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Does Ecotourism in Nature Reserves Have an Impact on Farmers' Income? Counterfactual Estimates Based on Propensity Score Matching

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Abstract: Farmers' participation in ecological tourism management in nature reserves is an important way to increase income. Based on 921 pieces of household survey data from 44 villages in six nature reserves in Liaoning Province, this paper uses multiple linear regression (OLS) and propensity score matching (PSM) to explore the impact of ecotourism on rural household income. The research results show that (1) a total of 90 rural households participated in ecotourism management, accounting for 9.78% of the total, and 831 rural households did not participate in ecotourism management, accounting for 90.22% of the total. The participation rate of farmers around the nature reserves was not high; (2) the participation in ecotourism management of farmers around the nature reserve has a positive and significant impact on the per capita annual net income of their households; and (3) multiple linear regression analysis will overestimate the income effect of ecotourism. This article provides inspiration for the government to propose relevant policies to encourage farmers to participate in ecotourism.

Keywords: nature reserve; ecotourism; rural household income; propensity score matching (PSM)

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1. Introduction

Biodiversity is the basis for sustained and stable economic and social development [1–4]. It has a long history, and countries around the world have set aside certain areas to protect precious animals, plants and their habitats. Yellowstone National Park, the first national park approved by the US government in 1872, is generally regarded as the earliest nature reserve in the world [5–8]. Since the 20th century, the cause of nature reserves has developed rapidly. In particular, many international organizations were established worldwide after the Second World War to engage in the publicity, coordination, and scientific research of nature reserves, such as the International Union for Conservation of Nature and Natural Resources and UNESCO's Man and the Biosphere Programme. The number and area of nature reserves have been increasing all over the world and have become one of the symbols of a country's civilization and progress. Since the early 1990s, China's nature reserves have developed rapidly. By September 2019, a total of 2750 nature reserves (excluding Hong Kong, Macao, and Taiwan) had been established, with a total area of 1,473,300 square kilometers, accounting for 14.86 percent of the country's landmass (Data: Website of Ministry of Ecology and Environment, PRC https://www.mee.gov.cn/, accessed on 23 August 2023). Most of the nature reserves are located in areas with the most abundant natural landscape, which brings superior advantages in the natural environment for the development of ecotourism. Based on natural resources and under the guidance of strict planning, management and norms, ecotourism emphasizes the participation of nature reserves, tourists, operators, and local communities and is a form of sustainable tourism activities with protection, development, and educational functions [9–12]. Ecotourism in nature reserves around the world attracts about 8 billion tourists every year, generating domestic expenditure of about 600 billion USD [13].

Scholars from different countries have studied the relationship between ecotourism in nature reserves and farmers' income. Scholars generally believe that the development of ecotourism in nature reserves can provide farmers with long-term sustainable economic activities, and farmers can obtain more economic benefits from the development of ecotourism [14–16]. Zhou W et al. found that the development of ecotourism can bring locals employment opportunities and give farmers who rely on traditional farming methods more opportunities to participate in the ecotourism business, which makes them discard the means of livelihood based on original resources [17]. Mehta pointed out that farmers' participation in ecotourism management requires service training, and farmers can better participate in ecotourism management through training [18]. Shi found that most farmers are engaged in operating hotels, selling handmade souvenirs, and handling work in nature reserves, and these methods have been taken by more and more farmers as the best ways to reduce land dependence [19].

A large number of scholars have studied the relationship between ecotourism in nature reserves and farmers' income and have obtained fruitful results [20–23]. However, there are still shortcomings in the following aspects: First, academic circles pay more and more attention to the impact of ecotourism on farmers' income, which has gradually become the research focus, but there is a lack of research on the causal relationship between ecotourism in nature reserves and farmers' management behavior choice and income. Second, the quantitative research on farmer's income in the existing literature has not been able to pay attention to and effectively solve its possible endogenous problem, in which it is usually seen as a 0–1 variable or an order variable for simple OLS regression, ignoring the interference of sample selection bias on the estimation results. The problem that the heterogeneity of causality between ecotourism and farmers' income may lead to sample self-selection bias is not solved. There are often some errors between research results and reality, and the impact effect of farmers' income will be overestimated or underestimated. In view of this, based on 1002 pieces of household data from 44 villages in six nature reserves in Liaoning Province, China, to address the above-mentioned research gaps, this paper aims to empirically analyze the impact of ecotourism on community household income to enrich the research content in the field of household income.

The academic contributions of this paper are mainly reflected in three aspects: First, most of the existing studies conduct analysis from the perspective of ecotourism development in nature reserves, and few studies engage in exploration from the perspective of farmers' participation. This paper will discuss the impact of ecotourism on farmers' income in nature reserves in Liaoning Province from the perspective of farmers' participation. Second, the application of propensity score matching (PSM) can effectively solve the problem of endogeneity of samples, deal with the heterogeneity of effects, and reduce the bias of results. Third, it empirically tests the relationship between ecotourism in nature reserves and farmers' income by using micro-survey data, which provides evidential support for farmers' income with micro-data and provides a reference for policymakers' decision-making.

