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# The impact of farmers' tourism participation and social capital on environmentally responsible behavior

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**Introduction:** Understanding the drivers of environmentally responsible behavior among rural households is essential for global sustainability and China's rural revitalization. Although tourism is reshaping rural economies, its environmental implications at the household level remain underexplored. This study examines the extent to which tourism participation encourages pro-environmental behavior and clarifies the underlying behavioral pathways.

**Methods:** The analysis uses survey data from 1,721 households in Jiangxi Province. An analytical framework is developed to link tourism participation with environmentally responsible behavior, with social capital incorporated as an extended mechanism. Stepwise regression, instrumental variable estimation, robustness checks and heterogeneity analyses are employed to ensure credible identification.

**Results:** Tourism participation significantly improves environmentally responsible behavior, and this finding is consistent across alternative model settings. Social capital mediates this relationship and strengthens the environmental effect through interaction terms. The positive impact is more pronounced in ordinary villages, plains regions and villages where cash crops dominate local production.

**Discussion:** The results highlight tourism participation as an important contributor to rural pro-environmental behavior and reveal the micro-level role of social capital in shaping these outcomes. The study offers empirical support for rural environmental governance and sustainable development in agricultural regions.

## KEYWORDS

tourism participation, environmentally responsible behavior, rural sustainable development, agricultural sustainable development, green production behavior

## 1 Introduction

Global ecological crises and the sustainable development agenda have brought the green transition of rural regions to the forefront of both academic and policy debates (Wang L. et al., 2024; Li et al., 2021; Zhu et al., 2024). China's Rural Revitalization Strategy not only emphasizes economic revitalization but also highlights ecological livability as a central objective. Within this strategy, rural tourism has been assigned a crucial role due to its capacity to increase farmers' income, stimulate rural transformation, and revitalize local resources (Tang et al., 2021; He et al., 2023; Xu et al., 2025). In recent years, the number of visitors and tourism revenues in rural China have increased steadily, and tourism has gradually shifted from being a supplementary source of income to a primary livelihood strategy for many households.

This transformation has fundamentally reshaped farmers' behavioral logic: they are no longer only agricultural producers, but also tourism operators, service providers, and custodians of the rural environment (Liu et al., 2022). In ecologically sensitive areas, farmers are increasingly aware that a sound environment is the foundational asset for the long-term sustainability of tourism. Consequently, emerging studies suggest that tourism participation may encourage farmers to adopt environmentally responsible practices such as waste management, water conservation, and ecological restoration. From a theoretical perspective, tourism operators face higher environmental sensitivity and public scrutiny, which may increase their willingness to adopt eco-friendly behavior (Liu et al., 2025). Yet tourism activities can also generate new ecological burdens, including waste accumulation, traffic emissions, and land degradation (Kennedy and Dornan, 2009; Wang et al., 2020; Wang X. et al., 2024), thereby aggravating environmental externalities. Whether tourism participation ultimately promotes or undermines farmers' environmentally responsible behavior remains an open question.

Existing research has primarily focused on factors such as environmental awareness, policy incentives, and village regulations as determinants of farmers' environmental responsibility (Pretty, 2003; Tang et al., 2023). Much less attention has been paid to tourism participation as a behavioral driver. Even where tourism has been considered, analyses have largely remained at the level of qualitative description or empirical correlations, with limited exploration of institutionalized mechanisms (Zhu et al., 2024). Moreover, farmers' behavior is deeply embedded in social structures, and their choices are strongly shaped by neighborhood interactions, trust networks, and social norms. These dimensions of social capital may act as critical moderators in the relationship between tourism and environmental responsibility (Liu et al., 2014; Gu et al., 2025).

