subjective norm refers to the influence of external social factors on an individual’s behavioral intention [53], reflecting the impact exerted by significant individuals or groups in one’s social environment. Accordingly, the following hypothesis is proposed:

H2: *Subjective norms influence farmers’ willingness to participate in the NTFPs industry.*

2.4.3. Perceived Behavioral Control (PBC)

Perceived behavioral control refers to the constraints derived from one’s past experiences and anticipated obstacles [54]. It reflects an individual’s confidence in successfully performing a given task and their perceived degree of control, representing a subjective evaluation of available resources, actual capabilities, and external opportunities. Accordingly, the following hypothesis is proposed:

H3: *Perceived behavioral control influences farmers’ willingness to participate in the NTFPs industry.*

2.5. Scale Design

Guided by the TPB, and informed by the results of the pre-survey and the actual conditions of the study area, 19 scale items were designed to measure BA, SN, PBC, and behavioral intention. The scale adopted a five-point Likert format, ranging from “strongly disagree” 1 to “strongly agree” 5, as shown in Table 1.

Table 1. Scale of farmers’ willingness to participate in the NTFPs industry.

Variable Type	Latent Variable	Observational Variable	Coding	Assignment
Independent Variable	Behavioral Attitude	Developing the NTFPs industry is an effective way to increase your family’s income.	BA1	1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
		Developing the NTFPs industry is beneficial for protecting the ecological environment of Yunling Provincial Nature Reserve.	BA2	
		Developing the NTFPs industry can bring more development opportunities to our village.	BA3	
		After participating in the NTFPs industry, your family’s income will increase significantly in the next two years.	BA4	
		You think that developing the NTFPs industry is a good thing with more advantages than disadvantages.	BA5	
	Subjective Norm	Your family supports you in participating in the NTFPs industry.	SN1	
		Most of your relatives and friends agree with your participation in the NTFPs industry.	SN2	
		You can feel the encouragement from the government/protected area administration for villagers to participate in the NTFPs industry.	SN3	
		There are people in the village or nearby who have made money through the NTFPs industry. You also want to give it a try.	SN4	
		The village officials or government departments believe that villagers should participate in the NTFPs industry.	SN5	
	Perceived Behavioral Control	Without the help of others, you can also do well in the NTFPs industry by yourself.	PBC1	
		The current forest reform policies guarantee your right to develop the NTFPs industry.	PBC2	
		You are clear about what can and cannot be done near Yunling Provincial Nature Reserve.	PBC3	
		For you, there is no problem in selling the produce, and there is a place to collect it.	PBC4	
		The risks of the NTFPs industry are ones that you can bear and handle.	PBC5	
Dependent Variable	Behavioral Intention	You are willing to try participating in the NTFPs industry within the next year.	BI1	
		You are willing to invest the necessary time, funds and effort in developing the NTFPs industry.	BI2	
		You are willing to participate in the technical training related to the NTFPs industry.	BI3	
		You are willing to recommend participating in the NTFPs industry to your relatives and friends.	BI4	

3. Results

3.1. Sample Description

In terms of demographic characteristics, males accounted for 59.8% of the sample, compared with 51.17% at the county level according to the 2024 statistical bulletin on national economy and social development of Lanping County; females accounted for 40.2% versus 48.83% countywide. The higher proportion of male respondents is consistent with a common reality in rural household surveys, where male household heads, as main family decision-makers, are more likely to be respondents. The sample shows acceptable representativeness for the study of farmers' behaviors. With respect to ethnic composition, the Bai and Lisu groups together accounted for 77.8% of the sample, with the remainder distributed among the Yi, Pumi, Han, and other ethnic groups, indicating a distinctly multi-ethnic settlement pattern basically in line with the overall ethnic structure of Lanping County.

