frontiers | Frontiers in Forests and Global Change

TYPE Original Research
PUBLISHED 27 March 2023
DOI 10.3389/ffgc.2023.1144116

OPEN ACCESS

EDITED BY
Satyapriya Rout,
University of Hyderabad, India

REVIEWED BY
David Mwesigye Tumusiime,
Makerere University, Uganda
Nataliya Stryamets,
Ca' Foscari University of Venice, Italy

*CORRESPONDENCE
Ke Chen
✉ chenke@syau.edu.cn
Dan He
✉ hedan@syau.edu.cn

SPECIALTY SECTION
This article was submitted to Forest Management, a section of the journal Frontiers in Forests and Global Change

RECEIVED 13 January 2023
ACCEPTED 10 March 2023
PUBLISHED 27 March 2023

CITATION
He D, Wang J, Zhang T, Xu Z, Wang Y, Liu S and Chen K (2023) The impact of tourism on farmers' household income in the context of China's regulatory policies of protected areas.
Front. For. Glob. Change 6:1144116.
doi: 10.3389/ffgc.2023.1144116

The impact of tourism on farmers' household income in the context of China's regulatory policies of protected areas

Dan He*, Jingwen Wang, Tingting Zhang, Zhe Xu, Yang Wang, Shiyu Liu and Ke Chen*

College of Economic and Management, Shenyang Agricultural University, Shenyang, Liaoning, China

China's central government has issued several governance policies for protected areas since 2015. Some of these affected the use of natural resources by the farmers living in protected areas. Tourism is an important source of income for farmers around such areas. Based on the survey data of 1,028 farmer households, this study use propensity score matching (PSM) method to solve the samples selection bias and improve the accuracy of evaluation. For both the vertical and horizontal, this study explores the changes in the impact of tourism on farmers' household income under regulatory policies. Longitudinally, before the introduction of these policies, the income effect of tourism on the per capita net income of households was about 49.21%, while this percentage dropped to 41.36% after their introduction. Horizontally, before these policies were implemented, the farmers involved in the protected areas' tourism experienced 16.30% higher tourism income effect than those outside protected areas. Post implementation, the income effect of tourism in protected areas dropped by 9.83%. Empirical data based on the abovementioned were used to verify the inhibitory effect of the existing control policies on tourism in protected areas, and put forward the direction of policies reform in China or state governance-protected areas in other countries.

KEYWORDS

China, protected areas tourism, policies effect, policies impact, household income, propensity score matching (PSM)

1. Introduction

By 2020, there were at least 22.5 million square kilometers of terrestrial and inland water ecosystems (accounting for 16.64% of the global land area) and 28.1 million square kilometers of coastal waters and oceans in protected areas (UNEP-WCMC and IUCN, 2021). The establishment of protected areas is key to preventing habitat and species degradation (Wang and Liu, 2021). The West has used the mode of Yellowstone National Park, i.e., the fence-and-fine approach, for a century (Kitamura and Clapp, 2013). Although the management mode of protected areas has been reformed, from the management ownership perspective, the state still governs 90.00% of the world's protected areas (Nyaupane et al., 2022).

China's protected areas are legally designated areas to protect representative natural ecosystems and rare or endangered wildlife species (Regulations of the People's Republic of China on Protected Areas, 2017). State governance is the only governance mode of protected areas in China. According to the differences of importance, they can be divided into national-level protected areas and provincial-level protected areas. By the end of 2018, there were 2,750 protected areas of various types in China, including 474 national-level protected areas and 2,276 provincial-level protected areas, covering a total area of about 1.47 million square kilometers, accounting for 14.88% of the land area. National-level protected areas funds are provided by the central and provincial governments, and provincial-level protected areas funds are provided by provincial governments. Provincial-level protected areas have no regional governance policies, and are generally managed protected areas according Regulations of the People's Republic of China on Protected Areas. China's protected areas (similar to the I-IV categories of the IUCN protected areas) learned from Yellowstone's "fencing" management principle. They are divided into three zones: core zone, buffer zone, and transition zone. None is allowed to enter the core zone except those who have been approved by management committee for scientific research. In order to deliver successful conservation outcomes, indigenous people have to be excluded from core zone. For those residents who cannot relocate temporarily, a transition period shall be established for them. Indigenous people can continue to live in the buffer zone. However, the indigenous people living in the core zone and the buffer zone are only allowed to carry out necessary agricultural production, but can't expand the areas of house, production facilities or cultivated land. Scientific experiments, tourism and breeding of rare wild animals are allowed in the transition zone. Indigenous people living in the transition zone shall not build production facilities that maybe pollute the environment, destroy resources or landscapes, such as small farms.

Numerous people reside in and around protected areas in China, and these areas are also the country's poverty-stricken zones (Wang, 2017). It is relatively difficult for China to achieve the dual goals of biodiversity conservation in protected areas and the development of the surrounding communities. Farmers around the reserves face innumerable adverse effects of the biodiversity conservation policies, which deny them developmental opportunities. This can be detrimental because if they are deprived of the benefits of conservation, they will stop taking an active interest in the conservation of such areas (Wang et al., 2010). Services or natural resources are considered to be a key part of farmers' production activities and life around protected areas, and these kinds of environments and their resources offer economic value (Thondhlana and Muchapondwa, 2014; Bakkegaard et al., 2017). Especially, under the policy of restricting the use of tangible natural resources by the management department of protected areas, tourism employs intangible environmental services to realize value-added environmental income, which can alleviate the contradiction between protection and economic development (Lamsal et al., 2015). According to the Regulations of the People's Republic of China on Protected Areas, ecotourism can be carried out in the transition zone of protected areas, and 80.00% of the protected areas in China involve ecotourism activities (Zhou et al., 2021).

The regulatory policies of protected areas include governmental measures aimed at prohibiting or restricting the relevant persons in such areas from engaging in activities that may adversely impact the ecology (Qi and Ke, 2021). Problems in the policy and governance of protected areas have always been regarded as a great threat to protected areas (Hockings, 2003). Under the single governance mode of the Chinese government, protected areas pay too much attention to ecological protection (Shen, 2018). Tourism and community farmers are regarded as external threats to protected areas. Regulations tend to expand the authority of the state by imposing restrictions in populated areas formerly not under control of protected areas officials (Heinen and Mehta, 2000). Since 2015, the laws and regulations of China's central government regarding the management of protected areas suddenly intensified. Protected areas have been included into the prohibited development areas of the "national ecological protection red line," with an emphasis on control. Prohibited development areas refers to the "prohibition of industrialization and urbanization" development areas. It should not refuse the environmentally friendly use of traditional agriculture and animal husbandry, low-intensity ecotourism and sightseeing. However, during the implementation of the policies, the local authorities worried about tourism activities that adversely affect protection, so they shut down and dismantle tourism facilities across the board over a short period (Wu et al., 2022). They are also very sensitive to the approval of new tourism projects (Yang and Zhang, 2021). Due to the lack of classified guidance, the existing tourism in the transition zone of protected areas has been disturbed to varying degrees in terms of scheme preparation, infrastructure construction, and routine maintenance. This, to some extent, hinders the development of tourism in protected areas.

While protecting the ecological environment, the regulatory policies related to protected areas should reduce the adverse social impact, or at least not intensify farmers' poverty (Duan and Ouy, 2020). In recent years, the systematic concept that tourism, community, and protected areas are an interactive whole has been established, and the policy of identifying the interests of different groups has been emphasized in the context of improving the sustainable management of tourism in protected areas (Wilson et al., 2009; Pfueller et al., 2011; Snyman and Bricker, 2016). State-governed is an important governance mode of global protected areas. The dual objectives of protecting biodiversity in protected areas and improving community livelihood may contradict each other, leading managers to face the arduous task of balancing human, and economic development and protecting biodiversity priorities (Nyaupane et al., 2022). Under the State-governed framework, designing incentive-compatible tourism policies in protected areas and improving policy efficiency is a vital issue that needs to be addressed urgently by the government and the concerned academic scholars (Cai and Yu, 2012).

