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Measurement and Influencing Factors of Willingness to Accept Payment for Ecosystem Service Provision: A Case Study of a Leading Forest Farm in China

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Abstract: The Saihanba Forest Farm, a leading planted forest farm, is one of the essential ecosystem service providers for the Beijing–Tianjin–Hebei region in China. Its efforts in afforestation and landscape restoration have been recognized with the award of the Champions of the Earth from the United Nations. However, the Saihanba Forest Farm is facing the challenges of less income resulting from less commercial cutting since it has to prioritize providing ecosystem services such as water conservation, wind prevention, sand fixation, and so on, instead of timber. It is crucial to understand providers' attitudes toward ecosystem service provision and willingness to accept payment, as it might affect the quantity and quality of ecosystem service provision in the future. In this study, the contingent valuation method was applied to measure the willingness to accept payment for the economic losses incurred due to providing ecosystem services by cutting less wood. A questionnaire survey was conducted among the staff of the Saihanba Forest Farm. A double-hurdle regression model was used to analyze the influencing factors of the willingness to accept payment, with the validation via a Tobit model. The results showed that the Saihanba Forest Farm was willing to accept a payment of CNY 9800.84 (USD 1407.24) per hectare per year for providing ecosystem services to enhance social welfare. The factors, including basic sociodemographic characteristics, attitudes toward conservation activities, and awareness on the concept of payment for ecosystem services, significantly influenced their willingness to accept payment.

Keywords: forest ecosystem services; willingness to accept; contingent valuation method; payment for ecosystem services; double-hurdle regression model; Saihanba Forest Farm

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1. Introduction

China has accomplished appealing land-greening achievements recognized across the world, and its state-owned forest farms play a pivotal role in this land-greening process. Currently, there are 4297 state-owned forest farms located in 1600 counties over 31 provinces, covering around 65 million hectares of forest area [1]. These state-owned forest farms provide various ecosystem services (ESs, here just referring to non-market ecological services), such as water supply and regulation, habitat provision, carbon sequestration, and climate mitigation [2]. They fulfill the growing needs of society for beautiful environments and ecological services [3,4]. Meanwhile, the protection-oriented policy for ES provision has led to cutting nearly all the forest farms' economic income.

The forest farms provide a wide range of ESs, most of which are intangible and exhibit non-exclusive and non-competitive characteristics [5,6]. Although these ESs do not have explicit prices attached, they have been regarded as increasingly important welfare for human life [7–10]. For example, planted trees have been identified as a potential source of

carbon dioxide sequestration, climate change mitigation and adaptation, water regulation and supply, and human health benefits [11–14]. As a leading state-owned forest farm, Saihanba Forest Farm (SFF) in Hebei province, north China has the largest area of planted forest in the world, and it is recognized for its ES provision contribution. For instance, SFF is a green ecological barrier for the Beijing–Tianjin–Hebei region against sandstorms, and there was a noteworthy increase in frost-free days, rising from 52 to 64. The number of days with strong winds decreased from 83 to 53. The annual average precipitation significantly increased from the previous value of less than 410 mm to more than 460 mm. SFF could conserve and purify approximately 284 million cubic meters of water for the Luan River and Liao River. In December 2017, SFF was honored with the award of the Champions of the Earth by the United Nations.

Nevertheless, the economic development of state-owned forest farms does not match their ecological achievements. With strong restrictions on timber harvesting, state-owned forest farms are losing their main source of revenue. Therefore, these forest farms need to be compensated for ceding direct economic benefits from timber production to provide ESs. Payment for ecosystem services (PES) is generally designed and carried out to balance the costs of ecosystem protection [15]. Although the central and provincial governments have provided state-owned forest farms with subsidies for ecological restoration and protection, without a good understanding of ES value the PES is too low to fully reflect their value. Therefore, it is necessary to further measure the level of PES.

PES needs to be formulated based on ES assessments, which are increasingly used to ensure a continued supply of ESs while pursuing social goals such as sustainable livelihoods and poverty alleviation [16–18]. PES takes conservation outcomes as a condition in exchange for a negotiated payment [19], which has the potential to reach a win–win solution because it highlights the importance of the environment and provides incentives to the hard-working staff who put forest management first [20]. As quantitative and monetary estimations are preferred in decision-making contexts, the application of ES value should be as precise as possible. Not accounting for the potential monetary value of ESs might lead to inefficient provision of ESs in the future. Decision makers can use valuation studies to develop strategies for natural resource management [21–23].

How to account for the value of ESs has been widely discussed in academia [5,6,24,25]. Most existing studies are related to watershed and regional scales. In terms of research objects, both single and multiple ESs have been studied [26,27]. Scholars have developed a few evaluation methods. Fu et al. (2019) used the evaluation methods in the System of Environmental–Economic Accounting 2012 and found that the total ES value of SFF was CNY 18.16 billion (USD 2.61 billion) per year [28]. This result indicated that SFF had a relatively higher value than other forest farms because SFF had better forest quality. The lack of connection to stakeholders in the benefits of ESs has limited the impact of ES research on policy [29,30]. Furthermore, it is difficult to distinguish how much ESs have been increased due to human interventions [31].

The contingent valuation method (CVM) has been applied widely to reflect the relationship between the value of ESs and the PES, which focuses on respondents' answers [32–34]. It conforms to the theory of preference and utility with the advantage of covering the intrinsic value assessment. By exploring the environmental preference of the ES providers or consumers, the outcome of CVM studies could show the value of ESs. Namely, the CVM assesses the economic value of ESs. It has a strong ability to provide data sources when the given prior information is limited [35,36]. The CVM usually uses a questionnaire to collect respondents' willingness to pay (WTP) or accept (WTA) payment for non-market services or goods. An early study by Davis that estimated the recreational value in Maine was viewed as the beginning of the CVM [37]. The U.S. Environmental Protection Agency first attempted to synthesize the CVM in a workshop [38]. One of the most substantive contributors to the CVM was a book by Mitchell and Carson that presented a detailed discussion on designing a CVM study [36]. Thus far, the CVM has appeared in thousands of

case studies in more than 130 countries around the world [39,40]. The US federal agencies have also recommended it to be used to measure the non-market value of ESs [41].