This article consists of eight parts. The first part is the introduction. The second part introduces the theoretical analysis framework and research methods of the paper. The third part elaborates on the data sources and conducts a descriptive statistical analysis of the samples. The fourth part analyzes the empirical results of the article. The fifth part is a discussion, conducting a comparative analysis between the results of this study and some existing studies. The sixth part summarizes the research conclusions of this article. According to the research findings, the seventh part proposes policy recommendations. Finally, the limitations and prospects of this study are elaborated.

2. Theoretical Analysis Framework and Research Methods

Based on the theory of farmers' behavior, this paper establishes a theoretical framework for analyzing the relationship between ecotourism in nature reserves and farmers' income. In order to explore the impact of ecotourism on farmers' income in nature reserves, multiple

linear regression model and propensity score matching model were constructed to carry out empirical test.

2.1. Theoretical Analysis Framework

2.1.1. The Theory of Economies of Scale

In 1776, American economist Adam Smith first put forward the theory of economies of scale in his book An Inquiry into the Nature and Causes of the Wealth of Nations. The theory of economies of scale mainly means that the unit cost decreases when the absolute quantity of enterprise products increases in a specific period; that is, expanding the operation scale can reduce the average cost and thus increase the profit level [24–26]. According to microeconomics, economies of scale mean that the enterprise income increases progressively, and the cost decreases progressively because of the expansion of the production scale of the enterprise, thus achieving savings and increasing profits. In contrast, diseconomies of scale mean that the multiple that output increases will be smaller than the multiple that cost increases when production is expanded; that is, the average cost continues to rise as output increases. It can be seen that if the scale of production is too large or too small, the cost of the unit product will increase, the profit will decrease, and losses will even occur, which fully shows that the scale economy effect can only be pursued through moderate scale operation. Similarly, at present, the agricultural production structure of farmers in nature reserves is single, and the land is seriously fragmented, making it difficult to form a scale effect, which leads to the poor benefit of agricultural operation and a slow increase in farmers' income. Therefore, to promote the increase in farmers' income in nature reserves, we should give full play to the competitive resources of nature reserves, vigorously develop the combination of characteristic agriculture and moderate scale management (such as ecotourism) and reduce production and transaction costs through moderate scale management, so as to obtain greater economic benefits [27,28].

2.1.2. The Externality Theory

From the perspective of economics, the concept of externality, proposed by Marshall and Pigou in the early 20th century, refers to the phenomenon that an economic agent (producer or consumer) has a positive or negative effect on the welfare of bystanders in its own activities; the benefits (or gains) brought by this beneficial effect or the losses (or costs) brought by this adverse effect are not acquired or bore by the producer or consumer itself, which are incidental effects of one economic force on the "non-marketability" of another. The economic significance of the concept of externality lies in two points: first, the problem of scarcity of natural resources can be introduced into market economy analysis; second, discount rate can be introduced into the problem of intergenerational equity of resource utilization for intertemporal analysis [29–32]. The ecological protection of nature reserves has typical externalities, with strong positive externalities in ecological and social benefits in particular. The supply of such goods is likely to lead to insufficient market supply, resulting in market failure [33–35]. In order to strengthen the effective protection of natural resources and species, the Chinese government has adopted the salvage-style way of quickly establishing protected areas and excluding people's use of resources in protected areas, including local farmers, to forcibly manage and protect resources. The government's correction of this failure did not bring the expected effect. On the one hand, the prohibition of the use of resources in protected areas has brought about the waste of resources; on the other hand, the fierce confrontation between nature reserves and local farmers has triggered social instability, which has caused greater damage to the resources in many protected areas. In view of this, the externality theory is an important theoretical basis for this paper to analyze the path selection of farmers in nature reserves to increase their income (such as participation in ecotourism) [36,37].

2.1.3. Ecotourism and Sustainable Development

The past 20 years have witnessed an important increase in ecotourism research [38]. Ecotourism refers to a safe form of tourism that respects natural and cultural diversity and involves the protection of natural resources [39]. The development of ecotourism is a comprehensive, multi-level, complex system that involves many stakeholders. Local farmers are the key subjects, and their choice to participate in ecotourism management belongs to the decision-making behavior of pursuing their own interests; that is, they are "rational economic individuals", which belongs to the view of the school of formal economics. Harrison and Schipani studied the relationship between tourism development and poverty alleviation in Laos and concluded that ecotourism is the most effective form of tourism for poverty alleviation [40]. Taking Botswana forest reserves, for example, Manwa and Manwa explored the poverty reduction effects of ecotourism with an interview and discussion method, and the research results showed that ecotourism may help the poor obtain short-term or medium-term benefits [41]. Wondirad found that the longer farmers participated in ecotourism, the more obvious the effect is in their income increase [42]. In addition, Ogutu believes that the development of ecotourism promotes farmers' behavior of participating in ecotourism operations improves their management ability, and effectively guarantees farmers' sustainable economic benefits [43]. On the whole, ecotourism not only affects the economy and behavior of farmers, but also improves the living standard of farmers. Based on this information, the following hypotheses were developed.