The contradiction between resource protection and farmers' development in protected areas is rooted in economic interests. The modern ecological protection concept emphasizes the coordinated advancement of ecological benefits and social economy while attaching importance to farmers' benefits from the protection process (Bennett and Dearden, 2014). On the one hand, the implementation of regulatory policies in protected areas deprives communities of some rights to use natural resources, which may inhibit tourism. On the other hand, it increases the quality of ecosystem services to a certain extent or promotes tourism.

Under the combined influence of inhibition and promotion, from an economic perspective, this study verifies the changes in the effect of tourism on farmers' household income before and after the intensive introduction of protected areas' control policies. Whether the existing protected areas' tourism control policies have yielded benefits or incurred losses for farmers' tourism, the conclusion of this study can response to the impact of a series of intensive protected areas' tourism control policies in China through empirical data on the changes in farmers' household income contribution. State governance in China and other countries around the world has the potential to achieve effective biodiversity conservation. However, this governance will need to undergo some improvement before it becomes more inclusive, more equitable and reduce conflict. This study provides empirical support for alleviating the contradiction between protection and development and improving the tourism development policies in the state-governed protected areas.

2. Literature review

Having constitutional status is a key strength of protect areas governed by the state (Wicander, 2015). The IUCN and CBD recognize and recommend four governance modes of protected areas: governance by government (at various levels), governance by private individuals and organizations, governance by indigenous peoples and/or local communities, and shared governance (i.e., governance by various rights holders and stakeholders together). The governance mode determines who has authority and responsibility in protected areas (Borrini-Feyerabend et al., 2013). Governance by private individuals and organizations, governance by indigenous peoples and/or local communities, shared governance these three modes are not applicable when land ownership is held by the state, as the case of China. The government governance mode implies that the government (including the central or provincial government) has the authority, responsibility, and obligation to manage protected areas, and it decides upon the protection objectives. In China's constitution, there is a general provision for the state ownership of natural resources. The state (all citizens) has the ownership of all natural resources related to the national economy and individual livelihood (Liu, 2014). Therefore, the current protected area system in China needs to follow a top-down holistic path, governance by government is a more suitable governance mode for China's protected areas.

From their origin and following a global pattern, the vast majority of protected areas were established under tight government (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018c). Compared to the other types, protected areas under government governance often tend to cover larger pockets of land, which have the ability to safeguard greater amounts of species and maintain intact habitats as well as maintain ecosystem services (Ladle and Whittaker, 2011). The case studies provide further examples supporting this trend: state governance protected areas are reported to, in the very least, have achieved conservation success in terms of maintaining the integrity of a large habitat in a landscape of increasing poaching, and land encroachment. Although the use of natural resources and illegal activities continue to some extent, levels have been observed to be lower inside protected areas than outside (Borrini-Feyerabend et al., 2013; Wu et al., 2022). But, major budget cut, extractive activities, protected area downgrading, lack the necessary social acceptance (Bruner et al., 2001; Ferro et al., 2014), political corruption (Irland, 2008), these undermined protected areas in many parts of the world, rendering state governance protected areas ineffective (Borrini-Feyerabend et al., 2013). Addressing these issues is likely to depend on reforms of improve management (Ladle and Whittaker, 2011). Biological Diversity, the Aarhus Convention and the 2030 Agenda for Sustainable Development, call for alternative modes of governance to include effective collaboration among different public and private actors and stakeholders (Couix and Gonzalo-Turpin, 2015; Decker et al., 2016). Decentralization that would improve livelihoods for specifically marginalized groups near protected areas (Larson and Soto, 2008). As a response to this call, European Union member States and Central Asia tend to decentralize or public-private govern. For example, gave subnational authorities the power to create protected areas led to closer involvement of local authorities in the management of protected areas in France (IUCN France, 2013). Norway introduced regional large carnivore committees, with local politicians appointed by the Ministry of the Environment to manage human-wildlife conflicts. In Africa, whether the community-based forestry that emerged in 1980 or the community wildlife management schemes recent initiative and Integrated Landscape Management (ILM), these all make a great effort to empower local resource users. In eastern- and southern Africa where natural features are favorable to develop markets for wildlife and where land tenure regimes and legislation favor private ownership. Non-state governed protected areas start to establish, making up great majority of protected areas gazetted after 2010 (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018a). Such governance mode reforms may contribute toward better taking account of the needs of local governments, communities, citizens and local knowledge holders when designing and implementing conservation policies and actions, and alleviate the contradiction between resource protection and community development.

Some scholars reported that the control policies of protected areas negatively affect tourism. Policies determine the ownership or the right to use the natural resources of protected areas and prohibit or restrict the exploitation and use of natural resources by residents (Masud et al., 2014; Nakakaawa et al., 2015). Several studies have been based on concerns about the negative impact of such control policies on tourism. There are too many governance policies that restrict tourism activities in protected areas, and there is a belief that the welfare of farmer households is adversely affected (Naidoo et al., 2019). This calls for flexible policies to address the situation (Drescher and Brenner, 2018). The negative impact of protected areas' control policies on tourism is reflected in three aspects. First, policies give more weight to protective approaches to biodiversity conservation and restrict ecotourism stringently (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018b). For example, in Nepal, such policies restrict traditional access and land use in the buffer zones, resulting in farmers' economic loss (Heinen and Mehta, 2000). Second, since the tourism operators must abide by the restrictions of the management department of protected areas regarding the types of tourism that can be managed (Pfueller et al., 2011), even in the transition zone where tourism is allowed, some tourism projects have to be shut down.

The new construction and repair of tourism infrastructure in protected areas cannot be carried out because it is difficult to obtain the approval of the protected areas' management department. In developing countries, tourists have not arrived at a consensus on the form of wilderness tourism in protected areas, and they prefer tourist destinations with relatively complete tourist facilities, all of which affect the development of tourism in protected areas. The control policies of the marine reserve in Tioman Island, Malaysia, prohibit all construction activities that may threaten biodiversity, including tourism, thus affecting the development of regional tourism (Masud et al., 2017). Third, the management department of protected areas and the existing policies of protected areas lack the policy design of community participation in tourism and sharing of tourism benefits, tourism income is unequally distributed among the households. The tourism of protected areas has become a form of mass tourism controlled by powerful stakeholders, and farmers around protected areas lack the right to voice their opinions when it comes to higher-income projects, such as tourism franchising; they also lack external financial support (Badola et al., 2018; Sene-Harper et al., 2018). Ezebilo and Mattsson (2010) examined the contribution of the Cross River National Park, Nigeria, only few household benefited from income from tourism who live in closest village, the households who have not benefited from tourism have to earn additional income to reach their initial utility level, this may risk the primary objective of biodiversity conservation. Su (2004) stated that farmers' participation in tourism in protected areas in China is low. Only 10.70% of the protected areas constitute more than 50.00% of farmers' benefits from tourism, while 22.70% of the farmers around protected areas do not benefit from tourism.

Numerous studies have also verified the success of tourism depends on policies that mix nature conservation goals with income generation and, in given areas, community development (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018b). That as long as the corresponding interest-protection measures are undertaken, the protected areas' regulation policies positively impact tourism. Tourism can help increase employment (Roberts, 2002), earn income (Ma and Wen, 2016; Baral et al., 2017), alleviate poverty (Corson, 2014), improve infrastructure (Cuthill, 2009; Ezebilo and Mattsson, 2010), obtain financial subsidies (Ezebilo and Mattsson, 2010), and to some extent, alleviate community resistance to nature conservation policies (Chaminuka et al., 2011). Such as, Africa has been considered as one of the fastest growing tourism regions in the world. "Wildlife Watching Tourism" provide job opportunities for the local population through providing services to visitors, working as tour guides, staff, and cultural performers (UNWTO, 2017). The existing literatures highlight three aspects. First, communities that are highly dependent on natural resources are prone to economic losses when external forces affect these resources. To avoid losses, farmers have to liberate their labor force from primitive natural resource exploitation activities and realize diversification and non-agriculturalization of livelihood strategies (Bown et al., 2013). Tourism is of utmost significance to the non-agricultural livelihood choices of farmers because of its fewer barriers to entry (Muresan et al., 2016). Second, to prevent farmers from engaging in resource-consuming industries, the management department of protected areas offers farmers eco-friendly employment opportunities and development projects, such as ecotourism, and support measures like skill training and funds, thus enhancing farmers' ability to develop (Ma et al., 2019). Third, tourism activities require a good natural environment and a complete ecosystem (Wu et al., 2021). The governance policies of protected areas have improved the service quality of ecosystems and the value of recreational services. Such as environmental certification is effective tool in promoting sustainable tourism in Europe (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2018c).