Jiangxi Province, a representative agricultural region in central China, provides a unique setting for such inquiry. With abundant natural resources and a solid ecological base, rural tourism in Jiangxi has grown rapidly and exhibits diverse patterns, ranging from economy-oriented villages centered on homestay clusters to ecotourism villages reliant on natural landscapes. For example, Wuyuan County, known as "the most beautiful countryside in China," has emerged as one of the most dynamic homestay clusters in eastern China. In 2023, the county received 26.20 million tourists, generating a comprehensive tourism revenue of RMB 25.68 billion. Wuyuan has actively built a full-chain tourism-residence supply system, promoted an "intensive and shared" development model, introduced the innovative "Homestay Loan" financial product, and explored a "collaborative guest attraction" strategy, thereby pioneering a path for homestay reform and driving the sector's rapid expansion (China Daily, 2025). This study is based on extensive household surveys and constructs an analytical framework for "tourism participation and environmental responsibility," using social capital as a regulatory mechanism. Specifically, this study addresses two core questions: Does the participation of the tourism industry significantly promote farmers' environmentally responsible practices? Will social capital amplify or weaken this influence?

By combining theoretical insights with empirical evidence, this research extends rural tourism studies into the domain of environmental governance and provides new support in modeling sustainable rural behavior. Furthermore, highlighting the role of social capital deepens the understanding of how rural social structures interact with individual environmental choices. Using Jiangxi Province

as a case study, the findings also yield practical implications for agricultural provinces pursuing green transition and rural governance.

## 2 Literature review and research hypotheses

### 2.1 Literature review

In traditional agricultural economies, farmers' production activities have largely revolved around resource use and livelihood security, with their environmentally responsible behaviors constrained by limited environmental awareness and external policy enforcement. With the rise of rural tourism, however, the behavioral logic of farmers is undergoing a profound shift. Tourism not only provides new sources of household income but also strengthens farmers' dependence on ecological quality(). The environment is no longer merely an object of passive protection but has become a productive asset that directly determines the long-term viability of tourism-based livelihoods. Accordingly, the relationship between tourism, ecological sustainability, and farmers' behavior has emerged as a critical lens for understanding pro-environmental motivations in rural contexts (Zhou et al., 2024; Huo et al., 2025).

Empirical research to date presents mixed evidence. On the one hand, several studies suggest that tourism participation encourages farmers to place greater emphasis on environmental protection in order to maintain the quality of natural resources and safeguard their reputational capital. On the other hand, tourism can also generate new ecological burdens, such as land degradation, solid waste, and water pollution, which may trigger short-term profit-seeking behaviors that weaken farmers' pro-environmental commitment. Despite these debates, most prior research has not embedded tourism participation into a coherent theoretical framework for explaining behavioral mechanisms (Zhao, 2025; Ren et al., 2021). As a result, the causal pathways between tourism and environmentally responsible behavior remain underexplored.

A further gap concerns the role of social capital in shaping the tourism-environment nexus. Social capital has increasingly been introduced into studies of tourism and environmental governance. Relational dimensions of social capital, such as interpersonal trust, reciprocity, and social norms, may foster the diffusion of pro-environmental practices through demonstration and peer pressure (Zhou et al., 2024; Dai et al., 2021). At the same time, structural social capital, including participation in village committees or tourism associations, can provide farmers with policy information, technical knowledge, and collective resources that enhance their capacity to implement environmental practices (Zhu et al., 2022). These mechanisms suggest that social capital may serve as both a mediator and moderator in the relationship between tourism participation and environmentally responsible behavior. Yet systematic analyses of these interactions remain scarce, and fragmented governance structures may further constrain ecological accountability in tourism expansion (Wei, 2022).

Taken together, existing studies reveal at least three major gaps. First, few studies have explicitly integrated tourism participation and environmentally responsible behavior into a theoretical model, particularly in the context of developing countries. Second, empirical evidence on the causal mechanisms linking tourism and environmental responsibility remains limited, with insufficient attention to agricultural provinces in central China where rural tourism is rapidly expanding.

Third, the mediating and moderating effects of social capital have not been fully incorporated into analytical frameworks of the tourism-environment relationship. In response to these gaps, the present study constructs a theoretical model linking tourism participation and farmers' environmentally responsible behavior, with social capital introduced as a key moderating mechanism. Drawing on household survey data from Jiangxi Province, the study proposes and empirically tests a set of research hypotheses regarding the direct impact of tourism participation, the mediating role of social capital, and the heterogeneity of effects across village types and ecological contexts.

