



Implementation gaps affecting the quality of biodiversity conservation management: An ethnographic study of protected areas in Fujian Province, China

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ABSTRACT

Policies play a vital role in setting goals for biodiversity conservation management. China has set an ambitious biodiversity conservation target since acceding to the Convention on Biological Diversity (CBD); however, there remains an obvious gap between China's conservation targets and the results of policy implementation. To understand the barriers to policy implementation, this study examined local actors' perceptions of biodiversity conservation policy implementation based on an adaptive management logic. We systematically investigated the status of policy implementation in protected areas in Fujian Province, China, through face-to-face interviews. We identified a series of barriers that affect the implementation of biological conservation policies, including conflicting priorities in functions, objectives and operations between local governments and local forestry bureau, controversy over forest tenure, inadequate funding and hierarchy-induced funding misallocation, insufficient professional expertise, and a lack of scientific support for the establishment, enlargement and routine management of protected areas. By incorporating the decomposition of interest, beliefs and power structure of multiple actors, we were able to establish links between management inadequacies and the broader political and institutional context. The intertwined interactions between multiple actors create the action arena through which bureaucratic structures and institutional deficiencies combine to distort the implementation of conservation policies. Our research has important implications for developing countries that are undergoing changes in their conservation systems.

1. Introduction

There is a growing awareness of the need to improve the effectiveness of biological conservation worldwide. Evidence on the impact of conservation policies is only beginning to accumulate and still lags behind other public policies in adopting best practices (Baylis et al., 2016). In practice, management actions are often untested (Powlen et al., 2021). This paper uses an ethnographic study to systematically evaluate the implementation of conservation policy in Fujian Province, China, highlighting the importance of context and the urgent need for a comprehensive understanding of local social and political conditions in the policy implementation process.

Since the Rio Summit and the Convention on Biological Diversity

(CBD), biodiversity conservation has been a chief subject in international environmental discussions (Paloniemi and Tikka, 2008). Establishing protected areas (PA)¹ is an essential tool for conserving natural areas, reducing biodiversity loss, and protecting cultural values. CBD has driven the creation of a large number of PAs globally (Dudley et al., 2010); however, the biodiversity loss continues, even within PA boundaries (Butchart et al., 2010). Without effective management of PAs, the increasing number of PAs will have minimal impact on biodiversity conservation. Therefore, the quality of PA management is critically important to halt the loss of biodiversity (Eklund and Cabeza, 2017). The CBD consequently calls for good management practices in PAs by expanding and institutionalising management effectiveness assessments (Juffe-Bignoli et al., 2014). For improving management

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¹ There are many different types of PAs in China, the most common ones are national parks and nature reserves.

practice, Protected Area Management Effectiveness (PAME) assessments have been conducted in many countries to evaluate the strengths and weaknesses of PA management since 1990s (Rivero Blanco and Gabaldo, 1992; Hockings, 2003; Leverington et al., 2010). Additionally, the International Union for Conservation of Nature–World Commission on Protected Areas (IUCN-WCPA) has developed a management effectiveness evaluation framework for managers, government agency employees, and donor institutions to evaluate PA management (Hockings et al., 2004, 2006).

Despite existing methods designed to monitor biological conservation programmes (Nobre et al., 2019), results have been unsatisfactory. After compiling details of over 8000 PA assessments globally, Leverington et al. (2010) found that about 40% showed major deficiencies and 14% lacked the basic requirements for effective operation. However, the complex reasons behind performance, including specific political and social contexts, such as historical events, institutional design, multi-department overlaps, and environmental constraints are noticed but still greatly undervalued (Habel et al., 2015). The managerial and administrative factors affecting the success of conserving biodiversity can be categorised into three aspects (Hockings, 2003; Lee and Abdullah, 2019).