The survey on WTP or WTA is a key issue in applying the CVM. the differences between WTA and WTP have been identified in terms of several key factors: (1) Income effects: WTP tends to be significantly correlated with respondents' incomes, while WTA has no such correlation [42]. (2) Substitution effect: WTP and WTA values are more different for less substitutable alternatives [43]. (3) Prospect theory: in risk management, people tend to avoid risk when they gain while accepting risk when they face loss [44]. (4) Public goods attribute: many respondents preferred government involvement in environmental resource management through financial transfers for public environmental governance [45]. After experiencing environmental damage, most respondents recognize the importance of the environment to their lives. They preferred to receive higher financial compensation after such damage rather than paying personal costs for improving the environment before the damage occurred [46]. Most of the studies on PES measurement that incorporated public participation focused on the beneficiaries' WTP due to its more cautious measurement methodology, limiting the use of WTA as a valuation measurement. However, when gauging the actual value of losses, WTA measurements are likely to provide an accurate assessment [47,48]. For many developing countries, the most significant concern is often the adverse impacts of environmental change on socially disadvantaged groups, who bear the social costs of significant environmental losses, particularly when addressing perceived well-being losses in the environment or ecosystem [49]. In addition, the majority of PES programs in China are funded by the government rather than the beneficiaries, indicating that the purchasers of ecosystem services are often not the actual users [50,51]. For ES providers, their WTA values are preferable to the beneficiaries' WTP. Using WTA values allows for a better understanding of the actual costs of environmental degradation or improvement, leading to more informed options in land use, resource management, and conservation measures [52].

Numerous factors affect an individual's WTA in their participation in ecological protection efforts, spanning various sociodemographic and socioeconomic aspects. The ES value is influenced by fundamental characteristics, including income level, education, and environmental awareness [53,54]. In particular, environmental awareness has significant impacts on ES value assessments, making it easier for individuals to recognize the inherent value of environmental public goods [55]. People may consider safeguarding environmental public goods an ethical obligation beyond mere economic transactions. Individuals with heightened environmental awareness tend to consider the long-term environmental benefits associated with such protection efforts [56].

Currently, most studies have focused on the relationship between the direct costs of ecological conservation and the WTA value. For example, to achieve ecological improvement, agricultural land at the forest edge faces challenges in cultivation [57]. Grassland grazing bans and livestock reduction policies have negative impacts on income [58]. Increases in wildlife also threaten land revenue and personal safety [59]. Moreover, the loss of opportunity costs for ES providers due to conservation is also a key factor affecting willingness to accept [60,61]. The PES gives significant and positive motivation to the receivers regarding their behaviors in ecological conservation [62].

In this study, the CVM was applied to assess the WTA value of a forest farm based on a survey among the staff of the SFF. Then, an econometrical analysis was conducted to explore the significance of influencing factors such as basic sociodemographic characteristics, attitudes towards conservation activities, PES familiarity and awareness, etc.

2. Materials and Methods

2.1. Study Area

The SFF is located between 116°32′–118°14′ E and 41°35′–42°40′ N in northern Hebei as shown in Figure 1. It comprises six sub-farms including Dahuanqi, Disanxiang, Sandaohekou, Qiancengban, Yinhe, and Beimandian. SFF encompasses 92,634.7 hectares of

land with forest coverage of 82% and forest stock of 10.4 million m^3. The forest farm at the southern edge of Hunshandak Sandland has served as an ecological shield, mitigating the risk of sandstorms for many years. It is a crucial water source for the Luan and Liao Rivers. The extreme maximum temperature reaches 33.4 °C, the extreme minimum temperature drops to −43.3 °C, and the average annual temperature is −1.3 °C. Snow covers SFF for up to 7 months per year. The SFF has an annual frost-free period of 64 days, annual precipitation of 479 mm, annual gale of 53 days, and has a typical semi-arid and semi-humid cold temperature continental monsoon climate.