## 2.2 Research hypothesis

### 2.2.1 Impact of tourism participation on environmental responsibility behavior

The formation of farmers' environmentally responsible behavior is driven by multiple factors. Against the backdrop of rapid rural tourism development, farmers are no longer only producers in the agricultural system but also operators and service providers in the tourism economy. Their behavioral logic is shifting from the traditional "resource-livelihood" model to a more complex "tourism-environment-income" model (Yan and Chen, 2025).

On the one hand, rural tourism increases the economic value of natural resources. Farmers who depend on tourism revenue have strong incentives to protect the environment, since ecological quality directly determines the sustainability of their income. From this perspective, pro-environmental behavior can be seen as an investment in the long-term productivity of tourism assets. Empirical evidence also shows that farmers' adoption of sustainable practices is closely tied to their perception of economic returns; they are more likely to engage in environmental responsibility when they recognize tangible benefits from doing so.

On the other hand, tourism activities inevitably generate negative externalities, such as waste disposal, water pollution, or land degradation. These ecological burdens increase environmental costs, compelling farmers to balance economic gains with ecological constraints in their management practices. Theoretical frameworks such as joint production and undesirable outputs highlight that tourism generates both desirable outcomes (income, services) and undesirable outcomes (pollution, ecological degradation). Farmers' decision-making therefore involves weighing the marginal benefits of tourism income against the marginal costs of environmental damage and ecological protection.

Within this framework, tourism participation enhances farmers' motivation to adopt pro-environmental measures because greater involvement in tourism improves the efficiency of environmental protection efforts. The closer the linkage between ecological quality and household revenue, the stronger the incentive for farmers to increase their investment in environmental responsibility. This leads to the following hypothesis:

*H1: Farmers' level of tourism participation has a significant positive effect on their environmentally responsible behavior.*

### 2.2.2 The moderating role of social capital

While economic incentives are essential in shaping farmers' environmental responsibility, farmers' behavior is also deeply

embedded in the social networks of rural society. As "embedded actors," their willingness and ability to implement pro-environmental measures are strongly influenced by their social capital (Wan and Du, 2022).

Social capital can affect farmers' environmental behavior in two ways. First, it exerts a direct effect: higher levels of trust, reciprocity, and shared norms within a village foster collective awareness of ecological protection and enhance the likelihood of adopting environmentally responsible practices. Structural forms of social capital, such as participation in village committees or tourism associations, provide farmers with access to policy information, training, and shared resources that strengthen their capacity to act sustainably (Zhou et al., 2022).

Second, social capital plays a moderating role in the relationship between tourism participation and environmental responsibility. Farmers with higher social capital are better able to translate the economic incentives from tourism into effective environmental practices. Social interactions and peer influence amplify the reputational pressure to maintain ecological quality, while cooperative networks reduce the individual costs of adopting pro-environmental behavior. As a result, the marginal effect of tourism participation on environmental responsibility is stronger for households with higher levels of social capital. Based on this reasoning, the following hypothesis is proposed:

*H2: Social capital not only has a direct positive effect on farmers' environmentally responsible behavior but also significantly strengthens the positive relationship between tourism participation and environmental responsibility.*

## 3 Model construction and variable selection

### 3.1 Benchmark regression model

In order to systematically reveal the intrinsic mechanism of tourism participation on farmers' environmental responsibility behavior, this paper constructs a benchmark regression model. Considering that this article uses cross-sectional farmer questionnaire data and the sample only covers one time period, it does not have the condition to introduce time fixed effects. In order to control the heterogeneity that does not change over time at the regional level, this paper introduces individual fixed effects in the model to ensure the robustness of the estimation results. The specific models are as follows:

$$e_i = \alpha + \beta T_i + \gamma Z_i + \mu_i + \varepsilon_i$$

Based on the above benchmark model, this article further explores the mechanism by which social capital affects farmers' environmental responsibility behavior in the process of tourism participation, and constructs a moderation effect model:

$$e_i = \alpha + \beta_1 T_i + \beta_2 S_i + \beta_3 (T_i \times S_i) + \gamma Z_i + \mu_i + \varepsilon_i$$

Among them,  $e$  is the level of environmental responsibility behavior of farmers,  $T$  is the degree of tourism participation,  $S$  is the

level of social capital,  $Z$  is the control variable vector,  $\mu$  is the individual fixed effect,  $\varepsilon$  and is the random error term.