Within international protected area management, the relationship between protected areas and tourism is developing dynamically. The existing research results and national tourism governance policies of protected areas highlight the key significance of protected area tourism. However, there lack of research on the governance policies of China's protected areas, especially the tourism governance policies. Since 2015, a series of control policies of protected areas intensively introduced in China. Political and academic circles in China and world attach importance to this, but there is a lack of quantitative research in this area. Presently, most studies have qualitatively analyzed the relationship between control policies and tourism from a theoretical perspective (Badola et al., 2018; Wu et al., 2021). Only a few studies have quantitatively examined the impact of control policies in protected areas on tourism(Ezebilo and Mattsson, 2010; Ma and Wen, 2016; Ekayani et al., 2019). The ones that did, arrived at different conclusions mainly because of the differences in research methods and sample selection. Most existing studies adopted descriptive statistical analysis or traditional linear regression measurement methods combined with into reviews. The sample heterogeneity is usually not considered, and the research area remains limited to a specific protected area. This causes the lack of a larger sample range and more scientific and reasonable research methods. In this study, 1,028 households around 6 protected areas were considered. The effects of tourism on household income highlighted the impact of control policies on farmers' tourism and verified whether the existing tourism governance policies in protected areas are reasonable. This study maybe provide some empirical data from China for the research of protected areas tourism in the world.

3. Overview of the research areas and data sources

3.1. Overview of the research areas

The data of this study were obtained from the investigation of 1,028 households in 44 villages around 6 protected areas in Liaoning Province from July to August 2021. Protected areas cover 2.22 million hectares of land in this province, accounting for about 11.00% of the entire province's land area. Among the 44 villages surveyed, 27 are located in the protected area and 17 are on its periphery. These six protected areas were established from 1998 to 2007. According to the Regulations of the People's Republic of China on Protected Areas promulgated in 1994, "the transition zone of the protected area could carry out appropriate tourism." At that time, the tourism governance policies of the protected areas were relatively lenient, and the farmers around protected areas had chances to engage in the tourism business. In 2015, the control policies of nationally protected areas became stricter, and many management rules were listed for tourism businesses in protected areas. From 2011 to 2019, the proportion of farmers living in the protected areas who can get jobs in tourism enterprises have

declined from 32.00 to 21.00% because of untrained and lack the skills. Even employees working can only engage in low-skilled work such as ticket sales. They have no opportunity to participate in the decision-making of tourism enterprises. According the Articles 2 and 3 of the Interim Measures for the Approval and Administration of Construction Facilities in National Protected Areas stipulate issued in 2018. That the construction of facilities, including temporary and permanent facilities, by crossing or occupying national protected areas should be reviewed and approved by the state or provincial Forestry Administration. Even in the transition zone, it is difficult to obtain approval for the tourism infrastructure construction such as restaurants or hotels, and some leisure farm originally operating in the protected areas have to move out of the protected areas, so the proportion of restaurants and hotels operating outside the protected area has increased from 30.00 to 43.00% (**Figure 1**). For example, the Haitang Mountain Protected Area started its tourism operation in 1991 and faced the problems of aging tourist trails and insufficient parking areas. It was necessary to cut some forest resources for infrastructure construction and restoration, and the local forestry management department refused to approve it. Among the respondents, no one has obtained the franchise right, such as cruise ships or campsites in protected areas, and these franchise rights are monopolized by large companies outside the protected areas or state business in the tourism sector. State issued the tourism management policy of the protected areas, limited or insufficient involvement of all stakeholders, in particular local famers, in setting objectives and strategic direction as well as in planning,management or monitoring of the protected areas. This leads to resentment by local stakeholders who feel they have no voice.

Boundary disputes have caused dissatisfaction among stakeholders. While enjoying a high level of national authority, the state expanded the scope of protected areas without consulting stakeholders or making appropriate compensation. During the boundary survey, the Liaoning Province found an overlap between various types of protected areas, and the overlapping proportion of protected areas and natural parks (similar to V in the IUCN classification) accounted for 5.00% percent of the protected areas. For example, the Monkey Stone Protected Area and Monkey Stone National Forest Park partially overlapped. The solution to this problem was to shut down the tourism projects already in operation in these areas. Expand the scope of the protected areas including the original natural park. The interests of tourism operators in the natural park are damaged.

3.2. Data sources

According to the World Data on Protected Areas (2013), farmers living in protected areas (including farmers living in the core area, the buffer area, and the so-called transition zone) and those within 10 km range outside the fence of protected areas are considered "farmers around protected areas." The data collection was made by face-to-face questionnaire survey. A total of 44 villages were surveyed. According to the list of farmers provided by the village committee, we took random sampling and typical sampling method. For the tourism operation farmers in the village, we adopted the typical sampling method, and for the non-tourism operation farmers, we adopted the random sampling method. In principle, 30 samples would be surveyed in each village (due to the unfavorable organization of individual village cadres or the lack of cooperation of farmers, the survey samples were less than 30 in individual villages, but at least the sample number was guaranteed to be more than 25). The questionnaire included questions on the geographical location of farmers' households, the basic situation of their members, agricultural forestry and non-agricultural management, tourism management, and so on. All the data in the questionnaire have been approved by the surveyed farmers and promised to be used only for academic research and not to disclosure that will damage the information security of person.

The total survey sample included 1,028 farmers, with 980 valid responses. Among the 980 farmers, 400 lived within the protected fence, and 580 outside the protected area fence. To investigate the impact of control policies on tourism in protected areas, this study selected the years 2011 (before the implementation of control policies) and 2019 (after the implementation of control policies) for comparison. The survey was conducted in 2021, but the data on farmers in 2019 were examined because the data on farmers' tourism changed greatly in 2020 due to COVID-19. Therefore, the data from 2019, a normal year before the pandemic, was considered and analyzed. Data from 2011 were drawn from the surveyed farmers who reviewed the basic situation of their households 10 years prior. In 2019, 116 farmers engaged in the tourism business, accounting for 11.84% of the total sample. **Figure 2** shows the sample and distribution. In 2011, 59 farmers engaged in the tourism business, accounting for 6.00% of the total sample. The participation ratio reflects that farmers' participation in tourism around the protected areas was not high before and after implementing the policies.

4. Research methods

4.1. Ordinary least squares (OLS) regression analysis

This study compares the data on the contribution of farmers' tourism to their household income in 2011 and 2019. It investigates the changes in farmers' participation in tourism and its impact on household income before and after the implementation of control policies. It reflects the impact of the control policies on tourism in protected areas. In previous studies, the OLS method was used to estimate the impact of tourism on household income. The regression equation is as follows:

$$\text{Ln Yi} = \alpha + \beta 1\text{Xi} + \beta 2\text{Ti} + \mu\text{i} \quad (1)$$

where Ln Yi is the logarithm of the i^{th} farmer's household net income, and Xi is the observable characteristic variable and resource endowment of the household and the head of the household that affect the i^{th} household's net income, including the age, gender, educational level, political identity of the head of the household, household labor force, household woodland area, household cultivated land area, the distance to the county government (reflecting the transportation convenience), the short distance to the entrance of the protected area (the value of farmers in the protected area is 0), and evaluation of tourism resources in