First, resources are constrained. There is an accelerating trend of shrinking government budgets and manpower support for PAs in North America, Australia and West Africa (Watson et al., 2014). Geitzner et al. (2017) acknowledged that a lack of finances and low funding uptake constitute major challenges to the implementation of Natura 2000, the core pillar of the European Union's (EU's) biodiversity conservation policy. The lack of transparency on reporting is responsible for the difficulty of monitoring fund use and thus breeding misallocation of funds to species of low conservation value (Hermoso et al., 2017, 2019). Limited contract duration and interruptions to funding have also received much criticism (Geitzner et al., 2016, 2017). However, the integrative conservation funding system in EU (European Commission, 2004) differs significantly from decentralised fiscal institution in China.

Second, there is the challenge of building institutions and capacity, which is recognised as a bundle of conservation skills, knowledge, expertise, approaches and data, and so on. (Geitzner et al., 2016). The effective sharing of specialist skills, advice and support between conservancies is stressed for the management and recovery of threatened species (Seabrook-Davison et al., 2010). The lack of scientific planning for classification and zoning, shortage of facilities, and limited survey data are proved to severely restrict the development of marine PAs in China (Hu et al., 2020; Zeng et al., 2022; Zhao et al., 2022).

Finally, there can be confusion regarding governance, which is inextricably linked to negotiations, conflict resolution and interest coordination between various stakeholders across policy levels and sectors. Due to divergent priorities, competing interests and incompatible concerns of involved administrations and agencies, procedural, interest-based/material, political-institutional, and idea and knowledge-based conflicts between stakeholders pervade the implementation of Natura 2000 (Geitzner et al., 2016; Winkel et al., 2015). However, their inherent structures of interest, beliefs and power are not well-defined. This undoubtedly restricts our understanding of the interactions between multiple actors, which serve as an action arena for political and institutional context to intervene in the conservation policy implementation.

Lee and Abdullah (2019) claim that all restrictions above could weaken regulatory capacity of PA and trigger legally prohibited private activities such as poaching, thus ultimately counteracting conservation management efforts. While local governments' misbehaviour, such as illegal infrastructure construction, appears to be more common in China. Consequently, the reason why conservation policies encounter barriers in the implementation process, as well as the internal motivations of the multiple micro-actors and their interaction mechanisms at the operational level remain implicit. It is in this area that this study makes its contributions.

Since China's accession to CBD in June 1992, PAs have increased from 6.8% of the territorial area in 1993 to 18% in 2020; the number of PAs has increased from 763 to 11,800 in the same period (Ministry of Ecology and Environment of the People's Republic of China, 2020). Although the number of PAs has risen dramatically, conservation effectiveness has been criticised for conflicts over land tenure, institutional overlap, lack of ongoing financial and scientific support, confusion between the objectives of generating revenue and conservation, and conflict with local community (Xu and Melick, 2007). Environmental policies are often compromised during the implementation process, as China's decentralised fiscal structure and cadre performance evaluation system provide poor incentives for local officials to enforce regulations (Kostka and Nahm, 2017). This has also occurred in the implementation of China's biodiversity conservation policy. The central government has set well-defined biodiversity conservation goals and passed a series of related laws and regulations, including Rules on Management of Forestry Parks, the Regulations on Nature Reserves, the Regulations on Scenic and Historic Areas, Environmental Protection Law (revised in 2014), the Forest Law, Grassland Law, Water Law, and the Wild Animal Protection Law (McBeath and Leng, 2006). However, they have not been fully implemented and usually stall at a sub-national level (Kostka and Nahm, 2017). This study aims to provide a systematic prescription to diagnose inherent barriers to effective conservation, and understand the causes of these hurdles and mechanisms of action during the policy implementation process, based on developing country with a newly changed PA system.

This paper has five sections. The second section presents study area, materials and the data collection and analysis methods. Findings are presented in the third section, following the logic of the IUCN-WCPA management effectiveness framework. In the fourth section, key insights are integrated and discussed in relation to existing research. Conclusions and policy implications are presented in the last section.

2. Study area, materials and methods

2.1. Selection of the study area

To gain a thorough understanding of current PA management systems, operation mechanisms, contradictions, and conflicts, we considered a province as a study unit. As provincial decrees and resource allocations are implemented uniformly, comparing key PAs within one province allows maximum exclusion of confounding contextual differences. We selected Fujian province as the study area and focused on PAs in the Fujian forestry system (Fig. 1).