## 3.2 Variable selection

To empirically identify the impact mechanism of farmers' tourism participation on environmental responsibility behavior, this article constructs the following variable system based on theoretical models and survey questionnaire design, including dependent variables, core explanatory variables, control variables, and mechanism variables, as follows.

### 3.2.1 Explained variable: environmental responsibility behavior

This article takes the environmental responsibility behavior of farmers as the dependent variable to measure the degree to which they fulfill their environmental protection obligations in daily life and production activities. The construction of this variable mainly refers to relevant literature on environmental psychology and sustainable behavior research, and combines with survey questionnaire design to measure from five dimensions: garbage classification, energy conservation, resource protection, green consumption, and low-carbon travel. Specifically, the questionnaire consists of 5 declarative items: (1) Whether recyclable waste is classified and collected in daily life; (2) Do you pay attention to saving energy such as electricity, water, and gas in daily life; (3) Whether to reduce behaviors such as indiscriminate logging that damage the ecological environment; (4) Do you tend to choose environmentally friendly and low-carbon products in daily consumption; (5) Whether to actively choose walking or public transportation in daily travel to reduce the use of private cars. In terms of measurement methods, each behavior is assigned a normalized score of 1 to form a single indicator, with a total score range of 0–5 points. The higher the score, the more positive the level of environmental responsibility behavior of farmers.

### 3.2.2 Core explanatory variable: tourism participation

In this study, we treat tourism participation as an ordered discrete variable ranging from 0 to 3, capturing the intensity and stability of farmers' engagement. A value of 0 denotes no involvement; 1 denotes occasional or seasonal work (typically less than 6 months per year); 2 denotes stable employment in tourism enterprises with continuous work for at least 6 months per year; and 3 denotes independent operation of tourism businesses such as homestays, farm restaurants, or souvenir shops, where tourism provides the main share of household livelihood. These operational rules translate qualitative distinctions into a reproducible coding scheme and form the basis for subsequent analyses of environmentally responsible behavior.

### 3.2.3 Mechanism variable: social capital

In addition, this article uses social capital as a mechanism variable and measures it through four questionnaire items, namely: the relationship between farmers and village cadres, the frequency of social and entertainment activities with neighbors, the level of trust in neighbors, and the possibility of mutual assistance between neighbors when encountering difficulties. All items are assigned using a five level Likert scale, with 1 indicating "very poor/very disagree" and 5

indicating "very good/very agree." During the data processing, the scores of the four items are normalized and their mean is calculated as the comprehensive index of social capital. The higher the score, the higher the capital level of farmers in terms of social network, trust, and mutual assistance. This index can better reflect the social resources possessed by farmers in the community and be used to examine the mechanism and role of social capital in the process of tourism participation affecting environmental responsibility behavior.

### 3.2.4 Control variables

In the model, this article also controls for a series of individual and family characteristic variables that may affect farmers' environmental responsibility behavior. At the individual level, it includes whether they serve as village officials, age, and education level to reflect the social roles, life processes, and differences in human capital of farmers. At the household level, it includes the scale of arable land (mu), the number of household laborers (person), and the total household income (yuan) to measure the resource endowment and economic status of the household (Wang et al., 2022; Shen et al., 2023). Setting these control variables can help reduce the bias of omitted variables and ensure a more robust estimation of the impact of tourism participation on environmental responsibility behavior.

### 3.2.5 Descriptive statistics

See Table 1.

## 4 Empirical analysis

### 4.1 Benchmark regression results

Based on the construction of econometric equations, this article will use household survey data to empirically test the impact of tourism participation on environmental responsibility behavior. To ensure the robustness and logicity of identification, this article adopts a stepwise regression method to observe the stability and significant changes of the core explanatory variable "tourism participation" coefficient. Table 2 shows the results of stepwise regression.