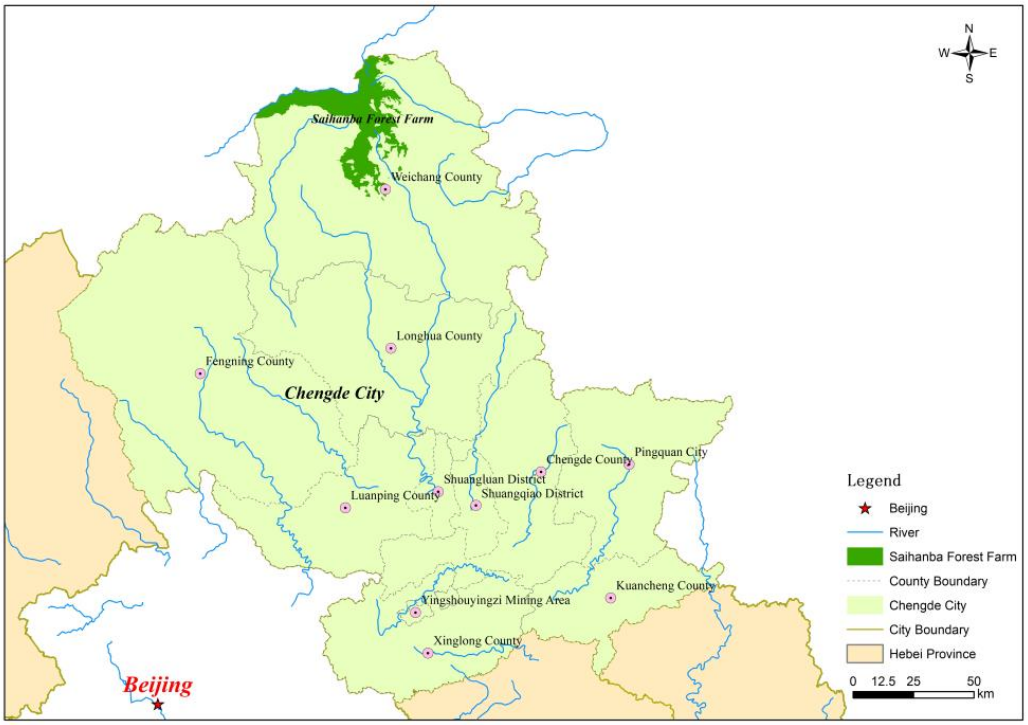

Figure 1. Location of SFF (Chengde, Hebei Province, China).

2.2. Survey Design

The harvesting of timber has been substantially restricted by regulations to provide ESs for the region. An analysis framework with data mainly from a questionnaire was established to measure the WTA value of SFF to participate in supplying ESs by cutting less wood. The intended payment ways and usage of the PES funds were surveyed in the questionnaire. The analysis framework is shown in Figure 2.

First, the questionnaire briefly introduces the survey purpose, followed by an investigation of the possible influencing factors of WTA.

The factors influencing the WTA for SFF's participation in ecological protection are categorized in Table 1. The first category was the basic characteristics of respondents, such as individual characteristics and their livelihood status. Next was their attitude toward conservation activities, such as the effectiveness and necessity of conservation activities and the opportunity cost awareness of providing ESs. The third category was their awareness on the concept of PES. The variables are shown in Table 1.

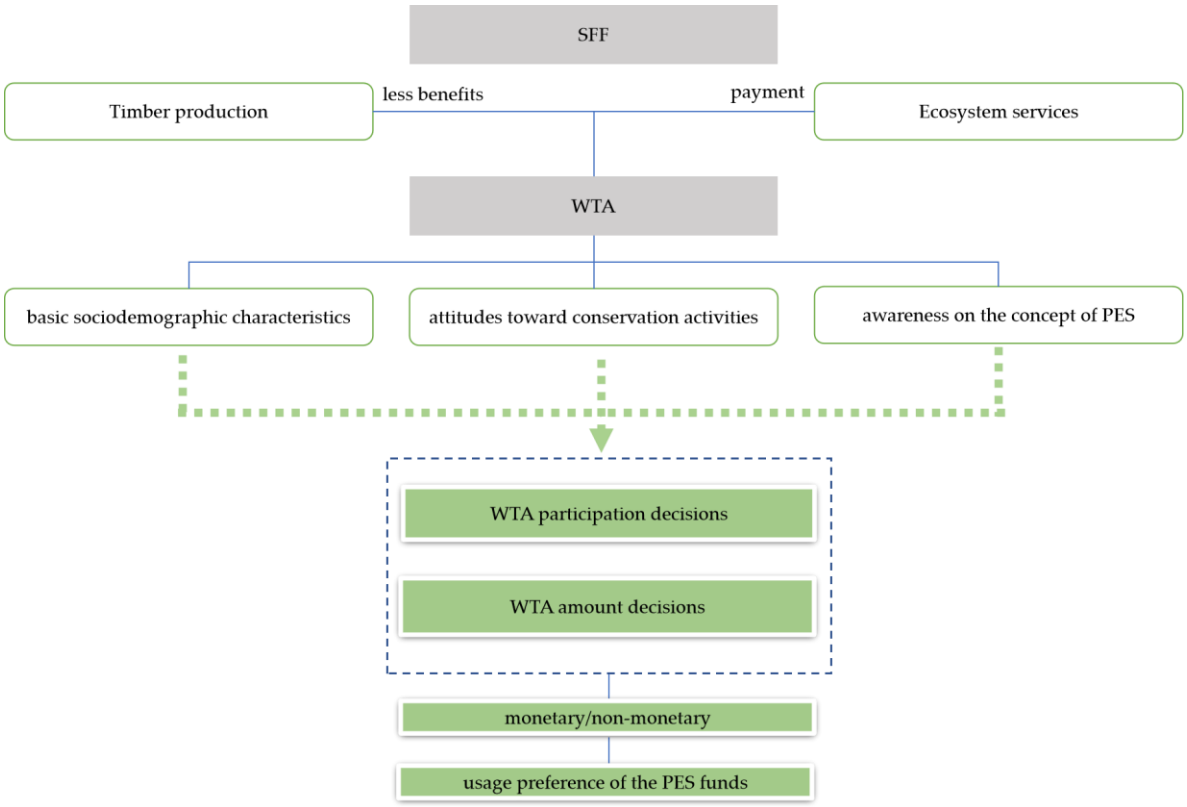

Figure 2. Flowchart of the analysis framework.

Table 1. The factors and variables of the research model.

Category	Variables
Basic sociodemographic characteristics	
Individual characteristics	Gender, age, education status, family size
Livelihood status	Household labor force, number of family members employed in SFF, family income, and post
Attitude toward conservation activities	
Attitude toward ESs	The impact of environmental protection on life or income
Conservation activities' effect	General trend cognition of the SFF's ecological environment
Conservation activities' necessity	Importance of human intervention in environmental protection for social welfare
Opportunity cost awareness	Whether providing ESs would negatively affect the economic benefits
Awareness on the concept of PES	
PES concept familiarity	Familiarity with the PES concept
PES awareness	Whether having received publicity on PES

After the survey on the variables in Table 1, the contingent questions were proposed to explore the WTA decision, WTA value, and the usage preference of PES funds. The core question is as follows:

"For the ES provided by SFF, if PES is adopted, how much do you expect if the SFF is offered an annual payment of ¥___per hectare?"