Fujian Province serves as a crucial ecological barrier in the south-eastern coastal region of China. Mountains and hills occupy nearly 90% of Fujian Province's land area, and the few arable lands are mainly concentrated in coastal plains, river basins, mountain valleys and low hilly terraces, with only 0.61 mu of arable land per capita, less than half of the national average. In contrast, Fujian possesses the top forest cover of 66.8%. However, forest land has been increasingly encroached by built-up land expansion in recent years due to large-scale urbanisation and industrialisation (He et al., 2021), indirectly leading to biodiversity degradation (Seto et al., 2012).

Fujian has built a complicated PA network composed of 357 different-level PAs, some of which were established in the 1950s and 1960s. Synthesized ecosystems have empowered PAs in Fujian to conduct effective conservation on over 85% of the province's rare and endangered species and over 70% of typical ecosystems. However, continued population growth and the rapid development of forestry have greatly stressed these ecosystems and hindered conservation efforts. The population of Fujian has maintained an average annual growth rate of 0.8% over the past decade, reaching a resident population of 39.73 million and an urbanisation rate of 66.5% in 2019. The booming forestry, including timber processing, bamboo, flowers and seedlings, forest tourism and forest economy, contributed RMB 645.1

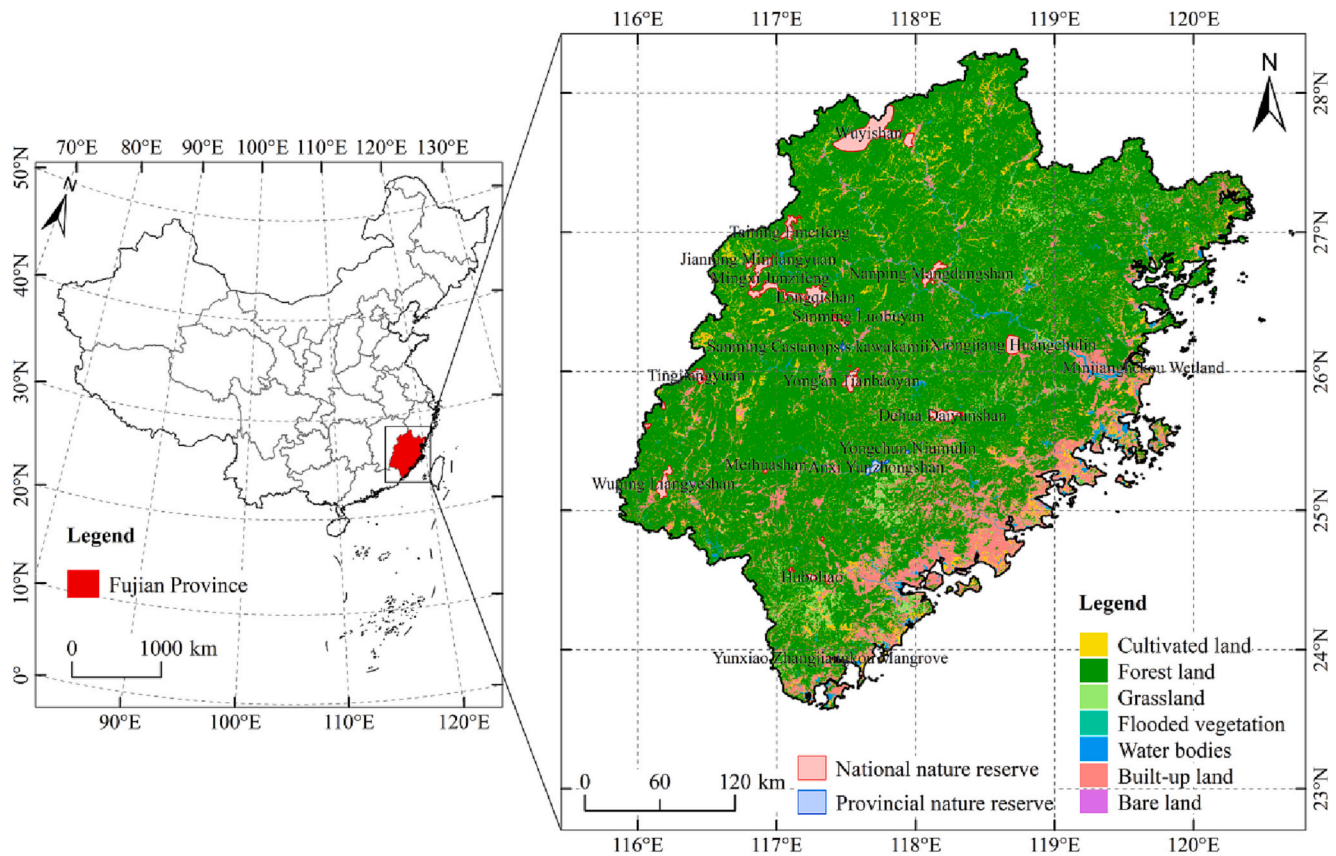


Fig. 1. Land use and spatial distribution of sampled protected areas in Fujian Province, China (2019).