H1. *The participation of farmers in ecotourism in nature reserves has a positive impact on their income.*

H2. *The impact of ecotourism on the income of farmers in nature reserves varies from person to person.*

2.2. Research Methods

Based on the analysis above, it can be concluded that farmers' participation in the operation of ecological tourism in nature reserves will affect their income. In this paper, the multiple linear regression method is used to estimate the parameters in the first place, and then the propensity score matching method is used to carry out further testing so as to ensure the stability and reliability of the results.

2.2.1. Multiple Linear Regression Analysis

In order to investigate the impact of farmers' participation in ecotourism operations on the per capita annual net income of rural households, previous studies generally adopted the multiple linear regression method to analyze the impact effect estimation of the per capita annual net income [16,44,45]. The specific equation is as follows:

$$\ln Y_i = \alpha_0 + \beta_1 X_i + \beta_2 D_i + \mu_i \quad (1)$$

$\ln Y_i$ is the logarithm of per capita annual net income of the rural household in i place; X_i refers to various factors affecting the per capita annual net income of rural households, including the interviewee's age, gender, nationality, educational level, health condition, being a village cadre or not, number of workforce members in their family, the area of farmland and woodland the household owns, and the fact of being in the protected area or not. β_2 represents the income effect of ecotourism; D_i indicates whether the family participates in ecotourism management or not. $D_i = 1$ indicates that the family participates in ecotourism management, and $D_i = 0$ indicates that the family does not participate in ecotourism management. μ_i is the random error term.

2.2.2. Propensity Score Matching Method

Farmers' choice of whether to participate in ecotourism operations is a non-random "self-selection". Self-selection should be taken into consideration in the estimation of the

income effect brought by farmers' operation of ecotourism [15,46,47]. This paper will use the steps of the propensity score matching method for analysis: The Logit model will be used to estimate the propensity score, then the result will be estimated according to the score; nearest neighbor matching method, radius matching method and kernel matching method will be selected to carry out propensity score matching; a control group similar to the non-participating families in ecotourism operations could be found in the families involved in ecotourism operations, and an approximately randomized data could be constructed; the matching quality will be tested and evaluated, and the standard deviation, T-value, and Pseudo R^2 before and after matching will be compared.

The first step is to establish the Logit model of whether farmers participate in ecotourism, and the estimated propensity score is as follows:

$$P(D_i = 1|X = X_i) = P(X_i) \quad (2)$$

In Formula (2), Di is the dependent variable (that is, when its value is 1, farmers participate in ecotourism; when it is 0, farmers do not participate in ecotourism), X_i is the independent variable, such as educational level, planting scale, whether they are in the protected area, etc. P is the propensity score to be estimated, representing the probability of farmers' participation in ecotourism. The second step is to calculate the treatment effect of farmers' participation in ecotourism and then average the difference in income levels of the two groups, after which the average treatment effect (ATT) is estimated. The expression is:

$$ATT = \frac{1}{N_i}\sum i : D_i(y_{1i} - y_{0i}) \quad (3)$$

In Formula (3), $N_i = \sum iD_i$ is the number of farmer households participating in ecotourism, $\sum i : D_i = 1$ indicates that only the farmers' households participating in ecotourism are added up, y_{1i} represents the per capita annual net income of households participating in ecotourism, and y_{0i} represents the per capita annual net income of households that participate in ecotourism based on the assumption that they are not engaged in ecotourism. y_{1i} is observable, while y_{0i} is a counterfactual result.

There are many different matching methods of PSM. If the matching results are similar, then it can be concluded that the results are robust. Drawing on existing research [48–50], the nearest neighbor matching method (n = 4), radius matching method (r = 0.01), and kernel matching method are used to carry out matching, and the robustness of the results of PSM is tested in this paper. Since PSM cannot solve the problem of estimation bias caused by unobservable heterogeneity, the Rosenbaum boundary method will be used to inspect whether this study's results are disturbed by hidden bias [51,52].

3. Data Sources and Sample Descriptive Statistics

On the basis of the theoretical analysis framework and model framework, 1002 pieces of rural household survey data from 44 sample villages in six nature reserves in Liaoning Province were selected; the process of variable selection was expounded, and descriptive statistical analysis was made on the processed variable data.

3.1. Data Sources

With the support of the National Social Science Foundation's "Study on the Impact of Collective Forest Land Use Regulation in Nature Reserves on the welfare of surrounding farmers and Ecological compensation System", the research group conducted a field survey of nature reserves in Liaoning Province from July to August 2021. The total area of nature reserves surveyed was 2.22 million hectares, accounting for about 11% of the province's land area. The survey adopted a two-stage sampling method, and the specific process is as follows: in the first stage, based on the comprehensive consideration of the location, establishment time, development status, forest resources, and other factors of nature reserves in Liaoning Province, six nature reserves in Liaoning Province were selected through typical sampling method in order to ensure the validity of the questionnaire. The sample included three national nature reserves (Haitangshan, Laotudingzi, and Baishilazi)