The question included the selection of the acceptable payment amount options (CNY 600, 1800, 2400, 3000, 4500, 6000, 7500, 9000, 12,000, 15,000, higher) based on expert consultation and literature review.

Here, to reduce the bias of the CVM, we repeatedly discussed with experts when designing the questionnaire, conducted a one-week field survey, held symposiums, and conducted a pre-survey before issuing the questionnaire. On this basis, we used the payment card questionnaire to study the core valuation issues. The payment card questionnaire

was chosen because the respondents' WTA value can be obtained directly from the raw data and the monetary value of WTA can be presented. There is no issue of starting point bias or of too many extreme outliers, while the calculation is also relatively straightforward [63].

The questionnaire also set preferences regarding the payment ways (monetary or in-kind) and the usage of the payment (Figure 3).

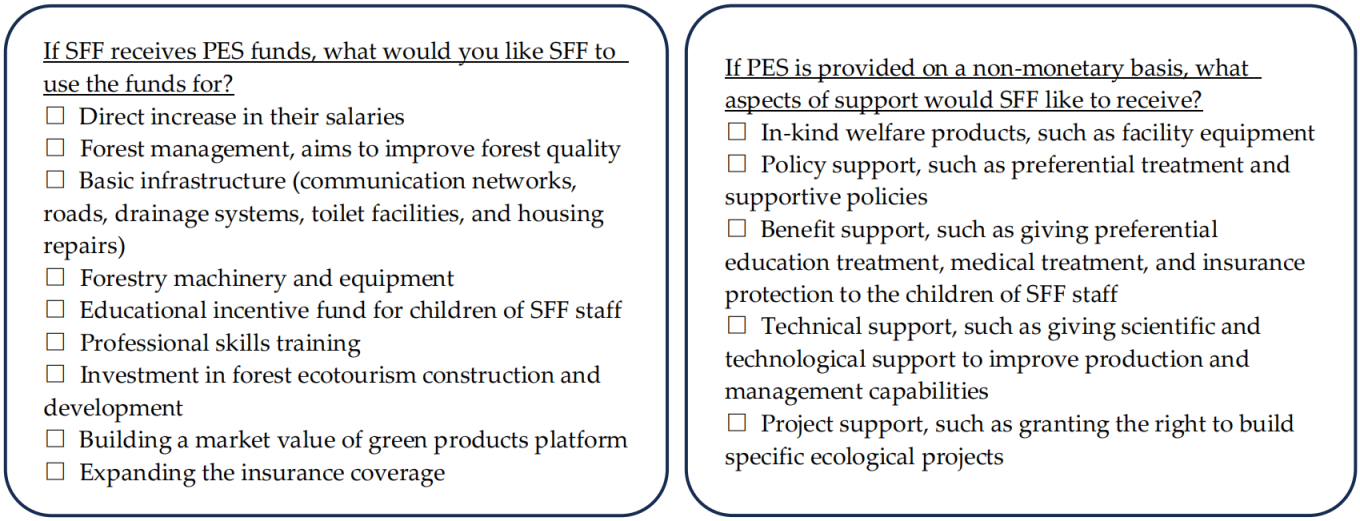

Figure 3. The usage preference of the PES funds.

2.3. Sampling Size

To ensure the reliability of the questionnaire, the required sample size was first determined. At a confidence level of 95%, we used the standard normal distributed quantile table to find the quantile value t = 1.96, the maximum absolute error $\Delta P = 0.05$. It was supposed the population variance reaches the maximum value, $\pi = 0.5$. According to the pre-survey, the total number of staff in SFF N reached 1945 in 2022. The resulting available sample size n1 is:

$$n1 = \frac{Nt^2 \cdot \pi(1 - \pi)}{(N - 1)\Delta P^2 + t^2\pi(1 - \pi)} \quad (1)$$

Considering the invalid responses during the sampling process, we assumed that the rate of valid questionnaire r could reach 85%, and the final sample size n2 was estimated to be at least:

$$n2 = \frac{n1}{r} \quad (2)$$

To achieve the desired level of accuracy, it was initially determined that at least 378 questionnaires were required for collection. However, more samples generally lead to greater accuracy.

The pre-survey was conducted between 16 and 17 August 2022, and the improved questionnaire was used between 18 and 21 August 2022. The survey was collected using a professional survey platform. In total, 630 respondents from SFF participated in the survey, and 546 were valid for analysis. The total number of samples is far more than the accuracy requirements.

2.4. Model Specification

The respondents' decision-making process about receiving PES consisted of two parts. In the first part, the need for monetary PES provided by SFF was estimated. In the second part, respondents who stated SFF is willing to accept payment provided further answers

about their expected value. WTA probability uses the partition group processing method, which is indicated by Equation (3):

$$E(PES) = E(\overline{y}) = \sum_{h=1}^{L} W_h \sum_{i=1}^{n} A_i P_i \quad (3)$$

where E(PES) means the expectation of the value the forest farm is willing to accept. $\overline{y}$ represents the sample mean. L indicates that the sample is divided into L layers. W_h is the layer weight, which is the different sub-farms' area percentage. A_i indicates the value of WTA, P_i indicates the probability of choosing each value, and n indicates the alternative WTA value. P_i is the probability that the interviewees determine the amount, and n is the sample size of the interviewees willing to accept the amount.