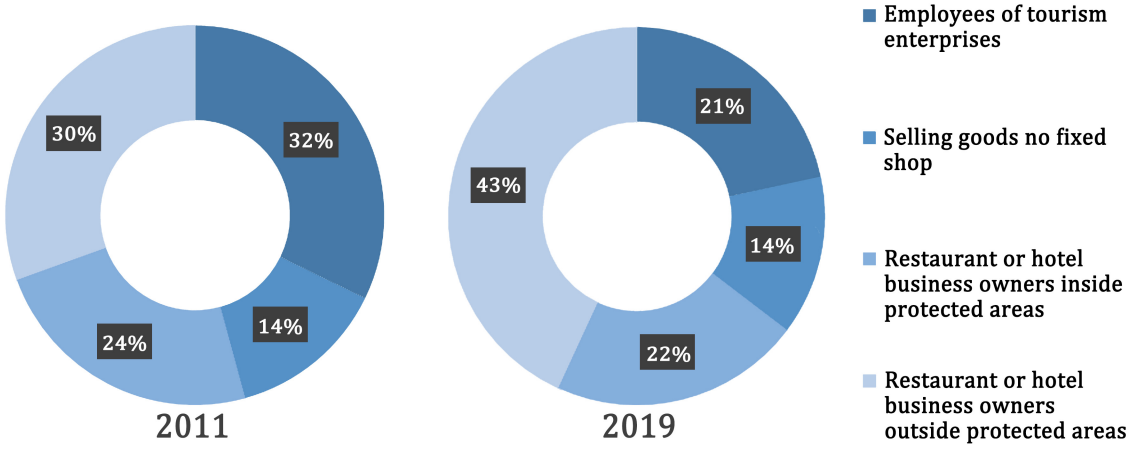

FIGURE 1
Types of tourism employment.

the village (self-evaluation of surveyed farmers, as shown in Table 1). Ti indicates whether the household participates in tourism ($i = 1$ for farmers who operate tourism and $i = 0$ for farmers who do not), β2 is the income effect of tourism, and μ_i is the random error term.

4.2. Propensity score matching (PSM)

First, farmers' participation in tourism around the reserve is not random behavior. It is a choice that farmers make based on their household characteristics and resource endowments, which is the result of self-selection. Whether farmers participate in tourism is not an exogenous but a virtual endogenous variable. Therefore, using the OLS to estimate the impact of participation in the tourism business on household income would lead to deviation caused by self-selection. Second, farmers' participation in tourism may be determined by their household characteristics and resource endowment, affecting their net household income. This would cause endogenous problems when estimating the impact of tourism on a household's net income, that is, household participation in tourism is related to the household's net income as well as error terms (Ma and Wen, 2016).

To solve these problems, the PSM method was adopted to solve the deviation problem caused by self-selection (Rosenbaum and Rubin, 1983; Naidoo et al., 2019) and a counterfactual framework to approximately randomize non-random data was constructed. The households that participated in the tourism business could only observe the household income after participating in the tourism business. Therefore, using the propensity score to construct a quasi-natural experiment proved beneficial. The logit model was employed to calculate the propensity score of each household according to the characteristics that affect farmers' participation in tourism. A control group similar to the one that included those participating in tourism could be identified among the households that did not participate in tourism. Consequently, the approximate randomized data could be constructed. According to Rosenbaum, the average treatment effect of the treatment group is:

$$\mathrm{ATT} = \frac{1}{\mathrm{N}} \Sigma_{\mathrm{i:D_i}} \left(\mathrm{Y_{1i}} - \mathrm{Y_{0i}}\right) \tag{2}$$

where N denotes the number of farmers engaged in tourism, $\Sigma_{i:D_i}$ means that only the farmers involved in tourism are added up, Y_{1i} is the household income of farmers involved in tourism, and Y_{0i} indicates the household income of farmers who have participated in tourism, now assuming that they have not participated in tourism. Y_{1i} is observable, while Y_{0i} is a counterfactual result, which needs to be estimated by the PSM method considering farmers who are not involved in tourism. There are some basic steps. First, the related variable X_i which affects (Y_{0i}, Y_{1i}i) and D_i must be selected. Thereafter, the propensity score of farmers' participation in tourism by using the logit regression model must be estimated. Finally, the propensity score according to the probability should be matched, and each component of X_i should be standardized as follows:

$$\frac{\left|\bar{X}_{treat} - \bar{X}_{control}\right|}{\sqrt{S_{x,treat^2} - S_{x,control^2})/2}} \tag{3}$$

where $\overline{X}_{treat}$ and $\overline{X}_{control}$ are the sample averages of the matched treatment group and control group, respectively, and ${S_{x,treat}}^2$ and ${S_{x,control}}^2$ are the sample variances of variables X in the treatment group and control group, respectively. After matching, the standard deviation is reduced, and finally, the average treatment effect is calculated according to the matched samples. In practice, different propensity score matching methods are generally adopted to compare the matching results. If the results are similar, the matching results are considered robust. According to the characteristics of the given sample, this study mainly used the radius matching method for matching and the nearest neighbor matching and kernel matching for matching verification.

5. Results

5.1. Benchmark regression results

The OLS model estimated the income effect of farmers' participation in the tourism business on the per capita net income of farmer households in 2011 before and 2019 after the

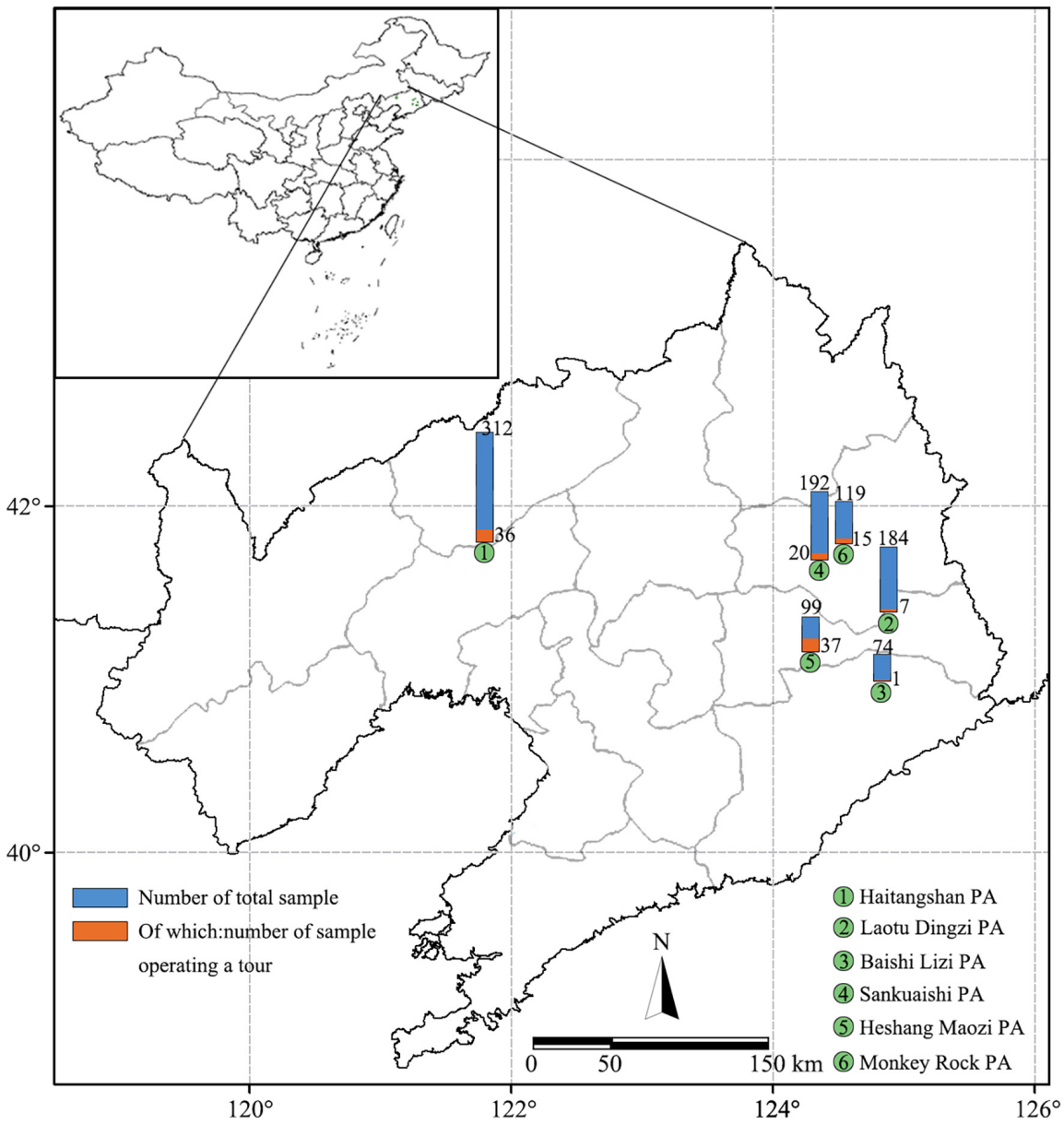

FIGURE 2
Diagram of samples distribution.

implementation of the control policies, as shown in Table 2. Before implementation, the net income of farmers who participated in tourism was 65.60% higher than that of farmers who did not participate in tourism. After implementation, there was a 59.40% increase. Evidently, under the effect of the control policies, the positive effect of tourism on farmers' household income has been declining, which indicates their restraining role.