billion, or 15.2%, to Fujian's GDP in 2019. Fujian is representative of collective-owned forest areas in China. Large collective-owned forest areas (about 61.25% of forests) and their complex property rights increased the management difficulties of PAs. In 2003, Fujian was selected as a pilot province to launch the second round of collective forest tenure reform characterised by the devolution of collective forests to individual villagers (Xu and Hyde, 2018), mobilizing foresters to participate in rural forestry construction.

2.2. Approach

Many PAME assessments are based on the IUCN-WCPA management effectiveness framework (Eklund and Cabeza, 2017), one of the most authoritative evaluation frameworks in global PA management. This framework divides PA management into three phases: design / planning, adequacy / appropriateness, and delivery (Fig. 2).

Planning is the most important component of PA management, and focuses on confirming the conservation status and threats, and formulating conservation objectives. We therefore need a thorough understanding of the following: (i) conservation value and importance, (ii) conservation threats, (iii) the influence of social, political and cultural factors on conservation management, (iv) stakeholders involved in the conservation process, (v) legal status and property rights associated with PAs, (vi) the integrity and systematicness of PA, (vii) the effectiveness of PA design, and (viii) the clarity of conservation objectives.

Conservation inputs and process involve the specific implementation of conservation actions and directly determine conservation outcomes. This makes it necessary to clarify the following: (i) conservation input status, i.e., whether the input is sufficient; (ii) rationality of conservation resource allocation, (iii) benchmark definitions and standards for effective management, and (iv) space for improvement in PA management, and so on.

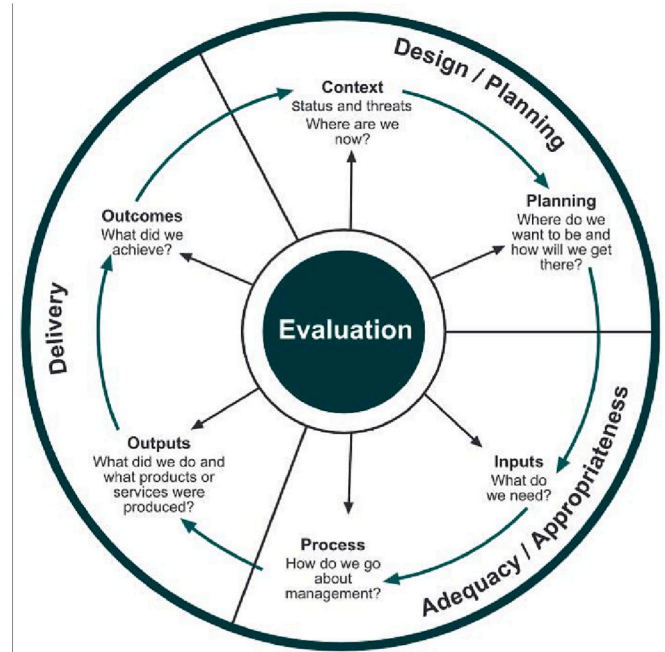


Fig. 2. IUCN-WCPA management effectiveness assessment framework of protected areas, adapted from Hockings et al. (2006).