Table 2 presents the baseline regression results. Tourism participation has a consistently positive and significant effect on farmers' environmentally responsible behavior across all model specifications, with coefficients ranging from 0.284 to 0.312. This indicates that greater involvement in tourism substantially promotes pro-environmental practices. Among the control variables, education level and household income show positive effects, while village cadre status, age, land area, and household laborers are not significant. The results remain robust after adding demographic and economic controls, underscoring the central role of tourism participation in fostering environmentally responsible behavior.

### 4.2 Endogenous test and instrumental variable regression

Although benchmark regression shows that tourism participation significantly promotes farmers' environmental responsibility behavior, tourism participation behavior itself may be influenced by

TABLE 1 Descriptive statistical results.

Variable	Obs	Mean	Std. Dev.	Min	Max
Environmental responsible	1,721	4.066	0.637	1.2	5
Tourism participation	1,721	0.683	0.909	0	3
Village cadre status	1,721	0.336	0.471	0	1
Age	1,721	4.667	1.114	1	6
Education level	1,721	2.826	1.148	1	5
Cultivated land area	1,721	1.941	3.147	0	20
Number of household laborers	1,721	2.19	0.802	0	4
Distance to tourism site	1,721	1.959	0.789	1	3
Total household income	1,721	4.645	4.165	0	120
Social capital	1,721	3.975	0.616	1.5	5

TABLE 2 Benchmark regression results.

Variables	(1)	(2)	(3)	(4)
Tourism participation	0.284*** (0.042)	0.296*** (0.043)	0.301*** (0.043)	0.312*** (0.045)
Village cadre status		0.012 (0.018)	0.015 (0.018)	0.014 (0.019)
Age		-0.003 (0.003)	-0.003 (0.003)	-0.004 (0.003)
Education level		0.021* (0.012)	0.026* (0.013)	0.027* (0.014)
Cultivated land area			0.005 (0.005)	0.006 (0.005)
Household laborers			-0.009 (0.013)	-0.007 (0.013)
Household income			0.152*** (0.037)	0.156*** (0.038)
Constant	0.471*** (0.082)	0.396*** (0.087)	0.352** (0.094)	0.318** (0.102)
Fixed effects	No	Yes	Yes	Yes
Observations	1,721	1,721	1,721	1,721
Adj. R <sup>2</sup>	0.071	0.143	0.197	0.215

Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , and \* $p < 0.1$ .

unobservable factors such as individual environmental awareness and social responsibility preferences, leading to endogeneity issues and estimation errors. To alleviate this issue, this article uses the instrumental variable method (two stage least squares, 2SLS) for endogeneity correction. Firstly, regarding the selection and rationality of instrumental variables, this article selects “the distance between the family and the tourist center or the main tourist route” as the instrumental variable for tourism participation. This variable is divided into three levels based on the actual distance between the residence of farmers and the main tourism facilities in the village: 1 = within 300 meters, 2 = 300–500 meters, and 3 = beyond 500 meters. The rationality of using it as an instrumental variable is reflected in the fact that farmers who are closer to each other are more

likely to receive tourist flow, business convenience, and employment opportunities, and therefore are more likely to participate in tourism activities; at the same time, this variable has strong exogeneity: the family spatial location is relatively stable, less affected by individual environmental awareness or behavior, and has no direct causal relationship with environmental responsibility behavior, meeting the exclusion limit (see Table 3).

The first-stage regression shows that households located closer to tourist facilities are significantly more likely to participate in tourism. Compared with households located more than 500 meters away, those within 300 meters and within 300–500 meters exhibit significantly higher participation levels, with coefficients of 0.247 and 0.124, respectively, significant at the 1% level. The first-stage  $F$ -statistic is 24.81, far above the conventional threshold of 10, excluding the risk of weak instruments. In the second stage, tourism participation maintains a strong and positive effect on environmentally responsible behavior, with a coefficient of 0.419 significant at the 1% level. This effect is notably larger than the baseline OLS estimate (around 0.312), suggesting that the OLS results may underestimate the true impact due to endogeneity. Moreover, the Hansen over-identification test yields a  $p$ -value of 0.483, failing to reject the null hypothesis and supporting the validity of the instrument. Overall, the IV results are consistent with the baseline findings in terms of direction, significance, and robustness, reinforcing the conclusion that tourism participation is an important driver of farmers’ environmentally responsible behavior.