The data of 2019 showed that the educational level, household labor force, household woodland area, household cultivated land area, and political status of the household head positively affected farmers' income. The age of the household head was negatively correlated to the household's net income. There was no correlation between the gender of the household head, the distance to the county government, the distance to the entrance of the protected area, the evaluation of tourism resources in the village, and the household's net income. According to the data of 2011, the number of people in the household labor force and the area of household forest land positively affected farmers' income.

5.2. Effect of tourism on farmers' income under the control policies

5.2.1. Vertical effect of the control policies

5.2.1.1. The estimation result of the PSM

The OLS regression results confirmed that the income of farmers who participated in tourism was higher than that of farmers who did not, but this is not the household income effect brought about by tourism. This is because farmers who are engaged in

10.3389/ffgc.2023.1144116

TABLE 1 Main explanatory variables and descriptive statistics.

Variable name	Variable interpretation	Total sample	Tourism farmers (treatment group)	Non-tourist farmers (control group)	Significance test
Dependent variable					
Logarithmic household net income (lnYi)		10.864	11.454	10.785	***
Independent variable					
Age of the head of the household (X1)	Actual survey data (years)	54.646	51.526	55.065	***
Gender of the head of the household (X2)	1 = Male 0 = Female	0.573	0.448	0.590	***
Educational level of the household head (X3)	1 = Haven't been to school 2 = Elementary school 3 = Junior high school 4 = High school 5 = Junior college 6 = Undergraduate 7 = Graduate	2.898	3.086	2.873	***
Political status of the head of the household (X4)	1 = Village cadre 2 = Ordinary communist party of China member 3 = State cadre 4 = National people's congress deputy 5 = Member of the Chinese People's Political Consultative Conference 6 = Member of any other party 7 = Others	5.715	5.612	5.729	Insignificant
The Number of the household labor force (X5)	Actual survey data 18 years old≤X7 <60 years old	2.293	2.474	2.269	**
Household woodland areas (X6)	Actual survey data (mu)	67.384	73.234	66.598	Insignificant
Household cultivated land areas (X7)	Actual survey data (mu)	12.096	8.609	12.564	**
Distance to the county government (X8)	Actual survey data (km)	39.736	48.474	38.563	***
Distance to the entrance of the reserve (X9)	Actual survey data (km)	5.009	2.866	5.297	***
Evaluation of tourism resources in the village (X10)	1 = Very poor 2 = Poor 3 = Fair 4 = Good 5 = Very good	3.987	4.405	3.931	***

, * are significant at the level of 5, and 1%, respectively. The significance level of continuous data was analyzed using the *t*-test, and the significance level of discrete data was analyzed using the Chi-squared test. Fences are generally set around protected areas in China, and only the entrance can be used to enter. Hence, X9 was set as the distance to the entrance of the protected area.

tourism may earn a higher household income than other farmers even if they do not engage in tourism owing to their household and resource characteristics. Constructing a counterfactual framework utilizing PSM can solve this problem. The first step in applying this is to estimate the propensity score; choosing the matching variables is also key. The selected variables must affect household income and tourism. According to the OLS regression in Table 2, the four variables are not related to household income, such as the gender of the household head (X2), the distance to the county government (X8), the distance to the entrance of the protected area (X9), and the evaluation of tourism resources in the village (X 10). Hence, they should be eliminated when matching the propensity score. In the data from 2011 and 2019, the variables that affected household income and tourism were selected inclusively. Six variables, namely age, education level, the political status of the household head, the number of people in the household labor force, the household cultivated land area, and the household woodland area were selected for PSM.

Tourism had a positive effect on farmers' household income, and it was significant at the statistical level of 1 or 10% (Table 3). The ATT estimation results of the three matching methods showed that, for farmers who engaged in tourism, the time before and after the implementation of the control policies was considered and was compared vertically. In 2019, after implementation, if tourism was not engaged in, the household income dropped by 36,173.11–40,425.42 yuan, with a drop rate of 38.37–42.87% and an average drop rate of 41.36%. In 2011, before implementation, if tourism was not engaged in, the household income decreased by 21,191.27–26,414.34 yuan, with the income decreasing range of 45.17–56.31% and an average decreasing range of 49.21%. The results of the three matching methods were similar, reflecting the stability of the results to some extent. Simultaneously, after eliminating the obvious deviation caused by the observable heterogeneity of the households participating in tourism and those not participating in tourism, the net income of the former was about 49.21% higher than the latter before the implementation of the control policies and about 41.36% higher after the implementation. The results indicate that the policies had an inhibitory effect on tourism in protected areas, causing the degree of influence of tourism on the net income to decrease by about 8.00%. Additionally, compared to the OLS regression results, the income effect of the PSM method decreased by about 17.00%. This indicates that compared to the traditional linear regression method, the research results were more accurate after the bias of sample selection was corrected by PSM.

TABLE 2 Regression results of household income effect using OLS model before and after implementation of control policies.

Variable name	The logarithm of household net income in 2019	The logarithm of household net income in 2011
Whether or not to operate a tour	0.594***	0.656***
(Operating = 1, not operating = 0)	(6.88)	(3.21)
Age of the head of the household (X1)	−0.015***	0.005
	(−5.71)	(1.06)
Gender of the head of the household (X2)	−0.076	−0.101
	(−1.33)	(−1.00)
Educational level of the household head (X3)	0.080**	0.026
	(2.15)	(0.39)
Political status of the head of the household (X4)	−0.025**	−0.026
	(−2.03)	(−1.14)
The number of the household labor force (X5)	0.240***	0.355***
	(8.30)	(8.44)
Household woodland area (X6)	0.064***	0.172***
	(4.63)	(7.05)
Household cultivated land area (X7)	0.140***	0.083
	(5.11)	(1.28)
Distance to the county government (X8)	−0.044	−0.088
	(−1.43)	(−1.60)
Distance to the entrance of the reserve (X9)	−0.004	−0.007
	(−1.21)	(−1.09)
Evaluation of tourism resources in the village (X10)	0.013	0.047
	(0.52)	(1.04)
_cons	10.717***	8.453***
	(35.90)	(16.06)
N	980	980
Adj. R^2	0.224	0.134

t statistics in parentheses ** $p < 0.05$, *** $p < 0.01$.

5.2.1.2. Stationarity test of PSM

It was necessary to use a stationarity test to verify the estimated quality of the propensity score and to check for a systematic difference between the treatment and control groups after matching. After matching, the values of "Pseudo R" were all extremely small, the likelihood ratio test was rejected at a 1 or 10% significance level before matching, but none was rejected after matching (Table 4). The mean and median of standard deviation decreased, and the *B*-value after matching was less than 25%. After the PSM, the distinct deviation of observable variables between the treatment and control groups was eliminated, and the balance test was conducted. The PSM result was reliable.

5.2.1.3. Robustness test of PSM

The selection bias can only be adjusted based on observed or measured covariates through PSM control. Such bias caused by unmeasured covariates remains problematic (Ma and Wen, 2016). Therefore, the Rosenbaum boundary method was used for sensitivity analysis, where Gamma was the distribution probability of difference caused by unobserved factors. A higher Gamma value decreased the study's sensitivity and increased the results' robustness. The radius matching method was the primary PSM method used in this study. The robustness of the estimated trend scores of the radius matching method in 2019 and 2011 was tested. When analyzing the impact of tourism on farmers' income, the values of sig+ and sig- were almost 0, implying that the ATT results of the model were insensitive to unobserved variables, and the PSM estimation results were robust (Table 5). Additionally, the same method was used to test the robustness of the estimated values of the nearest neighbor matching and kernel matching, showing little difference. In general, the processing effect of using the PSM method to estimate household income was more robust.