The Tobit regression model is always applied to analyze the distribution of WTA bidding, which is censored at zero [64]. However, the model does not distinguish between the WTA participation decision and the WTA amount decision. Cragg et al. (1971) used a double-hurdle regression model that integrated the Probit and truncated regression model to analyze the influencing factors [65]. The double-hurdle regression model uses a Probit regression to estimate relevant factors in participation decisions, while a truncated regression model was further used to estimate relevant factors in amount decisions. To ensure the result is robust, the Tobit regression model was used to verify the factors' significance and correlations.

The first part was about the WTA decision and constructed the following equation:

$$prob[y_i = 0|x_i] = 1 - \phi(\beta_i I_i) \quad (4)$$

$$prob[y_i > 0|x_i] = \phi(\beta_i I_i) \quad (5)$$

where i represents the observation sample, y indicates the WTA decision, and x represents the factor variable affecting the WTA participation decision. $\phi(\beta x_i)$ is the factor's cumulative normal distribution function, β is the regression coefficient; (4) shows the situation of respondents is not WTA, (5) shows participation decision is WTA.

The second part aimed at the WTA value (Equation (6)), μ denotes a stochastic error.

$$E[y_i|y_i > 0, x_i] = \sum_{i=1}^{n} \beta_i x_i + \mu \quad (6)$$

In addition, the conversion rate used in this study is 1:6.965 (USD:CNY), according to the information disclosed by the China Foreign Exchange Trading Center on 30 December 2022.

3. Results

3.1. Sample Demographics

The demographic data of the respondents extracted from 546 valid questionnaires are shown in Table 2. Among the respondents, there was a higher proportion of male employees (57.5%). In terms of age, the largest group of respondents (35.4%) fell into the range between 30 and 39. Only a minority of respondents (9.9%) had not completed their senior high school education. The average family size is 3.8 individuals, while on average 1.5 individuals had been employed in SFF. More than half of the respondents (64.8%) reported a monthly income of less than CNY 8000 (USD 1148.67). Furthermore, the majority (82.4%) identified the salary from SFF as the primary income source. A few respondents reported self-employment, farming, animal husbandry, housing rental, and employment by other public institutions as alternative incomes sources.

Table 2. Sociodemographic characteristics of SFF staff (N = 546), based on a survey conducted in 2022.

Symbol	Variables	Description	Frequency	Percentage (%)
GEN	Gender	Male	314	57.5
		Female	232	42.4
AGE	Age	20 or lower	6	1
		20–29	112	20.5
		30–39	194	35.5
		40–49	121	22.1
		50–59	108	19.7
		60 or higher	5	0.9
EDU	Education status	Primary or lower	4	0.7
		Secondary	50	9.1
		Senior high	80	14.6
		Junior college	151	27.6
		College	250	45.7
		Post-graduate	11	2
POF	Family size	1	9	1.6
		2	36	6.5
		3	233	42.6
		4	138	25.2
		5	69	12.6
		6	43	7.8
		7	10	1.8
		≥8	8	1.5
POW	Household labor force	1	59	10.8
		2	286	52.3
		3	145	26.5
		4	43	7.8
		5	11	2
		≥6	2	0.1
POS	Family members employed in SFF	1	317	58
		2	192	35.1
		3	31	5.6
		4	4	0.7
		5	1	0.1
		≥6	1	0.1
INCOME	Household income (CNY)	1800 or lower	10	1.8
		1801–3000	57	10.4
		3001–5000	99	18.1
		5001–8000	188	34.4
		8001–10,000	74	13.5
		10,001–15,000	81	14.8
		15,001–20,000	27	4.9
		20,001–25,000	8	1.4
		25,001 or higher	2	0.1
POST	Post	Administrative staff	85	15.5
		Professional	197	36
		Skilled worker	131	23.9
		Casual laborer	133	24.4

Note: The labor force refers to family members who can engage in production and earn money.

3.2. Cognition of the Respondents on ESs and PES

This part first focused on the perceived effect of and satisfaction with the environmental protection program (Table 3). When it comes to the impact of forest conservation work on staff's livelihood status, many respondents (78.2%) thought the environmental protection activities did not significantly influence their daily lives. A small number (3.2%) of respondents thought the environmental protection works showed negative impacts.

With environmental protection works, the staff's working hours increased, but their income levels did not rise accordingly. Meanwhile, approximately 18.4% of the respondents expressed that environmental protection works brought more positive impacts. Due to the quality improvement of the living environment, they could enjoy the beautiful forest landscape and fresh air.

Table 3. Respondent environmental awareness (N = 546).

Symbol	Variables	Description	Frequency	Proportion (%)
ECO1	What is the main impact of environmental protection work on life or income	Negative	18	3.2
		Makes no difference	427	78.2
		Positive	101	18.4
ECO2	What do you think are the general trends of the SFF's ecological environment	Better	487	89.1
		Makes no difference	52	9.5
		Worse	7	1.2
IES	Do you think human intervention in environmental protection is important for beautiful environmental welfare	Very unimportant	1	0.1
		Relatively unimportant	0	0
		Neutral	8	1.4
		Relatively important	27	4.9
		Very important	510	93.4
RES	Does the provision of ES negatively affect the economic benefits of SFF	Yes	132	24.1
		No	414	75.8
PES1	Do you understand the PES concept	Very unfamiliar	67	12.2
		Relatively unfamiliar	184	33.6
		Relatively familiar	210	38.4
		Very familiar	85	15.5
PES2	Have you received publicity on PES	Yes	297	54.3
		No	249	45.6