and three provincial nature reserves (Sankuaishi, Houshi, and Heshangmaozi) covering four cities (Fuxin, Fushun, Benxi, and Dandong) in Liaoning Province. In the second stage, the method that combines typical sampling and random sampling was adopted. Forty-four sample villages inside or outside 6 nature reserves in Liaoning Province were selected first, and then about 20–30 farmers were selected from each village. Researchers conducted one-to-one visits with the farmers and filled in questionnaires on-site according to the contents of the visits to obtain relevant data. Based on existing research, the questionnaire survey in this article is divided into three parts: (1) basic personal information, including the demographic characteristics of farmers like age, gender, educational background, political identity, and employment status [53–55]; (2) basic household information, including information on the assets and liabilities, income and expenditure, and agricultural production and operation of rural households [56–58]; and (3) survey information of farmers' tourism intention, including data about the basic information of farmers' participation in ecotourism, farmers' perception of ecotourism, and the reasons for farmers' participation in ecotourism management [59–61]. A total of 1002 questionnaires were distributed in this survey, and 921 valid questionnaires were obtained after eliminating 81 questionnaires with inconsistent and missing important data, with an effective rate of 92%. The name, location, and sample size of each surveyed region are shown in Table 1.

Table 1. Surveyed regions and sample distribution.

Name of the Nature Reserve	Location	Establishment Time	Valid Sample Size
Haitangshan National Nature Reserve	Fuxin Mongolian autonomous county, Fuxin city	1986	300
Laotudingzi National Nature Reserve	Huanren Manchu autonomous county, Benxi city	1981	175
Baishilazi National Nature Reserve	Kuandian County, Dandong City	1981	72
Sankuaishi Provincial Nature Reserve	Fushun County, Fushun City	2003	187
Houshi Provincial Nature Reserve	Xinbin County, Fushun City	2003	116
Heshangmaozi Provincial Nature Reserve	Benxi County, Benxi City	2005	71
total			921

3.2. Variable Selection

(1) Explained variables. Considering the reliability of data, this paper mainly takes the per capita annual net income of rural households as the measuring indicator for the evaluation of rural household income [62,63], and the variable unit is yuan/person. Per capita annual net income is calculated in the following way: the result of the sum of household income from farming, breeding, forestry, migrant works, self-employment, allowances, and other sources minus household operating costs divided by the total number of people of the household.

(2) Core explanatory variables. That is, whether to participate in ecotourism. The variable "whether farmers participate in ecotourism" was obtained by asking the interviewee, "Does your family participate in ecotourism activities". If the interviewee answers "no", it is recorded as "0", indicating that they do not participate in ecotourism. Otherwise, it is "1" [64–66].

(3) Control variables. The feature variables of rural households include the interviewee's age, gender, nationality, educational level, being a village cadre or not, health condition, and number of workforce members in the family as well as the area of farmland and woodland the household owns. Among them, educational level, health condition and number of workforce members in the family are important human capital elements. Being a village cadre or not determines whether the farmers can obtain more social resources [67–70]. The variables of resource endowment include the farmland area of households and the forest area of households. The area of farmland and forest land is the material capital representing land, whose influence on farmers' income cannot be ignored [71–73]. Being in a protected area or not also has an important

impact on farmers. The closer they are to the local protected area, the more convenient the transportation is, which will also have a certain impact on farmers' income [74].

3.3. Descriptive Statistics of Samples

The descriptive statistics of the main variables used in this paper are shown in Table 2. The results show that the annual per capita net income of farmers participating in ecotourism is 26,860.9 yuan, and that of farmers not participating in ecotourism is 16,147.71 yuan. The annual per capita net income of farmers participating in ecotourism is significantly higher than that of farmers not participating in ecotourism. A total of 90 rural households participate in ecotourism, accounting for 9.78% of the households surveyed, and 831 rural households have not participated in ecotourism, accounting for 90.22% of the total, which reflects that the rural households around the nature reserves are not widely involved in ecotourism. Of the farmers participating in ecotourism management, 56.89% are men, and 43.11% are women, showing that men are usually the main labor force in the family. The mean value of farmers' being village cadres or not is 0.065, which indicates that whether farmers are village cadres has no significant impact on ecotourism participation. The educational level of rural households is mainly concentrated in primary school and junior high schools, with a total of 745 households, accounting for 80.4% of the total, which indicates that the cultural levels of both farmers participating in ecotourism and farmers not participating in ecotourism are generally low. The mean value of farmers' health condition is 2.76, indicating that the farmers are in good health conditions, which is conducive to participation in ecotourism management. It is worth noting that the area of farmland and forest land does not have a significant impact on farmers' participation in ecological tourism. In addition, the proportion of rural households located in protected areas is 41.69%, indicating that the location of rural households has no close relationship with the operation behavior of ecotourism. All these reflect that farmers' participation in ecotourism operations is neither a random behavior nor a result of random allocation but the result of selection made by farmers according to their own family conditions. If the sample selection bias is ignored and only regression analysis is carried out, it is likely to lead to biased estimation.

Table 2. Explanation of main variables and descriptive statistics.