### 4.3 Robustness checks

To further validate the reliability of the baseline results, several robustness checks were conducted. First, we replaced the original multi-level measure of tourism participation with a binary indicator of whether a household engages in tourism employment. The results remain significantly positive, with coefficients close to those in the baseline regressions. Second, to account for heterogeneity across the distribution of environmentally responsible behavior, quantile regressions were estimated at the 30th, 60th, and 90th percentiles. Tourism participation exhibits consistently positive and significant effects at all quantiles, with stronger impacts observed in the middle and upper quantiles, suggesting that tourism is particularly effective in enhancing environmentally responsible practices among households with higher baseline engagement. Finally, to address potential bias from extreme values in household income and other variables, we re-estimated the models after applying a 95% winsorization. The results are highly consistent with the baseline, confirming that the significance and direction of the estimated effects are robust (see Table 4).

These results consistently confirm that the positive impact of tourism participation on farmers’ environmentally responsible behavior is robust across alternative measures, different points of the distribution, and after addressing potential outliers.

### 4.4 Heterogeneity analysis

To further explore the differentiated effects of tourism participation on environmentally responsible behavior, we conducted

TABLE 3 Instrumental variable regression results.

Variables	First stage (tourism participation)	Second stage (environmental responsibility)
Distance to tourist facilities	-0.247*** (0.038)	
Tourism participation		0.419*** (0.088)
Control variables	Yes	Yes
Village fixed effects	Yes	Yes
Observations	1,721	1,721
First-stage F-statistic	24.81	
Hansen test p-value		0.483
Adj. R <sup>2</sup>	0.161	0.228

Robust standard errors in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , and \* $p < 0.1$ .

heterogeneity analyses by village type, topographic conditions, and agricultural structure. This approach allows us to examine whether the impact of tourism varies across different locational, ecological, and industrial contexts, thereby shedding light on the conditions under which tourism is most conducive to promoting pro-environmental practices.

As shown in Table 5, the results reveal clear heterogeneity across the three dimensions. First, by village type, tourism participation exerts significantly positive effects in all subgroups, but the effect is strongest in ordinary villages (0.315,  $p < 0.01$ ), followed by remote (0.289,  $p < 0.05$ ) and suburban villages (0.268,  $p < 0.01$ ). This pattern suggests that ordinary villages, which are neither fully urbanized nor geographically disadvantaged, may be particularly well positioned to translate tourism opportunities into sustainable behavioral changes. In contrast, suburban villages may already rely on diversified income sources, diluting the marginal effect of tourism, while remoteness restricts infrastructure and market access, thereby constraining the strength of the effect. Second, in terms of topographic conditions, the positive effect of tourism participation is most pronounced in plain areas (0.322,  $p < 0.01$ ), moderate in hilly regions (0.287,  $p < 0.01$ ), and weakest in mountainous villages (0.251,  $p < 0.05$ ). The declining gradient indicates that geographical constraints such as fragmented land, steep terrain, and higher transportation costs in mountainous villages undermine the efficiency with which tourism fosters environmentally responsible practices. Conversely, the relatively favorable ecological and infrastructural conditions in plains provide an enabling environment for tourism-driven behavioral transformation. Third, when considering agricultural structure, the effect is markedly stronger in cash-crop villages (0.334,  $p < 0.01$ ) than in non-cash-crop villages (0.276,  $p < 0.01$ ). This result highlights the complementary relationship between tourism and commercial agriculture. In cash-crop areas, villagers are more accustomed to market-oriented production, and tourism provides additional marketing channels and income opportunities. This synergy incentivizes households to adopt practices aligned with environmental protection, whereas non-cash-crop villages, with more subsistence-oriented structures, respond less intensively. Taken together, these findings demonstrate that the effects of tourism participation are not

uniform but conditioned by local characteristics. The stronger effects observed in ordinary villages, plains, and cash-crop areas underscore the importance of accessibility, favorable ecological conditions, and market integration in maximizing the pro-environmental benefits of tourism. Policy interventions should therefore be tailored to address the structural disadvantages faced by suburban and mountainous villages, as well as non-cash-crop areas, in order to ensure more balanced and inclusive outcomes of tourism-driven rural revitalization.