From an economic perspective, 65.9% of the surveyed households reported an annual income below 20,000 yuan and 28.5% reported incomes between 20,000 and 40,000 yuan; together, these two groups accounted for over 90% of the sample. According to the same county bulletin, the average annual income of rural households is approximately 33,600 yuan, meaning the vast majority of sampled farmers earn less than the county average, consistent with the geographical characteristics of the protected area (remote mountainous areas with poor economic conditions). With regard to human capital, households with one or two laborers accounted for 70.9% of the sample; however, limitations in labor capacity were pronounced, as only 46.3% of respondents could participate in regular labor, 19.7% were limited to light labor, and 6.9% were unable to work. Consequently, most respondents reported difficulty in undertaking high-intensity production activities (Table 2).

Table 2. Basic characteristics of the sample.

Indicator	Option	Frequency/ Count	Frequency/%	Indicator	Option	Frequency/ Count	Frequency/%
Gender	Male	216	59.8	Ethnicity	Bai ethnic group	147	40.7
	Female	145	40.2		Pumi ethnic group	29	8
Age Group	18–30	12	3.3		Yi ethnic group	33	9.1
	31–40	72	19.9		Lisu ethnic group	134	37.1
	41–50	140	38.8		Han ethnicity	13	3.6
	51–60	111	30.7		Others	5	1.4
	>60	26	7.2	Labor Force (Person)	1	87	24.1
	<2	238	65.9		2	169	46.8
Total Income (in ten thousand yuan)	2–4	103	28.5		3	57	15.8
	4–6	16	4.4		4	40	11.1
	6–8	2	0.6		>5	8	2.2
	>8	2	0.6		Unable to engage in labor	25	6.9
					Can only participate in light labor	71	19.7
Educational Level	Primary School and Below	218	60.4	Health Situation	Can participate in regular labor	167	46.3
	Junior High School	122	33.8		Can participate in moderate labor	80	22.2
	High School/Vocational School	17	4.7		Labor capacity is unrestricted	18	5
	Associate Degree/Bachelor's Degree	4	1.1				

The descriptive statistics of the measurement items for each latent variable are shown in Table 3. Overall, the mean values of all items range from 2.75 to 3.54, clustering around the scale midpoint of 3.0. This pattern indicates that respondents generally held a neutral to mildly favorable stance across all dimensions, rather than expressing clear agreement or disagreement. The mean values of the BA items range from 2.93 to 3.34, with BA1 recording the highest score (3.34), suggesting that farmers cautiously recognize the comprehensive benefits of the NTFPs industry, though their assessment of living-standard improvements (BA3 = 2.93) remains relatively reserved. The SN dimension ranges from 2.95 to 3.54, with SN1 (3.54) recording the highest value in the entire sample, indicating that government support and external expectations are the most salient perceived influences. The PBC dimension ranges from 2.75 to 3.17, with an overall mean below the neutral midpoint, indicating relatively weak confidence in resource conditions; PBC5 (2.75) is the lowest, reflecting insufficient risk tolerance. The BI dimension ranges from 2.89 to 3.27, with BI1 (3.27) scoring highest, suggesting initial interest but an overall wait-and-see attitude toward participation.

Table 3. Descriptive statistics of measurement items.

Latent Variable	Coding	N	Mean	Std. Deviation
Behavioral Attitude	BA1	361	3.34	1.187
	BA2	361	3.04	0.971
	BA3	361	2.93	0.946
	BA4	361	3.04	0.971
	BA5	361	3.04	0.971
Subjective Norm	SN1	361	3.54	1.227
	SN2	361	2.95	0.997
	SN3	361	3.02	0.960
	SN4	361	3.01	0.992
	SN5	361	3.01	0.996
Perceived Behavioral Control	PBC1	361	3.17	1.250
	PBC2	361	2.87	1.015
	PBC3	361	2.78	0.997
	PBC4	361	2.83	1.006
	PBC5	361	2.75	0.963
Behavioral Intention	BI1	361	3.27	1.178
	BI2	361	2.89	1.006
	BI3	361	2.94	0.970
	BI4	361	2.96	0.939

3.2. Reliability and Validity Test

The design of the questionnaire scales directly affects the reliability and validity of the research conclusions. Cronbach's α coefficient is conventionally used for reliability testing, with values exceeding 0.7 generally regarded as indicating satisfactory reliability [55]. In this study, reliability and validity analyses of the overall questionnaire scale were conducted using SPSS 27.0, with the results presented in Table 4. The Cronbach's α coefficients for each observed variable ranged from 0.718 to 0.821, indicating high internal consistency across the questionnaire responses. The Kaiser–Meyer–Olkin (KMO) measure was used to assess the suitability of the data under each latent variable for factor analysis. The KMO values for all items ranged between 0.774 and 0.819, demonstrating that the sample data are well suited for subsequent factor analysis to verify structural validity [56]. Taken together, these results confirm that the scale exhibits strong reliability and stability.