5.2.2. Horizontal implementation of control policies

To further verify the effect of control policies on tourism in protected areas, the differences in treatment effects of tourism on

TABLE 3 The treatment effect of tourism on farmers' income under the vertical implementation of the control policies.

Whether the regulatory policy is implemented	Matching method	Household income of farmers engaged in tourism/Yuan	Do not engage in tourism household income/Yuan	Treatment group/Control group	Average treatment effect on the treated (ATT)	*P*-Value	*t*-Value
Implemented (2019)	Radius matching	94,183.47	53,846.89	116/856	40,336.58	0.001	7.24
	Nearest neighbor matching	94,277.70	58,104.59	116/856	36,173.11	0.001	4.14
	Kernel matching	94,277.70	58,104.59	116/856	40,425.42	0.000	7.23
Not Implemented (2011)	Radius matching	46,027.76	23,295.14	57/860	21,242.66	0.062	2.61
	Nearest neighbor matching	46,910.65	20,469.31	57/860	26,414.34	0.055	2.24
	Kernel matching	46,910.65	25,719.38	57/860	21,191.27	0.063	2.60

TABLE 4 Balance test of matching quality.

Whether the regulatory policy was implemented		Matching method	Pseudo R^2	LR chi^2	Mean bias	Med bias	*B*
Implemented (2019)	Before matching		0.090	64.00***	26.4	27.5	81.3*
	After matching	Radius matching	0.004	1.20	5.3	5.1	14.4
		Nearest neighbor matching	0.004	1.20	5.3	5.1	14.4
		Kernel matching	0.004	1.20	5.3	5.1	14.4
Not implemented (2011)	Before matching		0.024	10.69*	15.3	10.9	43.4*
	After matching	Radius matching	0.007	1.09	7.6	7.0	19.1
		Nearest neighbor matching	0.007	1.09	7.6	7.0	19.1
		Kernel matching	0.007	1.09	7.6	7.0	19.1

*If $B > 25\%$, R outside [0.5; 2]. LR chi^2: *$p < 0.1$ and ***$p < 0.01$.

TABLE 5 Rosenbaum boundary sensitivity analysis.

	Score of PSM in 2019				Score of PSM in 2011			
Gamma	Sig+	Sig-	CI+	CI-	Sig+	Sig-	CI+	CI-
1.0	0.000	0.000	0. 402	0.664	0.000	0.000	0.470	0.981
1.1	0.000	0.000	0.370	0.697	0.000	0.000	0.423	1.017
1.2	0.000	0.000	0.346	0.730	0.000	0.000	0.389	1.064
1.3	0.000	0.000	0.322	0.757	0.000	0.000	0.360	1.103
1.4	0.000	0.000	0.300	0.783	0.000	0.000	0.329	1.153
1.5	0.000	0.000	00.283	0.808	0.000	0.000	0.294	1.191
1.6	0.000	0.000	00.261	0.833	0.000	0.000	0.268	1.224
1.7	0.000	0.000	0.243	0.856	0.000	0.000	0.234	1.253
1.8	0.000	0.000	0.229	0.874	0.001	0.000	00.210	1.287
1.9	0.000	0.000	0.213	0.895	0.002	0.000	0.190	1.308
2.0	0.000	0.000	0.197	0.913	0.003	0.000	0.167	1.338

TABLE 6 Effect of tourism in and outside protected areas on the household income of farmers.

Is it in the protected area?	Year	Household income of farmers engaged in tourism/Yuan	Do not engage in tourism household income/Yuan	Treatment group/Control group	ATT	*P*-value	*t*-value
Within protected area	2019	88,432.96	56,218.43	58/336	32,214.52	0.000	3.77
Outside protected area		100,207.7	53,852.28	54/498	46,355.39	0.001	5.58
Within protected area	2011	50,970.382	22,444.48	32/336	28,525.9	0.055	3.56
Outside protected area		42,137.78	25,420.21	25/475	16,717.57	0.053	1.93

the income of households in protected areas affected by control policies and those outside this realm were compared horizontally. Before the implementation of the policies, in 2011, the income of farmers engaged in tourism in protected areas was about 55.97% higher than that of farmers not engaged in tourism. The income of farmers engaged in tourism outside protected areas was about 39.67% higher than that of farmers not engaged in tourism and that of farmers engaged in tourism inside protected areas was about 16.30% higher than that outside protected areas. The contribution of tourism to the household income of farmers in protected areas was higher than that of farmers outside protected areas. The reason may be that farmers in protected areas had better tourism resources, which is more conducive to tourism. However, this situation changed in 2019. In the year 2019, after the implementation of the control policies, the income of farmers engaged in tourism in protected areas was 36.43% higher than that of farmers not doing so, that of farmers engaged in tourism outside protected areas was 46.26% higher than that of farmers not engaged in tourism, and that of farmers engaged in tourism outside protected areas was about 9.83% lower. After the implementation of the policies, the farmers in protected areas still had better tourism resources than farmers outside protected areas. Why is the contribution of their tourism to household income less than that of farmers outside protected areas? The reasonable explanation is that the policies have a restraining effect on farmers' tourism in protected areas, negatively affecting tourism in these areas.

As evident, radius matching was used as the matching method of the propensity score, and nearest neighbor matching and kernel matching were also adopted to verify the robustness of the matching (Table 6). Like (Tables 4, 5) above, the results of the PSM were tested for stationarity and robustness. All tests were cleared, and the test process was an ellipsis.

6. Conclusion and policy implications

6.1. Study conclusion

Based on the survey data of 1,028 farmers in 6 protected areas, this study used the counterfactual framework to study the impact of farmers' tourism on their household income under the control policies of protected areas.

First, both before and after the implementation of the control policies, farmers' tourism around the protected areas had a significant positive impact on their households' net income.

Second, the age, education level, political status of the household head, the number of people in the household labor force, and the area of cultivated land and forest land affected the tourism and net income of farmers.

Third, a series of control policies were not conducive to the tourism of the reserve. From a vertical perspective, before implementation, the net income of farmers who participated in tourism around the reserve was about 49.21% higher than that of farmers who did not participate in tourism, while it was about 41.36% higher after implementation. Thus, the policies led to the decline of the income effect of farmers' tourism around the reserve areas. From a horizontal perspective, before implementation, the farmers involved in tourism in protected areas had a higher tourism income effect than those outside protected areas by virtue of their advantages in tourism resources, and the income effect in protected areas was about 16.30% higher than that outside protected areas. However, after implementation, even though the farmers in the protected areas still had better tourism resources than those outside the protected areas, the income effect in the protected areas was about 9.83% lower than that outside the protected areas. This highlights the inhibitory effect of the control policies on tourism in the protected areas.

6.2. Policy implications

Even under strict regulatory policies, farmers' tourism in protected areas can still help to increase household income, but participation in tourism around protected areas remains low. Most importantly, in recent years, a series of intensive control policies have harmed farmers' normal tourism business. Chinese protected areas' regulatory policies are troubling because they result in protected areas having disadvantageous economic outcomes for tourism farmers that ultimately result in ineffective long-term conservation outcomes. To reduce the negative impact of control policies on tourism in protected areas, the government

and relevant departments can make policy improvements in the following aspects:

Management mode should shift toward greater recognition of the rights of local communities and consciously seek to balance conservation with local livelihoods. The two goals of protect resources and promote community development is in addition to, rather than as a replacement for. Recreation value is an important part of the ecological value of protected areas. Although tourism exerts pressure on ecosystems, but tourism is also an incentives for local farmers to perceive environmental conservation positively. In the theory and practice of global protected area management, tourism has been proved to be an effective tool to achieve the dual objectives of protected areas. Therefore, the various levels governments should give more effective management to tourism, rather than blindly restriction.