Variable Name	Explanatory Variable	Complete Sample	Treatment Group	Control Group	Mean Value	Standard Deviation
Explained variable						
Per capita annual net income	Average annual net income (Yuan)	17,002.29	26,860.90	16,147.71	17,026.15	11,405.29
Core explanatory variable						
Whether has participated in ecotourism	Participation = 1; no participation = 0	0.096	1	0	0.097	0.297
Control variable age	Respondent's actual age (years)	54.720	51.788	54.843	54.527	10.566
Gender	1 = male; 0 = female	0.573	0.444	0.581	0.568	0.495
Nationality	1 = Han; 0 = other	0.396	0.533	0.381	0.396	0.489
Educational level	1 = primary school and below; 2 = middle school–high school; 3 = college or above	1.916	2.111	1.895	1.916	0.736
Being village cadres or not	1 = yes, 0 = no	0.065	0.055	0.066	0.065	0.246
Health condition	1 = poor, 2 = fair, 3 = good	2.760	2.900	2.745	2.761	0.508
Household labor force size	Actual number of respondents (persons)	2.275	2.455	2.255	2.274	0.948
Farmland area	Area of farmland actually owned (mu)	12.333	9.200	12.673	12.320	17.333
Forest area	Area of forest land actually owned (mu)	64.831	63.102	65.018	65.184	210.153
Being in a protected area or not	1 = yes, 0 = no	0.417	0.644	0.392	0.416	0.493

4. Empirical Results

Based on the theoretical framework and model setting, this paper uses Stata17.0 software to estimate the relationship between ecotourism and farmers' income in nature reserves through multiple linear regression and propensity score matching methods and conducts sensitivity analysis tests on the regression results.

4.1. Analysis Results Based on Multiple Linear Regression

The data type used in this paper is cross-section data. In order to correct the possible problem of heteroscedasticity in estimation, multiple linear regression (OLS) is used to give estimation to the model. As shown in Table 3, the income of households participating in ecotourism is 86.1% higher than that of households not participating in ecotourism, indicating that farmers' participation in ecotourism can improve their income to a certain extent. The number of workforce members in respondents' households has a significant positive impact on the per capita annual net income of rural households, with a coefficient of 0.112 and passing the test at the significance level of 5%. Research hypothesis 1 has been confirmed. Meanwhile, the coefficients of farmers' gender, educational level, health condition, farmland area and forest land area are −0.189, 0.112, 0.156, 0.006, and 0.001, respectively, which passed the test at the significance level of 1%, indicating that all these variables have a significant positive impact on the per capita annual net income of farmers' households. Research hypothesis 2 has been confirmed. It should be noted that respondents' age, nationality, being village cadres or not, and being in the protected areas or not failed to pass the significance test, indicating that these variables do not affect rural household income.

Table 3. Analysis of the estimation results of per capita annual net income of sample households based on multiple linear regression method.

Variable	Coefficient	Variable	Coefficient
Whether has participated in ecotourism (participation = 1, no participation = 0)	0.861 *** (0.095)	Being village cadres or not	0.021 (0.113)
Gender	−0.189 *** (0.058)	Household labor force size	0.066 ** (0.030)
Age	−0.003 (0.002)	Farmland area	0.006 *** (0.002)
Nationality	−0.044 (0.622)	Forest area	0.001 *** (0.000)
Educational level	0.112 *** (0.040)	Being in a protected area or not	−0.048 (0.062)
Health condition	0.156 *** (0.057)	Constant term	8.895 *** (0.279)
Prob > F	0.000		

** and *** indicate being significant at the level of 5% and 1% respectively.

4.2. Matching Results Based on Propensity Score

4.2.1. Estimation Result of Propensity Score Based on Logit

In order to explore the impact of farmers' participation in ecotourism, the propensity score will be estimated by the Logit model, according to which matching will be carried out. As can be seen from Table 4, respondents' gender, educational level, health condition, farmland area and being in the protected areas or not all have significant impacts on farmers' participation in ecotourism management. The probability of women participating in ecotourism is 4.3% higher than that of men, reflecting that the female labor force has gradually become the main body of ecotourism management. The feminization of the agricultural labor force is a new feature of current rural society. The higher educational level of the respondents brings a 2.7% increase in the probability of their participation,

which indicates that the higher a farmer's educational level is, the better their learning ability is, and its knowledge reserve is relatively rich, bringing obvious advantages to the participation in ecotourism management. The probability of the participation of respondents with good health is 5.4% higher than that of the participation of respondents with poor health, and it can be seen that the healthier a farmer is, the more conducive it is to participation in ecotourism operations. The decrease of every mu of a household's farmland area brings a 0.2% increase to the probability of participation, indicating that the smaller the farmland area is, the more energy farmers may have to participate in ecotourism operations. The participation rate of respondents in protected areas is 7.6% higher than that of those outside protected areas, which means that the closer the household is to the nature reserve geographically, the more conducive it is to the farmers' participation.

Table 4. Results of Logit estimation of the propensity score of ecotourism participation.