Table 4. Reliability and validity analysis.

Latent Variable	Coding	KMO	CITC	Cronbach's α	Totality
Behavioral Attitude	BA1	0.819	0.773	0.767	0.839
	BA2		0.624	0.811	
	BA3		0.588	0.821	
	BA4		0.618	0.813	
	BA5		0.618	0.813	
Subjective Norm	SN1	0.795	0.831	0.729	0.830
	SN2		0.579	0.810	
	SN3		0.608	0.802	
	SN4		0.600	0.804	
	SN5		0.538	0.821	
Perceived Behavioral Control	PBC1	0.805	0.806	0.738	0.830
	PBC2		0.668	0.785	
	PBC3		0.567	0.812	
	PBC4		0.556	0.815	
	PBC5		0.557	0.815	
Behavioral Intention	BI1	0.774	0.787	0.718	0.828
	BI2		0.673	0.775	
	BI3		0.608	0.804	
	BI4		0.568	0.820	

3.3. Empirical Results and Analysis

3.3.1. Model Fit

We used AMOS 29.0 to compute fit indices. Eight indicators were selected to evaluate model goodness-of-fit. Some indicators reflect the deviation between the sample data and the theoretical model. These include CMIN/DF, RMSEA, RMR, GFI, and AGFI. Other indicators measure optimization of the target model relative to a benchmark model. These include IFI, TLI, and CFI. Combining these two types of indicators allows a comprehensive and robust assessment of model fit. This approach is common in structural equation modeling research. The validation results are presented in Table 5. They demonstrate that the SEM in this study achieves an excellent fit with the empirical sample data. The model specification is well grounded [57,58]. This provides a robust basis for subsequent path analysis and hypothesis testing.

Table 5. Model fit test.

Indicator	Reference Standard	Actual Fitted Value	Model Goodness of Fit
CMIN/DF	1–3 is excellent, 3–5 is good	1.423	Satisfaction
RMSEA	<0.05 is excellent, <0.08 is good	0.034	Satisfaction
RMR	<0.05 is excellent, <0.08 is good	0.043	Satisfaction
IFI	>0.9 is excellent, >0.8 is good	0.980	Satisfaction
TLI	>0.9 is excellent, >0.8 is good	0.977	Satisfaction
CFI	>0.9 is excellent, 0.8–0.9 is acceptable	0.980	Satisfaction
GFI	>0.9 is excellent, 0.8–0.9 is acceptable	0.942	Satisfaction
AGFI	>0.9 is excellent, 0.8–0.9 is acceptable	0.924	Satisfaction

3.3.2. Convergent Validity and Composite Reliability

To ensure the validity of the structural equation model analysis, we first assess the measurement model for reliability and validity prior to testing the structural model hypotheses. Specifically, we employ confirmatory factor analysis to evaluate the consistency, reliability, and discriminant validity of the measurement indicators. These indicators be-

long to each latent variable. As shown in Table 6, the standardized factor loadings (Std. Est.) of all observed variables range from 0.581 to 0.978, exceeding the recommended minimum threshold of 0.5 [59], with t-values significant at the $p < 0.001$ level, confirming the effectiveness of the measurement indicators. Notably, the loadings of core indicators such as BA1, SN1, PBC1, and BI1 exceed 0.9, demonstrating excellent measurement quality. The composite reliability (CR) values of the four latent variables are 0.834, 0.834, 0.829, and 0.827, respectively, all surpassing the recommended threshold of 0.7 [60]. The average variance extracted (AVE) values are 0.508, 0.512, 0.501, and 0.553, respectively, all exceeding the standard of 0.5 [61]. These results indicate that each dimension exhibits satisfactory convergent validity and composite reliability, justifying further structural model analysis.