Even if it does not change the mode of government governance, the community in the protected areas can be involved in the formulation of tourism policies by building partnerships. Every protected areas will have a different balancing point with respect to resource preservation vs. development. The government should negotiate with the communities when makeup major issues, such as determining the boundary and protection goal. The partnerships will improve understanding of values of protected areas, improve biodiversity conservation, and safeguard the economic interests of communities.

Tourism policies should be aligned within government. Even local governments want to present better environmental performance, they should not set more additional limits exceeding law for protected areas. Tourism business or facilities be shut down is one of the unfavorable influence that the regulatory policies bring to farmers. Tourism can be carried out in the transition zone, it is the right granted by the national law. The Guiding Opinions on the Establishment of National Park-based Protected Area System issued in 2019 is the core policy document of China's protected areas' management. The document shows the objective facts of widespread tourism activities in protected areas in China and allows tourism in the transition zone. Total prevention of impacts is impossible, short of complete prohibition of recreational use (Clark and Stankey, 1979). For the tourism projects operated in protected areas, the provincial government should scientific estimate environmental impact and allow environment-friendly tourism business continue in transition zone. Since the tourism should be affirmed, necessary infrastructure construction and repair are required in the business process and the requests to cut a small number of forest resources involved in the tourism infrastructure construction process. The relevant administrative departments should provide a reasonable reply according to the environmental impact assessment instead of blindly rejecting it. If the existing tourism projects that have been assessed and confirmed to cause an adverse environmental impact are subject to restrictive measures, such as dismantling, they indulge in restrictive regulatory behaviors that should be compensated for ecological protection. Further, economic compensation should be granted according to Chinese existing laws and regulations on ecological protection compensation.

In the competition for tourism franchise rights in protected areas, the surrounding farmers and tourism enterprises in the surrounding communities should be given preference, so that the farmers in the vicinity can have enough participation rights and income-sharing rights in the tourism of protected areas. By taxation and financial policies encourage franchise rights tourism enterprises to hire farmers living in protected areas. At the same time, improve the farmers' ability by skills training. So that they can be competent for high-skilled jobs. The income of farmer household participating in tourism is significantly higher than that of non-participating. Income from tourism was unequally distributed among the local farmers. State business in the tourism sector or franchise rights tourism enterprises should invest in infrastructure or donate to the community. The tourism revenue sharing mechanism will improve the support of farmers in the protected areas.

Data availability statement

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

Author contributions

DH, KC, and JW contributed to the conceptualization, methodology, analysis, and writing. TZ and ZX contributed to the validation and resources. YW contributed to the experiment design and data collection. SL contributed to the investigation, supervision, and review editing. All authors read and agreed to the published version of the manuscript.

Funding

This study was supported by the National Social Science Fund (No. 20BGL173).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Badola, R., Hussain, S. A., Dobriyal, P., Manral, U., Barthwal, S., Rastogi, A., et al. (2018). Institutional arrangements for managing tourism in the Indian Himalayan protected areas. *Tour. Manag.* 66, 1–12. doi: 10.1016/j.tourman.2017.10.020

Bakkegaard, R. K., Hogarth, N., Bong, I. W., Bosselmann, A., and Wunder, S. (2017). Measuring forest and wild product contributions to household welfare: Testing a scalable household survey instrument in Indonesia. *For. Policy Econ.* 84, 20–28. doi: 10.1016/j.forpol.2016.10.005

Baral, N., Kaul, S., Heinen, J. T., and Ale, S. B. (2017). Estimating the value of the world heritage site designation: A case study from Sagarmatha (Mt Everest) National Park, Nepal. *J. Sustain. Tour.* 4, 1–16. doi: 10.1080/09669582.2017.1310866

Bennett, N. J., and Dearden, P. (2014). Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Mar. Policy* 44, 107–116. doi: 10.1016/j.marpol.2013.08.017

Borrini-Feyerabend, G., Dudley, N., Jaeger, T., Lassen, B., Broome, N. P., Phillips, A., et al. (2013). *Governance of protected areas: From understanding to action. Best practice protected area guidelines series No. 20*. Gland: IUCN.

Bown, N. K., Gray, T. S., and Stead, S. (2013). Co-management and adaptive co-management: Two modes of governance in a Honduran marine protected area. *Mar. Policy* 39, 128–134. doi: 10.1016/j.marpol.2012.09.005

Bruner, A. G., Gullison, R. E., Rice, R. E., and Fonseca, G. A. B. (2001). Effectiveness of parks in protecting tropical biodiversity. *Science* 291, 125–128.

Cai, Y. Y., and Yu, Y. (2012). The restriction of farmers'land development rights under prime farmland planning control: A case study of Wulijie town in Wuhan city.China Population. *Resour. Environ.* 22, 76–82. doi: 10.3969/j.issn.1002-2104.2012.09.012

Chaminuka, P., McCrindle, C. M. E., and Udo, H. M. J. (2011). Cattle farming at the wildlife/livestock interface: Assessment of costs and benefits adjacent to Kruger National Park, South Africa. *Soc. Nat. Resour.* 25, 235–250. doi: 10.1080/08941920.2011.580417

Clark, R. N., and Stankey, G. H. (1979). *The recreation opportunity spectrum: a framework for planning, management, and research. United States pacific Northwest forest and range experiment station USDA forest service general technical report Pnw-98*. Washington, DC: United States Department of Agriculture.

Corson, C. (2014). "Conservation politics in Madagascar: The expansion of protected areas," in *Conservation and environmental management in Madagascar*, ed I. R. Scales (Abingdon, UK: Routledge).

Couix, N., and Gonzalo-Turpin, H. (2015). Towards a land management approach to ecological restoration to encourage stakeholder participation. *Land Use Policy* 46, 155–162.

Cuthill, M. (2009). Strengthening the 'social' in sustainable development: Developing a conceptual framework for social sustainability in a rapid urban growth region in Australia. *Sustain. Dev.* 18, 362–373. doi: 10.1002/SD.397

Decker, D., Smith, C., Forstchen, A., Hare, D., Pomeranz, E., Doyle-Capitman, C., et al. (2016). Governance principles for wildlife conservation in the 21st century. *Conserv. Lett.* 9, 290–295. doi: 10.1111/conl.12211

Drescher, M., and Brenner, J. C. (2018). The practice and promise of private land conservation. *Ecol. Soc.* 23:3. doi: 10.5751/ES-10020-230203

Duan, W., and Ouy, B. (2020). Impacts of protected areas on multidimensional poverty of surrounding rural households: Analysis of the intermediary effect based on social capital. *Resour. Sci.* 42, 1074–1086. doi: 10.18402/resci.2020.06.06

Ekayani, M., Nuva, Pramudita, D., Istiqomah, A., Tampubolon, B. I., and Osmaleli. (2019). Economic benefits of natural tourism: Driving community's participation for conservation in Halimun Salak National Park, Indonesia. *IOP Conf. Ser. Earth Environ. Sci.* 285:012003. doi: 10.1088/1755-1315/285/1/012003

Ezebilo, E. E., and Mattsson, L. (2010). Socio-economic benefits of protected areas as perceived by local people around Cross River National Park, Nigeria. *For. Policy Econ.* 12, 189–193. doi: 10.1016/j.forpol.2009.09.019

Ferro, V. G., Lemes, P., Melo, A. S., and Loyola, R. (2014). The reduced effectiveness of protected areas under climate change threatens Atlantic Forest tiger moths. *PLoS One* 9:e107792. doi: 10.1371/journal.pone.0107792

Heinen, J. T., and Mehta, J. N. (2000). Emerging issues in legal and procedural aspects of buffer zone management with case studies from Nepal. *J. Environ. Dev.* 9, 45–67.

Hockings, M. (2003). Systems for assessing the effectiveness of management in protected areas. *BioScience* 53, 823–832. doi: 10.1641/0006-35682003053[0823:SFATEO]2.0.CO;2

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] (2018c). *The IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia*. Bonn: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] (2018a). *The IPBES regional assessment report on biodiversity and ecosystem services for Africa*. Bonn: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] (2018b). *The IPBES regional assessment report on biodiversity and ecosystem services for the Americas*. Bonn: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Irland, L. C. (2008). State Failure, Corruption, and Warfare: Challenges for Forest Policy. *J. Sustain. For.* 27, 189–223. doi: 10.1080/10549810802219963

IUCN France, (2013). *Protected areas in France: A diversity of tools for the conservation of biodiversity*. Available online at: http://uicn.fr/wp-content/uploads/2016/08/Espaces_naturels_proteges-EN-ok.pdf (accessed February 20, 2023).