## 4.5 Mechanism analysis

The empirical evidence suggests that tourism participation affects environmentally responsible behavior not only directly but also indirectly through the channel of social capital.

As reported in Table 6, Model (1) confirms the baseline finding that tourism participation significantly promotes pro-environmental practices. In Model (2), after incorporating social capital, its coefficient is positive and highly significant, while the coefficient on tourism participation decreases slightly. This pattern indicates that social capital acts as a partial mediator, suggesting that villagers' stronger social ties and trust networks play a meaningful role in shaping environmental responsibility.

## 5 Discussion

The empirical results show that tourism participation substantially enhances environmentally responsible behavior among rural households, lending strong support to the argument that economic diversification through tourism can generate environmental co-benefits. This finding complements earlier studies emphasizing the environmental externalities of rural tourism but extends the literature in two important ways. First, while prior research has largely relied on macro-level assessments of tourism's environmental footprint, our household-level evidence demonstrates that tourism also reshapes micro-level behavioral norms. Second, whereas existing studies often highlight negative externalities such as ecological degradation from tourism expansion, our results underline its potential to mobilize pro-environmental action when embedded in appropriate social contexts.

Beyond the overall effects, the mechanisms through which different types of tourism participation shape environmental responsibility also deserve attention. Independent operators, for instance, tend to perceive environmental quality as a long-term asset directly tied to their business reputation and income stability. Their engagement in eco-friendly practices often stems from self-motivation and future-oriented benefits, reflecting a logic of "environmental entrepreneurship." In contrast, full-time employees are more likely to act in response to formal environmental standards and institutional constraints established by tourism enterprises, where ecological management systems and workplace culture reinforce compliance-oriented environmental behavior. Part-time participants, whose involvement is more transient, may rely primarily on community norms or peer influence to adopt environmentally responsible behaviors. These differentiated mechanisms highlight that the pathways linking tourism participation and environmental responsibility are not uniform but shaped by actors' positions within the tourism economy.

TABLE 4 Robustness checks.

Variables	(1) Alternative indicator	(2) 30th quantile	(3) 60th quantile	(4) 90th quantile	(5) 95% winsorization
Tourism participation	0.289***	0.245***	0.302***	0.348***	0.308***
	(0.041)	(0.058)	(0.049)	(0.052)	(0.044)
Control variables	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,721	1,721	1,721	1,721	1,721
Adj. R <sup>2</sup>	0.208	0.192	0.201	0.223	0.21

Robust standard errors in parentheses. \*\*\**p* < 0.01, \*\**p* < 0.05, and \**p* < 0.1.

TABLE 5 Heterogeneity analysis.

Variables	Suburban villages	Ordinary villages	Remote villages	Plain	Hilly	Mountain	Cash-crop	Non-cash-crop
Tourism participation	0.268***	0.315***	0.289**	0.322***	0.287***	0.251**	0.334***	0.276***
	(0.051)	(0.048)	(0.072)	(0.047)	(0.052)	(0.081)	(0.045)	(0.056)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	612	782	327	865	566	290	910	811
Adj. R <sup>2</sup>	0.198	0.221	0.164	0.227	0.193	0.152	0.233	0.187

Robust standard errors in parentheses. \*\*\**p* < 0.01, \*\**p* < 0.05, and \**p* < 0.1.

TABLE 6 Mechanism test.

Variables	(1)	(2)	(3)	(4)
Tourism participation	0.284***	0.259***	0.243***	0.228***
	(0.042)	(0.044)	(0.046)	(0.048)
Social capital (M)		0.165***	0.152***	0.148***
		(0.039)	(0.041)	(0.041)
Tourism participation × M			0.087**	0.091**
			(0.037)	(0.038)
Control variables	No	Yes	Yes	Yes
Fixed effects	No	No	Yes	Yes
Observations	1,721	1,721	1,721	1,721
Adj. R <sup>2</sup>	0.071	0.139	0.194	0.212

Robust standard errors in parentheses. \*\*\**p* < 0.01, \*\**p* < 0.05, and \**p* < 0.1.