Table 6. Convergent validity and composite reliability.

Latent Variable	Coding	Std. Est.	S.E.	<i>p</i>	SMC	CR	AVE
Behavioral Attitude	BA1	0.927			0.859	0.834	0.508
	BA2	0.677	0.042	***	0.458		
	BA3	0.584	0.045	***	0.341		
	BA4	0.662	0.043	***	0.438		
	BA5	0.667	0.043	***	0.445		
Subjective Norm	SN1	0.978			0.956	0.834	0.512
	SN2	0.644	0.036	***	0.415		
	SN3	0.651	0.036	***	0.424		
	SN4	0.653	0.036	***	0.426		
	SN5	0.581	0.038	***	0.338		
Perceived Behavioral Control	PBC1	0.965			0.931	0.829	0.501
	PBC2	0.676	0.04	***	0.457		
	PBC3	0.636	0.038	***	0.404		
	PBC4	0.585	0.04	***	0.342		
	PBC5	0.61	0.037	***	0.372		
Behavioral Intention	BI1	0.973			0.947	0.827	0.553
	BI2	0.7	0.04	***	0.490		
	BI3	0.639	0.039	***	0.408		
	BI4	0.607	0.039	***	0.368		

*** $p < 0.01$.

3.3.3. Discriminant Validity

After verifying that each latent variable has good reliability and convergent validity, we test discriminant validity. This confirms whether the four constructs are sufficiently distinct from each other. As shown in Table 7, the square roots of the average variance extracted (AVE) for each latent variable (ranging from 0.708 to 0.744) are all greater than the corresponding inter-construct correlation coefficients (ranging from 0.370 to 0.653), thereby satisfying the Fornell–Larcker [62] criterion. This indicates that the four constructs—BA, SN, PBC, and behavioral intention—exhibit satisfactory discriminant validity, supporting the appropriateness of subsequent structural model path analysis.

Table 7. Discriminant validity.

Latent Variable	AVE	Behavioral Attitude	Subjective Norm	Perceived Behavioral Control	Behavioral Intention
Behavioral Attitude	0.508	0.713			
Subjective Norm	0.512	0.562	0.715		
Perceived Behavioral Control	0.501	0.370	0.578	0.708	
Behavioral Intention	0.553	0.438	0.653	0.567	0.744

3.3.4. Path Analysis and Hypothesis Testing

This study incorporates three influencing paths into a structural model. These paths are BA, SN, and PBC. They are estimated jointly. This approach has two key benefits. First, it enables us to clearly determine the effect size and significance level of each path. It does so while controlling the mutual influence among the variables. Second, it helps control the interrelationships among the three independent variables. We can obtain the effects of each variable after controlling the other variables. On the other hand, this approach allows for a direct comparison of the magnitudes of standardized path coefficients. This distinguishes the relative importance of each factor.

As shown in Table 8, both SN ($\beta = 0.444$, $p < 0.001$) and PBC ($\beta = 0.279$, $p < 0.001$) exert significant positive effects on farmers' willingness to participate in the NTFPs industry, with SN emerging as the strongest driver. In contrast, the positive effect of BA ($\beta = 0.085$, $p = 0.112$) is not statistically significant. Accordingly, Hypotheses H2 and H3 are supported, whereas H1 is not. These findings suggest that, within this sample, external social influence and farmers' perceptions of their own conditions are the decisive factors shaping participation willingness. At the same time, benefit cognition alone is insufficient to translate directly into participation behavior.

Table 8. Model path relationships.

Hypothesis	Path Relationship			Std. Est	S.E.	<i>p</i>	Result
H1	Behavioral Intention	←	Behavioral Attitude	0.085	0.056	0.112	Not valid
H2	Behavioral Intention	←	Subjective Norm	0.444	0.135	***	Valid
H3	Behavioral Intention	←	Perceived Behavioral Control	0.279	0.110	***	Valid

*** $p < 0.01$.

4. Discussion

This study draws on the Theory of Planned Behavior (TPB) and employs a structural equation model (SEM) to examine how behavioral attitude (BA), subjective norm (SN), and perceived behavioral control (PBC) influence farmers' willingness to participate in the non-timber forest products (NTFPs) industry, using survey data from 361 farmers around Yunling Provincial Nature Reserve. The main findings are as follows.