Regarding the overall trend of the ecological environment in SFF, the vast majority (89.1%) thought the environment has been getting better. In terms of the importance of human intervention in environmental protection, 93.4% of the respondents placed it as very important. Additionally, 75.8% of respondents thought providing ES would not negatively affect the economic benefits. This perspective arose from the fact that SFF depends heavily on various government subsidies, leading some employees to wrongly assume that all of these subsidies are for the ecosystem service provision. Therefore, PES should not be demanded. If the ESs were not provided, the forest farm would still be a wasteland and lack the basis for further economic development. In addition, 24.1% of respondents believed that developing the ecological protection program would negatively affect the economic benefits (Figure 4). They could realize that SFF has ceded related economic benefits such as timber production to provide ESs, so SFF should be compensated. The impacts were mainly reflected in the following aspects: timber cutting limitation, commercial activity forbiddance, insufficient ecological compensation mechanisms leading to lower production enthusiasm, too-dense stands with low quality, out-of-date facilities resulting in insufficient production safety, and other land utilization restrictions.

In terms of familiarization with the existing PES program, over half of the respondents (53.9%) thought they were relatively familiar or very familiar with PES. Over half of respondents (54.3%) have received publicity on PES.

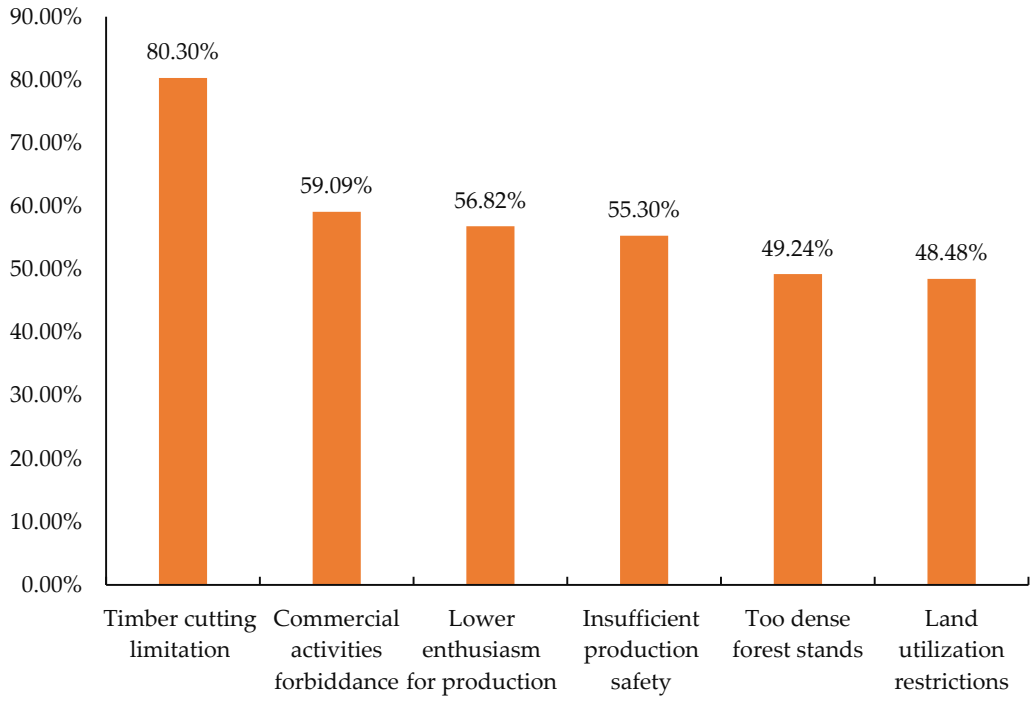

Figure 4. The negative impacts on SFF's economic benefits.

3.3. WTA and Its Value Estimation

The WTA and its value were surveyed in two steps. For the ESs provided by SFF, respondents who chose "SFF would be willing to accept" were asked to bid the WTA value. Overall, 83.3% of respondents voted "yes" to accept, while 16.6% opted for "no".

There were 485 respondents who voted "yes" and further answered questions about the mode and amount of PES. As for the PES mode, 63.9% of the respondents believed that monetary and non-monetary modes could be adopted, 15.5% chose monetary mode, and only 3.8% chose non-monetary mode.

The WTA value distribution was according to the payment card questionnaire. The frequency distribution of WTA in SFF was obtained. As depicted in Figure 5, the majority of respondents, constituting 38.7% of those expressing their WTA, favored an annual payment of CNY 12,001–15,000 (USD 1723.14–2153.75) per hectare. Other response options showed relatively even distribution, with CNY 601–1800 (USD 89.29–258.45) and CNY 3001–4500 (USD 430.89–646.12) ranking as the second and third most chosen preferences.

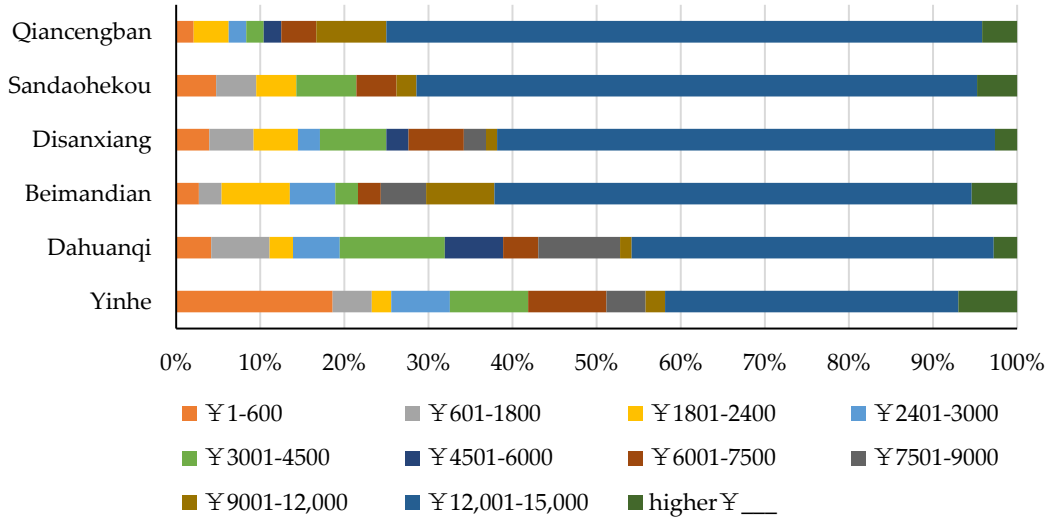

Figure 5. Distribution of WTA value.