Heterogeneity analysis further refines this picture. The stronger effects observed in ordinary villages, plain areas, and cash-crop communities indicate that locational accessibility, ecological endowments, and industrial orientation shape how tourism is translated into environmental responsibility. These patterns can be further understood through differences in resource endowments across village types. For example, suburban villages often benefit from diversified non-agricultural income and higher market integration, yet their residents may rely less on natural resources for livelihood, leading to weaker behavioral responses to environmental initiatives. In contrast, ordinary and peripheral villages with lower infrastructure levels and stronger dependence on local ecosystems tend to internalize environmental awareness more directly when tourism provides both

income opportunities and incentives for ecological protection. This perspective enriches the interpretation of heterogeneity results and highlights the role of structural conditions in mediating tourism’s environmental effects.

These insights add nuance to the current debate on tourism and sustainability by showing that the benefits of tourism are not evenly distributed, echoing but also extending findings from studies in rural Europe and Southeast Asia that underscore context dependency in tourism-environment linkages. A key contribution of this study lies in uncovering the mediating and moderating role of social capital. Our results resonate with the broader literature on trust and reciprocity as preconditions for collective environmental action, yet they advance this perspective by demonstrating how tourism actively fosters these relational assets. In doing so, the study bridges tourism research with theories of social capital, offering a novel explanation for how economic and social dynamics intersect to shape sustainable behaviors in rural settings. Collectively, these findings underscore that tourism is more than an economic activity; it is also a social process capable of reshaping norms and practices toward sustainability. This dual role distinguishes our study from prior work and positions tourism as a potential lever for broader rural sustainability transitions.

## 6 Conclusion

By integrating micro-level household survey data with econometric identification, this study demonstrates that tourism participation consistently promotes environmentally responsible behavior, even after addressing endogeneity and conducting multiple robustness checks. Importantly, the effects are heterogeneous, with

greater benefits observed in villages with favorable locational and industrial conditions. The mechanism analysis reveals that social capital—through networks, trust, and reciprocity—serves as both a mediator and amplifier of this relationship.

Our contributions are threefold. First, we provide household-level evidence that enriches the literature on tourism and environmental behavior, which has been dominated by macro- or destination-level perspectives. Second, we identify social capital as a critical transmission channel, thus extending theoretical frameworks on the tourism-environment nexus. Third, we highlight actionable policy implications: tourism initiatives should be tailored to local contexts, and equal emphasis should be placed on fostering social trust and networks to maximize the sustainability dividends of rural tourism. Nevertheless, several limitations remain. The cross-sectional nature of the data restricts the ability to make dynamic causal inferences about how tourism participation influences farmers' environmental behavior over time. Future research could employ panel data or longitudinal tracking to capture the evolution of behavioral changes and strengthen causal identification. Additionally, the study relies on self-reported indicators, which may be subject to social desirability or recall bias, potentially leading respondents to overstate environmentally responsible behaviors. Integrating behavioral observations, experimental designs, or administrative data could help validate self-reported outcomes and improve measurement precision. Moreover, the research focuses on a single province, and while Jiangxi offers diverse and representative rural tourism patterns, contextual heterogeneity across regions suggests that the findings may not be universally generalizable. Comparative studies across multiple provinces or cultural settings would help assess the external validity of the proposed mechanisms.

Despite these limitations, this study moves beyond conventional assessments of tourism's environmental impacts to demonstrate its capacity to foster pro-environmental behavior through social pathways. By linking economic participation to social capital formation and, in turn, to environmental responsibility, we highlight a previously underexplored mechanism that broadens the understanding of tourism's role in sustainable rural development.

## Data availability statement

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

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## Author contributions

HZ: Data curation, Writing – review & editing, Writing – original draft. FL: Conceptualization, Writing – review & editing. YY: Writing – original draft, Data curation, Validation. LW: Writing – review & editing, Supervision.

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## Conflict of interest

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