Kitamura, K., and Clapp, R. A. (2013). Common property protected areas: Community control in forest conservation. *Land Use Policy* 34, 204–212. doi: 10.1016/j.landusepol.2013.03.008

Ladle, R. J., and Whittaker, R. J. (2011). *Conservation Biogeography*. Oxford, UK: Wiley-Blackwell.

Lamsal, P., Pant, K. P., Kumar, L., and Atreya, K. (2015). Sustainable livelihoods through conservation of wetland resources:a case of economic benefits from Ghodaghodi lake,western Nepal. *Ecol. Soc.* 20:10. doi: 10.5751/ES-07172-200110

Larson, A. M., and Soto, F. (2008). Decentralization of natural resource governance regimes. *Annu. Rev. Environ. Resour.* 33, 213–239. doi: 10.1146/annurev.environ.33.020607.095522

Liu, C. (2014). Social function and right structure of climatic resources of state ownership. *Zheng Fa Lun Cong* 3, 55–63.

Ma, B., and Wen, Y. L. (2016). Impact of ecotourism management on rural households' income: Based on propensity score matching method. *China Popul. Resour. Environ.* 26, 152–160.

Ma, B., Cai, Z., Zheng, J., and Wen, Y. L. (2019). Conservation, ecotourism, poverty, and income inequality–A case study of nature reserves in qinling, China. *World Dev.* 115, 236–244. doi: 10.1016/j.worlddev.2018.11.017

Masud, M. M., Aldakhil, A. M., Nassani, A. A., and Azam, M. N. (2017). Community-based ecotourism management for sustainable development of marine protected areas in Malaysia. *Ocean Coast. Manag.* 136, 104–112. doi: 10.1016/j.ocecoaman.2016.11.023

Masud, M. M., Kari, F. B., Binti Yahaya, S. R., and Al-Amin, A. Q. (2014). Impact of residents' livelihoods on attitudes towards environmental conservation behaviour: An empirical investigation of Tioman Island Marine Park area, Malaysia. *Ocean Coast. Manag.* 93, 7–14. doi: 10.1016/j.ocecoaman.2014.03.008

Muresan, I., Oroian, C., Harun, R., Arion, F., Porutiu, A., Chiciudean, G., et al. (2016). Local residents' attitude toward sustainable rural tourism development. *Sustainability* 8, 2–14. doi: 10.3390/su8010100

Naidoo, R., Gerkey, D., Hole, D., Pfaff, A., Ellis, A. M., Golden, C. D., et al. (2019). Evaluating the impacts of protected areas on human well-being across the developing world. *Sci. Adv.* 5, 1–7. doi: 10.1126/sciadv.aav3006

Nakakaawa, C., Moll, R., Vedeld, P., Sjaastad, E., and Cavanagh, J. (2015). Collaborative resource management and rural livelihoods around protected areas: A case study of mount elgon national park, uganda. *For. Policy Econ.* 57, 1–11. doi: 10.1016/j.forpol.2015.04.002

Nyaupane, G. P., Poudel, S., and York, A. (2022). Governance of protected areas: An institutional analysis of conservation, community livelihood, and tourism outcomes. *J. Sustain. Tour.* 30, 2686–2705. doi: 10.1080/09669582.2020.1858089

Pfueller, S. L., Lee, D., and Laing, J. (2011). Tourism partnerships in protected areas: Exploring contributions to sustainability. *Environ. Manag.* 48, 734–749. doi: 10.1007/s00267-011-9728-y

Qi, W. W., and Ke, J. (2021). On the Normativity of the regulation of government in protected areas based on the typological analysis approach. *Tour. Sci.* 35, 152–160. doi: 10.16323/j.cnki.lykx.2021.05.003

Regulations of the People's Republic of China on Protected Areas (2017). Available online at: https://www.pkulaw.com/en_law/c88337de554fa034bdfb.html (accessed March 10, 2023).

Roberts, L. (2002). "Farm tourism — its contribution to the economic sustainability of Europe's countryside," in *Sustainable tourism: A global perspective*, eds R. Harris, T. Griffin, and P. Williams (New York, NY: Butterworth and Heinemann), 195–208.

Rosenbaum, P. R., and Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika* 70, 41–55. doi: 10.1093/biomet/70.1.41

Sene-Harper, A., Matarrita-Cascante, D., and Larson, L. R. (2018). Leveraging local livelihood strategies to support conservation and development in West Africa. *Environ. Dev.* 11, 1–38. doi: 10.1016/j.envdev.2018.11.002

Shen, X. X. (2018). Supply-side structural reform research on governance models of Chinese national nature reserve. *Wetland Sci.* 16, 24–29. doi: 10.13248/j.cnki.wetlandsci.2018.01.004

Snyman, S., and Bricker, K. S. (2016). Living on the edge: Benefit-sharing from protected area tourism. *J. Sustain. Tour.* 27, 705–719. doi: 10.1080/09669582.2016.1212528

Su, Y. (2004). Countermeasures for improving management of national reserves in China. *Green China* 9, 25–28. doi: 10.3321/j.issn:1000-7857.2004.09.011

Thondhlana, G., and Muchapondwa, E. (2014). Dependence on environmental resources and implications for household welfare: Evidence from Kalahari Dryland, South Arica. *Ecol. Econ.* 108, 59–67. doi: 10.1016/j.ecolecon.2014.10.003

UNEP-WCMC, and IUCN (2021). *Protected Planet Report*. Cambridge: UNEP-WCMC and IUCN Publishing.

UNWTO (2017). *UNWTO annual report 2016*. Madrid: UNWTO.

Wang, C. H. (2017). What do Chinese nature reserves give to surrounding communities-based on farmer household survey data in Shaanxi, Sichuan and Gansu provinces from 1998 to 2014. *Manag. World* 03, 63–75. doi: 10.19744/j.cnki.11-1235/f.2017.03.005

Wang, C. H., and Liu, X. B. (2021). Nature protection, environmental capital and improvement of households' livelihood. *Shanghai Econ. Res.* 4, 28–42.

Wang, C. H., Wen, Y. L., and Yang, L. F. (2010). Study on nature reserve policy on attribute of public goods. *For. Econ. Issues* 30, 292–297. doi: 10.16832/j.cnki.1005-9709.2010.04.003

Wicander, S. (2015). *State governance of protected areas in Africa. Case studies, lessons learned and conditions of success*. Cambridge, UK: UNEP-WCMC.

Wilson, E., Nielsen, N., and Buultjens, J. (2009). From lessees to partners: Exploring tourism public-private partnerships within the New South Wales national parks and wildlife service. *J. Sustain. Tour.* 17, 269–285.

World Data on Protected Areas (2013). Available online at: https://www.iucn.org/our-work/protected-areas-and-land-use (accessed March 12, 2023).

Wu, B. H., Xie, Y. F., and Zhang, Y. J. (2021). Recreation and tourism supply in protected areas:ecosystem services,legal obligations,and social responsibilities. *Tour. Sci.* 35, 1–10. doi: 10.16323/j.cnki.lykx.2021.05.001

Wu, B. H., Xie, Y. F., Li, Y., and Cong, L. (2022). *How to delineate and zone protected areas under the scope of ecological conservation redline strategy*. *Biodivers. Sci.* 30:21372. doi: 10.17520/biods.2021372

Yang, A. L., and Zhang, W. J. (2021). Practical misunderstanding and the resolution for China's strictest protection theory of national parks. *Inner Mong. Soc. Sci.* 42, 131–136. doi: 10.14137/j.cnki.issn1003-5281.2021.01,017

Zhou, D. C., Lu, X. B., and Chen, X. Y. (2021). Position and function of ecotourism of nature reserve in ecological civilization construction. *For. Invent. Plann.* 46, 5–62. doi: 10.3969/j.issn.1671-3168.2021.06.010