Variable	Coefficient	Standard Deviation	Marginal Impact	Coefficient
Age	−0.013	0.012	−0.001	−0.013
Gender	−0.527 **	0.245	−0.043	−0.527 **
Nationality	0.228	0.251	0.018	0.228
Educational level	0.338 **	0.160	0.027	0.338 **
Being village cadres or not	−0.400	0.499	−0.033	−0.400
Health condition	0.659 *	0.345	0.054	0.659 *
Household labor force size	0.169	0.124	0.014	0.169
Farmland area	−0.031 **	0.013	0.002	−0.031 **
Forest area	−0.000	0.000	−0.000	−0.000
Being in a protected area or not	0.928 ***	0.258	0.076	0.928 ***
Constant term	−4.417	1.417	—	−4.417
Log likelihood	−268.110	LR chi2(11)	53.090	−268.110
Prob > chi2	0.000	Pseudo R^2	0.090	0.000

*, ** and *** indicate being significant at the level of 10%, 5% and 1% respectively.

4.2.2. Impact of Ecotourism Operations on per Capita Annual Net Income of Rural Households

In order to ensure the robustness of the results of model matching, three matching methods are adopted in this paper, namely, K-nearest neighbor matching (n = 5), radius matching (r = 0.01) and kernel matching (r = 0.01). Table 5 shows the estimation results of the treatment effects of ecotourism operations in nature reserves on the per capita annual net income of rural households. In terms of per capita annual net income of rural households, the average treatment effects (ATT) obtained through the K-nearest neighbor matching method, radius matching method and kernel matching method are 9651.50582, 10,558.3882 and 10,088.1574 respectively, which are all significant at the 1% level. This indicates that the results of the three matching methods are similar when it comes to both the estimated value and significance of the average treatment effect, which reflects the stability of the results to a certain extent, indicating that farmers' participation in ecotourism operations significantly increases their income. After eliminating the apparent deviation caused by the observable heterogeneity of farmers participating in ecotourism operations and farmers not participating in ecotourism operations, the per capita annual net income of farmer households participating in ecotourism operations increases by 35.8%, 38.8% and 37.4%, respectively, compared with those not participating in ecotourism operations. The above results further confirm Hypothesis 1.

Table 5. Treatment effect of ecotourism operations on per capita annual net income of rural households.

Dependent Variable	Matching Method	Treatment Group	Control Group	ATT	Standard Error	T-Value
Per capita annual net income	K-nearest neighbor matching (n = 4)	26,954.4476	17,302.9418	9651.50582	1801.42201	5.36 ***
	Radius matching (r = 0.01)	27,181.2304	16,622.8423	10,558.3882	1679.96172	6.28 ***
	Kernel matching	26,954.4476	16,866.2903	10,088.1574	1647.37929	6.12 ***

*** indicate being significant at the level of 1%.

4.3. Balance Test of Matching

In order to ensure the estimation quality of propensity score matching, it is necessary to carry out a balance test on the three matching methods to check whether there are systematic differences between the treatment group and the control group after matching. The standardized deviation of each variable before and after matching in the nearest neighbor matching method, radius matching method and kernel matching method can be seen in Table 6. The results show that the standardized deviations of the variables matched all decrease greatly after matching.

Table 6. Standardized deviation of each variable before and after matching in the three matching methods.

		Nearest Neighbor Matching Method (n = 4)		Radius Matching Method (r = 0.01)		Kernel Matching Method	
Variable	Before or after Matching	Standard Error	*p*-Value	Standard Error	*p*-Value	Standard Error	*p*-Value
Age	U	−30.5	0.012	−30.5	0.012	−30.5	0.012
	M	2.7	0.874	6.6	0.696	−1.9	0.910
Gender	U	−22.6	0.070	−22.6	0.070	−22.6	0.070
	M	5.9	0.733	3.2	0.857	−1.1	0.951
Nationality	U	30.8	0.013	30.8	0.013	30.8	0.013
	M	−9.7	0.578	−0.5	0.978	4.4	0.799
Educational level	U	16.8	0.178	16.8	0.178	16.8	0.183
	M	0.5	0.976	0.6	0.972	1.3	0.938
Health condition	U	32.6	0.028	32.6	0.028	32.6	0.028
	M	−1.7	0.899	−2.0	0.884	6.1	0.669
Being village cadres or not	U	−9.8	0.467	−9.8	0.467	−9.8	0.467
	M	3.2	0.829	−2.6	0.873	−1.7	0.917
Household labor force size	U	27.9	0.018	27.9	0.018	27.9	0.018
	M	−7.6	0.668	−6.0	0.731	−0.1	0.996
Farmland area	U	−23.3	0.086	−23.3	0.086	−23.3	0.086
	M	−4.0	0.745	−4.6	0.720	−3.9	0.760
Forest land area	U	1.8	0.903	1.8	0.903	1.8	0.903
	M	11.2	0.319	−2.7	0.895	−1.3	0.940
Being in the protected areas or not	U	56.1	0.000	56.1	0.000	56.1	0.000

It can be seen from Table 7 that the Pseudo R^2 values are all very small, all being less than 0.02; the LR chi2 statistics in the income model significantly drop to 1.75, 0.48 and 0.71 respectively; the mean values of standard error and the medians drop significantly, and the B values are all less than 25% (Rubin believes that the equilibrium hypothesis is satisfied when the B value of samples matched is less than 25%). Although the Pseudo R^2 in Table 7 is relatively low, which may affect the explanatory power of the propensity score matching model for data variation; however, a sensitivity analysis was conducted in the

following text, using Rosenbaum's sensitivity analysis to test the level of estimation bias in propensity score matching. The results showed that the processing effect of estimating household income through the propensity score matching method has high robustness. Therefore, the issue of low Pseudo R^2 could be ignored. By taking the changes in the quality test index of each matching method into consideration, it can be seen that after matching through the propensity score method, the deviation caused by the heterogeneity of observable variables in the treatment group and the control group is basically eliminated, and the matching result is good, in addition, the matching qualities of different matching methods are basically the same, which also reflects the robustness and reliability of the matching result to a certain extent.