Based on the distribution of WTA value obtained during the survey (Table 4), we calculated the average of the expected value for every sub-farm of SFF. Based on estimated model parameters (Equation (3)), the mean WTA amount expected by SFF to provide ESs was CNY 9800.84 (USD 1407.24) per hectare per year.

Table 4. PES of various sub-farms.

Sub-Farms of SFF	WTA Value (CNY/hm^2·a)	Area (hm^2)	ES Value (Ten Thousand CNY/a)
Dahuanqi	7458.60	18,949.81	14,133.92
Disanxiang	7737.30	10,239.75	7922.80
Sandaohekou	8599.05	10,337.36	8889.15
Qiancengban	10,387.50	18,293.07	19,001.93
Yinhe	11,141.85	19,777.49	22,035.78
Beimandian	12,385.65	15,740.14	19,495.19
Overall	9800.84	93,337.62	91,478.75

For those respondents who chose to be willing to accept PES in monetary mode, we further asked about the intended use of the PES funds. Among them, a large number of the respondents (86.9%) expressed willingness to directly use that fund to increase their salaries; 66.4% believed that the fund should be invested into forest management for improving forest quality; 63.2% hoped to allocate the funds towards enhancing infrastructure and utilities in forest areas, including communication networks, roads, drainage systems, toilet facilities, and housing renovations; 56.6% believed the fund should be used to purchase types of machinery and equipment for enhancing the mechanization of the forest farm; 55.6% supported the establishment of an education reward fund for the children of SFF employers; 52.6% hoped for PES to be used for professional skills training and strengthening capacity; 48.5% advocated for investing in forest ecotourism construction and development; 43.7% of them suggested building an ES value transaction platform; 41.8% of them wanted to expand the insurance coverage.

For those respondents who preferred to accept PES in a non-monetary mode, 81.1% of those preferred physical products for welfare, for example, giving the SFF material products, facilities, and equipment to improve their production and living conditions; 71.7% preferred policy support, such as special and supportive policies, supporting ES development; 70.1% favored additional benefit support, for instance, preferential education treatment for the SFF staff's children, additional medical treatment and insurance coverage; 69.3% of respondents preferred technical support including giving scientific and technological support to enhance the production and operation capacity; 66.6% of them chose project support.

In addition, ninety-one respondents voted "no". Each respondent was allowed to choose one or more reasons, so the sum of the percentages exceeded 100%. Among them, 41.8% considered that providing ESs is an initial duty and the SFF should not require additional subsidies; 38% believed that ecological value is difficult to estimate and the PES cannot match actual ecological outcomes; 26.1% believed that the SFF could afford all the expenses without additional PES funds; 26.1% thought that PES would not benefit the individual employees; and 23.9% thought that PES funds are not necessary for improving the ecological environment and it is better not to accept them.

3.4. Analysis of Influencing Factors Based on Double-Hurdle Regression Model

The correlation matrix of the dependent and independent variables showed that the correlation coefficients between the different explanatory variables were well below 0.5, which meant there was no strong correlation. Moreover, their variance inflation factor was 1.27, well below 10, indicating that multicollinearity was not a concern.

Table 5 shows the double-hurdle model results about the factors associated with the WTA and their WTA values. In the first stage, the Probit regression model was used to assess the variables affecting whether PES should be accepted, and the results showed that

variables such as age, education status, family size, and "whether providing ESs would negatively affect the economic benefits" were significant factors.

Table 5. The regression results of the factors affecting the WTA and their WTA values.

Variable	Double-Hurdle Model		Tobit Regression Model
	Probit	Truncated	Tobit
GEN	0.0404	−0.8894 ***	−0.7712 *
	(0.2806)	(−2.6615)	(−1.7803)
AGE	0.1879 ***	0.4141 ***	0.8179 ***
	(2.6692)	(2.6599)	(3.9311)
EDU	0.1681 **	0.3716 **	0.6475 ***
	(2.2236)	(1.9801)	(2.6610)
POF	0.1117 *	0.1487	0.3353 **
	(1.7990)	(1.1761)	(2.0088)
POW	0.0190	−0.3589 *	−0.2949
	(0.1914)	(−1.7652)	(−1.0404)
POS	0.1403	0.1756	0.4436
	(1.1700)	(0.7619)	(1.3914)
Administrative staff	0.3635	0.5335	1.3308 *
	(1.4168)	(0.9286)	(1.7846)
Professionals	0.0922	0.6637	1.0544
	(0.4686)	(1.2152)	(1.6440)
Skilled worker	0.0697	1.0432 **	1.2621 *
	(0.3408)	(2.0660)	(1.9524)
INCOME	0.0603	0.2014	0.3224 **
	(1.2012)	(1.5563)	(2.0682)
ECO1	−0.0138	0.0816	0.1054
	(−0.0828)	(0.2059)	(0.2128)
ECO2	0.0315	0.0455	0.1649
	(0.1993)	(0.1276)	(0.3786)
IES	−0.0035	0.1557	0.0246
	(−0.0184)	(0.3595)	(0.0411)
RES	0.4130 **	−0.8980 **	0.0366
	(2.2209)	(−2.4475)	(0.0741)
PES1	0.0239	−0.0166	−0.0401
	(0.2781)	(−0.0780)	(−0.1502)
PES2	−0.2596 *	−1.5208 ***	−1.8989 ***
	(−1.7311)	(−4.2178)	(−4.1191)
_cons	−1.4071	3.9635	−1.9617
	(−1.1988)	(1.5723)	(−0.5572)
Sigma			21.6038 ***
			(13.9330)
N	546	455	546
="z statistics in parentheses"			