Conservation outputs and outcomes are used to evaluate the conservation effect. Conservation outputs are reflected by a bundle of quantitative proxies, e.g., the number of people participating in ecological education, the frequency of patrols, meetings with local

communities, resource investigations, and number of scientific research projects, and so on. It is more difficult to evaluate conservation outcomes because it relies on clear conservation planning, which is always vague or flexible in practice. For example, many PAs set their conservation objective as “start species monitoring” without quantitative indicators, such as increasing the population number or density of species in PA to a specified level within a defined number of years. Conservation outcomes include the identification of conservation goals, the completion of conservation evaluations and supervision indicators, biodiversity and socioeconomic evaluations, the completion of management objectives, and the elimination of conservation threats.

2.3. Data collection

Semi-structured interviews served as the primary method of data collection, providing insight into respondents' perspectives around specific themes (Charmaz, 2006) and concurrently accommodating new ideas (Creswell and Poth, 2013) not included in the initial research question design (Marshall and Rossman, 1999). Fieldwork was conducted in November and December 2019. We interviewed crucial PA officers in related departments of the Fujian Provincial Department of Forestry first, and then specific PA managers in 15 national PAs and 4 provincial PAs in Fujian. The interview questions were based on the IUCN-WCPA management effectiveness framework. Experts from research institutions and NGOs were also interviewed on their role in conservation management, cooperation with the government departments, and recommendations for improving the PA management system. Details are summarised in Table 1.

Secondary data from PA management organisations, including PA planning documents and implementation rules, were also collected to strengthen the reliability of the study's conclusions.

2.4. Analysis

Interviews were audio recorded and transcribed. The text was then coded using deductive and inductive approaches. Themes were identified based on the IUCN framework: establishment motivation and planning of PA, daily management inputs and processes, and outputs and outcomes. The interviews were also summarised using an inductive approach, which helped to supplement the existing analysis and find new ideas and themes (Mayring, 2000). We first performed a line-by-line

coding to excavate the initial concepts, then created codes for new points, and merged repeated and similar parts. Next, we extracted the internal relationship of each initial concept to determine the concept category. We then refined the core categories, merged and summarised the codes obtained in the previous steps, and acquired keywords that summarised the existing problems of PA management. NVivo qualitative data analysis software package was used to encode and analyse verbatim transcripts.

3. Findings

We illuminate implementation barriers following the IUCN-WCPA management effectiveness assessment framework. Supervision of PA by central government is also included for its salient relevance to effective conservation.

3.1. Problems in the conservation context and planning of protected areas

3.1.1. Improvements needed in scientific and systematic planning and design of protected areas

We evaluated the rationality of the planning and design of PA via three perspectives: (i) Completeness. Do PAs include species and ecosystems that should be covered? (ii) The trend of over-conservation. Do current PAs include areas that should not be covered? (iii) Systematicness. Can the PA system provide systematic conservation support for biological conservation in the area?

On the whole, Fujian's network of PAs has been completed, forming a hierarchical management system composed of national, provincial, county (municipal), and community PAs.² Different ecosystems are covered in the PA system, but gaps remain. One official noted, “Some areas should [be included in PAs], but not yet, such as Jiufeng Mountain area, and some coastal and wetland areas”. A conservation ecologist noted, “There are some areas (that should be conserved but are not). For example, we once saw very good Magnoliaceae forests in the mountains in the field [...] but it is not covered by PA”.

The establishment and adjustment of a PA in China follow a bottom-up declaration pattern that local government or national (sub-national) PA administrative department submit their application, and after evaluation by the national (sub-national) Nature Reserve Evaluation Committee, the State Council (higher-level government) administrative department in charge of environmental protection shall coordinate and

Table 1

List of interview participants.