First, behavioral attitude had no significant positive influence on farmers' willingness to participate in the NTFPs industry ($\beta = 0.085$, $p = 0.112$), indicating that farmers' positive evaluation of its comprehensive benefits, including economic, ecological, and social benefits as well as income expectations, was insufficient to reach statistical significance; thus, Hypothesis H1 is not supported. From the descriptive statistics, the mean value of the behavioral attitude dimension was slightly above 3 points, suggesting that the interviewed farmers generally recognized the comprehensive benefits of the NTFPs industry and held a mildly favorable perception of its development. However, this finding is not isolated, as a study of 247 farmers in Seychelles similarly found that although most farmers expressed willingness to learn agroforestry practices, behavioral attitudes were not statistically significant [51], suggesting that the explanatory power of each TPB dimension for behavioral intention varies across specific environments. The reasons for the non-significance in this study are multi-faceted. Strict institutional constraints in the protected area constitute a structural barrier, while the educational limitations of the sample, in which 94.2% had junior high school education or below, made it difficult for farmers to fully understand the policies and participation procedures. Furthermore, weak resource endowments weakened the attitude–intention transformation: farmers with total income of 40,000 yuan or below

accounted for 94.4%, and poor health conditions coupled with a lack of human and financial capital resulted in extremely limited risk-bearing capacity.

Second, subjective norms have a significant positive impact on farmers' willingness to participate in the NTFPs industry ($\beta = 0.444, p < 0.001$), indicating that external social pressures, including family support, recognition from relatives and friends, demonstrations by others, and government support and expectations, exert the strongest positive influence on farmers' willingness to engage in the NTFPs industry; thus, Hypothesis H2 is confirmed. The descriptive statistics show a relatively high overall score for the subjective norms dimension, with the item representing government support ranking first in the entire sample. This confirms that farmers can generally perceive external positive normative guidance from policy support, neighborhood demonstration, and family recognition, and that their behavioral decisions are largely driven by the attitudes and behaviors of key groups. The community is a typical close-knit society in which social network pressure and role model effects are significantly stronger than individual independent judgment. This finding is consistent with international research, as a survey of 563 farmers in Ireland similarly found that subjective norms had the most significant impact on farmers' willingness to participate in afforestation projects [63]. In this research area, this effect is further amplified because 76.7% of the farmers are over 40 years old, and long-term settlement has formed a close network of familiar relationships in which trust in successful cases and social evaluations far exceeds trust in general external information. In addition, local state-owned forest farms play a leading role in the NTFPs industry, providing an intuitive and credible reference benchmark for the community; thus, subjective norms occupy a dominant position in farmers' decision-making.

Third, perceived behavioral control has a significant positive impact on farmers' willingness to participate in the NTFPs industry ($\beta = 0.279, p < 0.001$), indicating a clear pattern: when farmers perceive that they possess certain capabilities, including self-capability, property rights protection, policy understanding, market channels, and risk tolerance, their willingness significantly increases; thus, Hypothesis H3 is confirmed. However, the descriptive statistics show that the overall score of the perceived behavioral control dimension is generally below the neutral critical value of 3, with risk tolerance-related items scoring the lowest. This demonstrates that the interviewed farmers generally face practical shortcomings, such as a lack of technology, insufficient market channels, and weak risk resistance ability, suggesting that enhancing farmers' perceived capabilities and resource availability cognition represents an important path to promote their participation. Existing research has confirmed this role; for instance, a study of 202 Ethiopian respondents found that PBC was crucial for feed collection intentions [64], and a survey of 300 farmers in Iran showed that perceived behavioral control significantly enhances farmers' sustainable environmental intentions and behaviors [65]. The above cross-regional and cross-context empirical evidence consistently indicates that the significant positive impact of perceived behavioral control on farmers' behavioral intentions has wide applicability.