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In the second stage, the truncated regression model was used. The results showed that the variables including gender, age, education, family labor, skilled workers, "whether the provision of ecosystem services would negatively affect the economic benefits of SFF", and "whether they had received PES publicity" were significant.

The double-hurdle model regression results revealed distinctions in the factors influencing decisions on the PES participation and the payment amount. In terms of respondents' characteristics, in both first and second stages of this model analysis, the variables such as age, education status, and family size were significant, and the coefficient was positive. In the second stage, both women and individuals with a large family labor force tended to choose lower WTA values. Skilled employees with longer operation experience might prefer higher WTA values.

Furthermore, the variable "whether providing ESs would negatively affect the economic benefits" was significant in both stages of the double-hurdle model analysis. In the first stage, the coefficient was positive, which indicated that the respondents believed that the SFF's economic benefits was negatively affected by the ES provision, thus they were inclined to accept PES. In the second stage, the coefficient was negative, indicating that even if the respondents believed that "the economic benefits of the SFF were negatively affected", they did not choose a higher WTA value accordingly. A higher proportion of respondents chose annual WTA values of CNY 1–600 (USD 0.14–86.15) and CNY 601–1800 (USD 89.29–258.45) per hectare.

The variable "PES awareness" was significant in both the first and second stages. This finding partially showed the reasonability of this survey because employees chose the PES amount based on their psychological expectations rather than the highest option. It reflects the positive effect of PES policy publicity on the reasonable valuation of ESs.

4. Discussion

We applied a Tobit regression model to test the robustness of regression results. The results showed that gender, age, education status, family size, family income, and "whether the respondents received publicity on PES" variables were significant factors affecting WTA values. The significant result of the double-hurdle model was largely consistent with the Tobit regression analysis, indicating that the regression results obtained from this study are robust. In general, applying the payment card and double-hurdle method might be marred with various bias, while it has been well considered in the questionnaire design, data collection, and analysis.

The mean WTA value in this study was relatively higher than that of similar studies in the surrounding area. For instance, the Bashang Plateau is located in the same province as the SFF, where the households expected a PES amount estimated at CNY 7168.65 (USD 1029.30) per hectare per year [56]. The research conducted in the Miyun Reservoir Catchment in an adjacent province interconnected with the same water system revealed a WTA value of CNY 8187 (USD 1172.15) per hectare per year [49]. Compared to the Bashang Plateau and the Miyun Reservoir Catchment, the SFF has a relatively better forest quality providing more ESs of more types such as sandstorm prevention, carbon sequestration, etc.

Additionally, most SFF forests are well managed with sound practices, significantly improving the forest quality. Hence, the potential value of ESs provided by the SFF forest is remarkable. Although the WTA value is measured with amounts per hectare, since the study area is large, where there is sure to be large variability in the type and amount of ecosystem services, follow-up research using choice experiments and GIS would be helpful to value the various ecosystem services with spatial heterogeneity.

Currently, the national conservation programs provide ecological compensation, but the payment amount is much less than the actual cost of implementing management practices. The cost includes monetary expenditures and non-economic factors such as commercial development opportunities, familiarity with conservation practices, and compatibility with farm operations [66]. Meanwhile, the average payments offered by the government for stopping commercial cutting and improved forest management in 2022 were CNY 150 (USD 21.54) per hectare per year [67]. The estimated payment of WTP from our study was much higher than the abovementioned payment by the government. Similar observations were found in various fields [68,69].

As indicated by the results, the current government-funded PES is relatively too low to offset the economic loss from limiting timber harvesting. Therefore, it is necessary to develop a PES scheme with diversified funding sources to increase the incomes of forest farms. A key next step for generating the funding sources of such a PES scheme is to recognize the WTP by diversified consumers of ecosystem services. Enhancing publicity of the importance of ESs in supporting human life is very helpful in realizing the WTP. Furthermore, it is indicated that the WTA is influenced by multiple factors including basic sociodemographic characteristics, attitudes toward conservation activities, and awareness

on the concept of PES. Thus, the PES scheme should be established in a differentiated manner to maximize the total utility. In addition, the utilization of the PES funds should be prioritized in forest management to improve forest quality for the sustainable provision of ESs.

5. Conclusions

In this study, the CVM was applied to measure the WTA of the SFF to provide non-market ESs while limiting the timber harvesting. The main findings are as follows:

(1) First, 83.83% of SFF staff are willing to accept a payment, and the average of the WTA value is CNY 9800.84 (USD 1407.24) per hectare per year.
(2) The factors such as age, education status, family size, and the attitude that "the ES provision negatively affected the economic benefits of SFF" positively affected the decisions of the respondents on whether they would be willing to accept a payment. The respondents who have received PES publicity showed a negative correlation with WTA participation.
(3) The factors including age, education status, and skilled employees are positively correlated with the WTA value. However, women, the respondents with more family labor force, the ones who thought "the ES provision negatively affected the economic benefits of SFF", and the ones who have received PES publicity tended to choose relatively lower WTA values rather than the highest amount.

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