Table 7. Balance test of matching qualities.

Dependent Variable		Matching Method	Pseudo R^2	LR chi2	MeanBias	MedBias	B Value
Per capita annual net income	Before matching		0.091	43.86	25.2	25.2	81.0 *
	After matching	Nearest neighbor matching (K = 4)	0.009	1.75	5.0	3.6	22.6
		Radius matching (r = 0.01)	0.003	0.48	3.3	2.9	11.9
		Kernel matching	0.004	0.71	3.3	1.8	14.3

* indicate being significant at the level of 10%.

4.4. Sensitivity Analysis of Matching

As shown by the empirical results above, the propensity score matching method can only control the selection bias based on the observed or measured variables, but the heterogeneity caused by unobserved or unmeasured covariates is still not effectively controlled, which will make the selection of matched samples non-random. This problem can be verified by estimating the level of deviation with Rosenbaum's sensitivity analysis. There may be some differences between the treatment group (participating) and the control group (not participating) before matching. Measuring the Gamma value is a method without hidden bias. By assigning different values to Gamma, the Rosenbaum boundary can estimate the upper limit of significance level, the lower limit of significance level, the upper limit of HL estimation, the lower limit of HL estimation, the upper limit of the confidence interval, and the lower limit of the confidence interval of the participation in ecotourism business. If the percentage increase of the Gamma value is small, it will result in a big difference between the results of statistical inferences and postulated study, then the results are not robust, suggesting that the propensity score matching method based on observable heterogeneity is not justified. If the Gamma value is close to 1, then there is no significant difference between the results of statistical inference and the postulated study, and the research conclusion is sensitive rather than robust. The results of the sensitivity analysis are shown in Table 8. Despite the over two-fold difference in the likelihood of farmers' participation caused by unobserved variables, the impact of farmers' participating in ecotourism operations on their per capita annual net income is still positive, whose significance level is less than 1%, and the confidence interval of the significance level of 5% is greater than 0. In addition, results show that there is no big difference among the estimated values of the three matching methods, and the estimation of the treatment effect of farmers' income through the propensity score matching method is relatively robust.

Table 8. Rosenbaum boundary estimation of ecotourism operations on household per capita annual net income.

Gamma	Sig+	Sig−	t-hat+	t-hat−	CI+	CI−
1.0	0.000	0.000	9399.79	9399.79	5875.05	13,219.0
1.1	0.000	0.000	8768.16	10,025.9	5297.86	13,842.4
1.2	0.000	0.000	8305.13	10,424.8	4799.10	14,419.4
1.3	0.000	0.000	7656.76	10,954.3	4446.09	14,905.4
1.4	0.000	0.000	7150.52	11,605.5	3883.16	15,435.6
1.5	0.000	0.000	6766.92	12,069.3	3507.04	15,922.4
1.6	0.000	0.000	6276.26	12,595.0	3186.25	16,379.3
1.7	0.000	0.000	6032.39	13,068.9	2851.23	16,827.6
1.8	0.001	0.000	5676.05	13,473.4	2557.38	17,239.0
1.9	0.003	0.000	5358.60	13,715.5	2189.49	17,674.8
2.0	0.001	0.000	5171.21	14,000.8	1852.85	17,996.7
1.0	0.000	0.000	9399.79	9399.79	5875.05	13,219.0

5. Discussion

Under the background of the development of ecological tourism in nature reserves, based on the survey data of 1002 farmers from 44 villages in or outside three national nature reserves (Haitangshan, Laotudingzi, and Baishilazi) and three provincial nature reserves (Sankuaishi, Houshi, and Heshangmaozi), this paper empirically analyzes the relationship between ecological tourism in nature reserves and farmers' income in the first place, then it carries out further discussion on the basis of the conclusion obtained, and finally, corresponding policy inspirations are proposed.

According to the research results above, it is found that the propensity score matching method can better measure the influential effect of ecotourism in nature reserves on the per capita annual net income of rural households, which provides an important reference for promoting the increase of the income level of rural households around nature reserves and enriching the research fields of rural households' income. Farmers' participation in ecotourism management is a key factor in the increase of their income, which can effectively increase farmers' income, and that is consistent with the research results of many existing studies in the literature [75–78]. Ecotourism employment plays an important role in socioeconomic development [79]. Farmers' gender, physical health condition and farmland area all have significant positive effects on farmers' participation in ecotourism management, and that is consistent with the findings of Ma et al. [16] and Aazami and Shanazi [80]. The more educated farmers are, the more knowledge and skills they master, which will significantly promote their participation in ecotourism management, and that is consistent with the view of Cheung L and Fok based on the research of respondents participating in ecotourism training [81].