Fourth, this paper focuses on the areas surrounding nature reserves, where the contradiction between ecological protection and livelihood development is particularly prominent. Starting from the psychological factors of farmers, we reveal the key paths influencing willingness to participate in the NTFPs industry and the differentiated effects of each TPB dimension. This research provides targeted empirical evidence and policy references for coordinating ecological protection in reserves and community livelihood development, as well as Chinese empirical experience for studying the behavioral decision-making mechanisms of communities surrounding protected areas globally.

5. Conclusions

Subjective norms significantly enhance farmers' willingness to participate in the NTFPs industry. They are the most significant influencing factor. The surrounding area of the protected area is a rural environment. Here, external influences have a much stronger effect on farmers' participation choices. These include government support, support from relatives and friends, and the leading role of exemplary farmers. Farmers' participation decisions are more influenced by external positive guidance. They are less influenced by their personal subjective judgments.

Perceived behavioral control is an important basic condition for farmers' participation in the NTFPs industry. Farmers generally believe that they have deficiencies. These deficiencies are in funds, technology, market channels, and risk tolerance. However, their subjective perception of their own capabilities and resource conditions can significantly enhance their participation willingness. This perception is an important practical threshold. It affects whether farmers participate in the NTFPs industry.

Farmers' participation attitude has not been effectively transformed into participation willingness. A significant disconnection exists. Farmers generally recognize the development value and comprehensive benefits of the NTFPs industry. However, their positive attitude is difficult to transform into actual willingness. This is because of the restrictions of the ecological management regulations of the protected area. It is also because of their own lack of resources and capabilities. Consequently, there is a phenomenon of positive attitude but insufficient willingness.

This study still has certain limitations. In terms of sampling, this paper uses convenience sampling to obtain the research samples. This may cause certain sample selection bias. It may also have a slight impact on the estimation accuracy of the model path coefficients. Therefore, caution is needed when extending the conclusions of this study to external regions. In the future, probability sampling can be adopted. Cross-regional research can be conducted. This will further enhance the universality of the conclusions. In terms of variable measurement, all data rely on farmers' subjective self-reports. These may have certain social expectation biases. In the future, cross-validation can be carried out. It can combine farmers' actual participation behavior data. This will improve the objectivity of the data. In terms of research methods, this study only uses quantitative model analysis. It studies the mechanism of farmers' participation intention. It cannot fully reveal the deep motives and true logic behind farmers' decisions. In the future, qualitative research methods can be combined. These include in-depth interviews and field observations. Mixed research methods can be used. This will further enrich the research conclusions. It will also enhance the policy reference value of the research results.

6. Recommendations

6.1. Strengthen the External Support System and Establish a Channel for Transforming Behavioral Attitude into Participation Intentions

Respondents hold neutral perceptions of the ecological and economic benefits of the NTFPs industry. This is consistent with the descriptive statistics of the behavioral attitude items. However, they face dual constraints. One is the strict institutional regulations in the protected area. The other is their own weak human capital. Under these constraints, their positive attitude is difficult to independently translate into a willingness to participate. Therefore, this paper puts forward the following suggestions.

First, we should follow the practice of the experimental and demonstration project for the NTFPs industry in Lanping County. A special support fund should be established in areas such as the Xinshengqiao Forest Area. This fund will provide farmers with physical subsidies such as seedlings, agricultural materials, and facilities. It may also provide small

credit support. The focus should be on promoting suitable varieties. These include forest medicinal herbs, forest vegetables, and forest fungi. Second, improve infrastructure in forest areas on a village basis. This means improving roads, irrigation, and storage facilities. This will reduce operating costs. Third, rely on the talent training program. Carry out practical technology training. This training should focus on suitable models such as forest medicinal herbs, forest vegetables, and forest fungi. This will help fill the gap in human capital. It will transform positive attitudes into motivation to participate and the capability to act.

6.2. Make Good Use of Social Network Resources to Maximize the Release of Positive Driving Forces of Subjective Norm

The willingness of farmers to participate is mainly influenced by external social pressures. These pressures include family support, recognition from relatives and friends, the impetus from model farmers, and government encouragement. These factors have the highest explanatory power. The following suggestions are proposed.

First, select and cultivate model households for the NTFPs industry. Draw on the successful experience of Lanping County, Yingpan Town. Their experience lies in developing NTFPs. Organize on-site visits and demonstrations. This will activate the driving effect through a visible increase in income. Second, leverage the leading role of key groups. These groups include village officials, Party members, and clan elders. Use methods such as village meetings and neighborhood mobilization. This will strengthen family support and community identification. Third, the government should clearly convey positive support signals. These signals include commitments to providing technical guidance, connecting with leading enterprises, and establishing a guaranteed purchase mechanism. External expectations should be internalized into social incentives that farmers can perceive. It is suggested to fully utilize the advantages of social networks. This will create a positive community participation atmosphere.

6.3. Precisely Enhance Perceptual Behavioral Control and Consolidate the Internal Driving Force for Farmers' Participation

Farmers make subjective assessments of their own capabilities and resource conditions. This assessment constitutes an important threshold for their participation in decision-making. Among these assessments, perceived risk tolerance and policy understanding are the lowest. "Information asymmetry" and "risk aversion" are the two core obstacles. Based on this, this paper proposes targeted optimization suggestions.

First, training programs should be implemented. They should focus on locally suitable models. These models include medicinal herb cultivation, mushroom conservation and promotion, and vegetable intercropping. The training should help farmers acquire skills in cultivation, primary processing, and e-commerce marketing. This will effectively enhance their self-efficacy. Second, property rights protection and policy dissemination should be strengthened. The boundaries of under-forest operation rights should be clearly defined by law. Accessible policy brochures should be developed in accordance with the special management requirements of nature reserves. This will alleviate farmers' concerns regarding compliance and tenure security. Third, market channels should be streamlined and risk-sharing mechanisms strengthened. The "Party organization + cooperative + enterprise + farmer" model should be promoted. This will build a community of shared interests. It will reduce intermediary links. It will ensure that farmers benefit directly from industry-driven income gains. At the same time, risk-mitigation tools should be explored. These include specialty agricultural product insurance and weather-index insurance. They will mitigate the uncertainties associated with market fluctuations and natural disasters. This will enable farmers to form a more favorable assessment of their control conditions.

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Abbreviations

The following abbreviations are used in this manuscript:

NTFPs	Non-timber Forest Products
TPB	Theory of Planned Behavior
SEM	Structural Equation Model
BA	Behavioral Attitude
SN	Subjective Norm
PBC	Perceived Behavioral Control

Appendix A

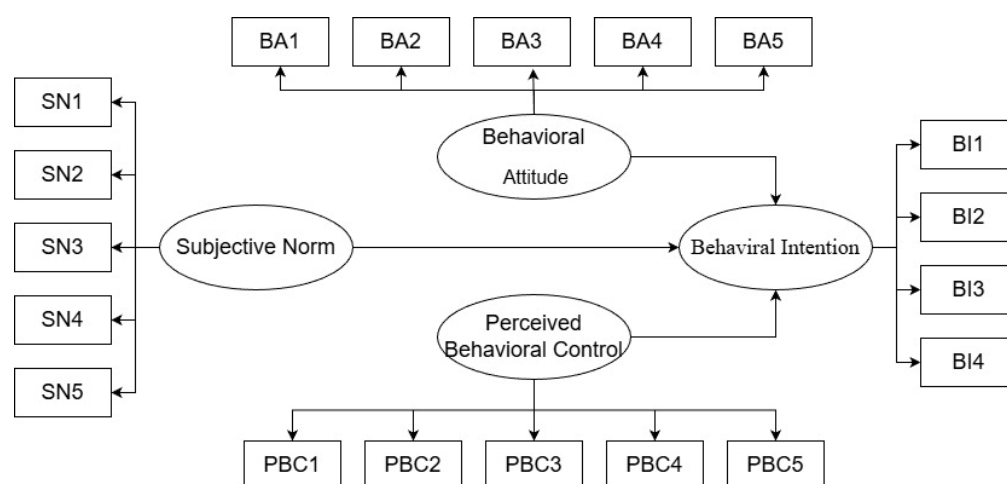


Figure A1. Model schematic diagram.

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