However, the research results of this article also differ from those of some existing studies. Stojanović et al. found in their research on the environmental impact of ecotourism in Gornje Podunavlje Special Nature Reserve, Serbia, that employees in Gornje Podunavlje SNR Authority believe that there are few opportunities to generate income from ecotourism, which contradicts the research findings of this article [82]. The differences in those results may be due to the different researched sites. Joo et al. examined ecotourism development from the perspective of participation and economic impact on the Bousra people in Cambodia. They found that most households acknowledge that ecotourism has a positive impact from the perspective of environment, society and economy, while some signaled negative backlash due to depleted natural resources and impact on local culture. Household participation in ecotourism was not significantly affected by assistance issued by government or non-governmental organizations [83]. That is to say, the impact of farmers' participation in ecotourism on their income varies from person to person. The demographic characteristics of farmers, such as gender and physical health, can affect the impact of ecotourism on their income.

6. Conclusions

Through multiple linear regression (OLS) and propensity score matching (PSM), this paper empirically analyzes the impact of farmers' participation in ecotourism management on their income and draws the following three conclusions:

(1) The proportion of farmers participating in ecotourism operations in nature reserves in Liaoning Province is small, with only 90 households participating in ecotourism operations in nature reserves and 831 households not participating in ecotourism operations in nature reserves. Farmers participating in ecotourism in nature reserves only account for 9.78% of the total number of farmers, and farmers not participating in ecotourism in nature reserves account for 90.22% of the total number of farmers.

(2) The results of multiple linear regression (OLS) and propensity score matching (PSM) show that the participation in ecotourism management of farmers around nature reserves in Liaoning Province has a positive and significant impact on their per capita annual net income. Among the core explanatory variables, whether the respondents participate in ecotourism operations brings a significant difference to their income. Among the control variables, the respondents' gender, educational level, health condition, household labor force size, farmland area, and whether they are in the protected areas all have a significant impact on the per capita annual net income of rural households.

(3) The multiple linear regression model (OLS) did not take selection bias into consideration when estimating the impact of households' participation in ecotourism on per capita annual net income and overestimated the income effect of participating in ecotourism. However, the propensity score matching method (PSM) estimated that the per capita annual net income of households participating in ecotourism operations is about 37% higher than that of households not participating in ecotourism operations in the context of considering the heterogeneity of households participating in ecotourism management, which is about 18% lower than the estimation result of the multiple linear regression. Meanwhile, the results of the robustness test and balance test, which were based on the propensity score matching method, show that the matching method basically eliminated the apparent deviation of observable variables and the heterogeneity of unobservable variables of the treatment group and the control group, and will not lead to significant differences in the estimation results.

7. Policy Implications

This article explores the impact of ecotourism in nature reserves of Liaoning Province on farmers' income from the perspective of farmers' participation. The propensity score matching method (PSM) was used to solve the endogenous problem of samples and the problem of heterogeneity of processing effects. Empirical testing was conducted on the relationship between ecotourism in nature reserves and household income with micro survey data, providing evidence support for household income with micro-data. According to the research, it is found that farmers' participation in ecotourism in nature reserves can increase their income, but there are shortcomings of ecotourism in attracting the participation of farmers in surrounding communities. In order to promote active participation in ecotourism management from farmers, the following implications can be drawn based on the research conclusions of this paper.

(1) The government should take the role of a guide and a bridge to provide farmers with opportunities to participate in ecotourism. By vigorously promoting tourism culture to farmers and letting them participate in seminars related to tourism, the government can make the cultural connotation of ecotourism known to farmers, improve non-participating farmers' cognition and understanding of the benefits of ecotourism development and promote successful ecotourism cases to encourage non-participating farmers to actively follow suit.

(2) The government can provide financial support for farmers with poor family conditions by providing financial subsidies and preferential policies or through other

methods to help them overcome the difficulties in investment in the early stage, and moderately lower the threshold of ecotourism operation and reduce the cost of participation, so as to effectively promote farmers' engagement in business activities related to ecotourism, such as agritainment, accommodation, and tourism commodity production and selling in nature reserves, and change the current situation of low proportion of farmers' participation.

(3) The government should establish training schools for farmers around nature reserves and promote education and training in various aspects for farmers, such as training on catering skills, service skills, language skills and management skills, so as to improve the competitive capacities and service level of farmers, so that they can better participate in ecotourism management to increase income.

8. Research Limitations and Future Prospects

This article explores the impact of ecotourism participation on the income of farmers in nature reserves through counterfactual estimation based on propensity score matching. The research objectives have been achieved, but there are still certain shortcomings that deserve further exploration in the future. Firstly, although the propensity score matching method solved the endogenous problem caused by sample selection bias, the endogenous problem caused by possible omitted variables and bidirectional causality still needs to be further addressed. Secondly, the sample size of households participating in ecotourism among the respondents is relatively small. In the future, research can be conducted on households in ecotourism sites with higher levels of participation to compare the differences in research results.

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