Institutions	Participants	Number of participants
Fujian Provincial Department of Forestry	Officials in: Conservation centres	2
	Wetland centres	1
	PA offices	2
	Forest farm development centres	1
Protected areas	National nature reserve (NNR)	18
	Managers of: Yunxiao Zhangjiangkou Mangrove National NNR, Huboliao NNR, Mingxi Junzifeng NNR, Taining Emeifeng NNR, Xiongjiang Huangchulin NNR, Minjianghekou Wetland NNR, Dehua Daiyunshan NNR, Tingjiangyuan NNR, Meihuashan NNR, Longqishan NNR, Nanping Mangdangshan NNR, Jianning Minjiangyuan NNR, Wuping Liangyeshan NNR, Yong'an Tianbaoyan NNR, Wuyishan NNR	
	Provincial nature reserve (PNR)	4
	Managers of: Sanming Castanopsis kawakamii PNR, Sanming Luobuyan PNR, Yongchun Niumulin PNR, Anxi Yunzhongshan PNR	
Research Institutions and NGOs	Experts from: Zhangzhou Forestry Bureau	1
	Xiamen University	2
	Beijing Forestry University	1
	Southern University of Science and Technology	1
	Fujian Bird Watching Society	1
	Alashan Fujian Centre	1

² Generally, a municipal PA is established at a county level across multiple counties, but its administrative level is often the same as a county PA.

make recommendations for approval and submit them to the State Council (higher-level government) for approval. Local governments hesitate to apply for new PAs as they are concerned this may limit local economic development. In addition, strict supervision from environmental inspections in recent years has further dampened local governments' willingness to establish new PAs. An official of the Fujian Provincial Department of Forestry mentioned:

Since ecological and environmental inspections by the central government started, local officials' understanding and awareness of ecological and environmental protection has improved, which is good; but it has reduced local government's willingness to establish PA. Like XXX [area], lots of work had been done [to apply to be a PA], but because of the environmental inspections over the past two years, they (the local government) gave up and retracted. (Interview No. 24).

An official serving in Fujian's NNR revealed the internal incentives of PA establishment and upgrade from sub-national to national level:

At that time, there were few national PAs, and the establishment of a national level PA had a relatively large impact. We were all aiming at this [national level] brand and that became a great driving force to upgrade our provincial PA to a national one. (Official of a national PA in Fujian, Interview No. 31).

In parallel with the cases that areas should be delimited into PA but are not, there are also cases of the reverse. Similar to most PAs in China, PAs in Fujian were initially established to conserve as much as possible. However, due to a lack of technical support and non-standard operations, the boundaries of PAs were roughly drawn. Consequently, farmland, residential houses, and infrastructure with poor conservation value were all included within PAs boundaries.

Earlier, there was no satellite remote sensing or aerial photography for technical support, and there was also not enough on-site investigation... Nearly 10,000 mu³ of villages were zoned into PA. In some cases, the entire village or town was included as PA. It was very common. (Manager of a national PA in Fujian, Interview No. 17).

A national PA needs to be at least 10,000 ha. In order to upgrade our PA to a national level one, the area was expanded from 50,000 mu to 160,000 mu in 2013. (Manager of a national PA, Interview No. 30).

Blindly expanding an area without sufficient scientific support cannot only increase conflicts with local residents, but also impair the development of surrounding villages. In addition to developing a PA's national brand, the ensuing promotion in position is also a strong impetus, which explains the enthusiasm of local officials in pursuing PA upgrades. This point was mentioned in most interviews.

3.1.2. Stakeholder issues

Agreement on optimal trade-offs and consensual solutions to conservation practices requires bargaining and compromise between multiple micro-actors across levels (Sunderlin et al., 2005). Given that the effectiveness of biodiversity conservation is highly dependent on local authorities and residents, we integrate key actors including forestry bureau, local governments and communities into the analysis of contradictions between conservation and development.

3.1.2.1. Conflicts between conservation and local communities. The collective forest land owned by local communities accounts for about 73% of PAs in Fujian (Official of the Fujian Provincial Department of Forestry, Interview No. 1), and only 27% of PAs in Fujian are state-owned land. In some PAs, such as Fu'an Guaxi Suoluo PNR and Putian Laoyingjian PNR, the proportion of collectively owned forest accounts

for about 90% of the total PA area. Consequently, there is considerable spatial overlap between PAs and the local villages, with intractable disruption to the production, livelihoods and development of the local residents.

Before the promulgation of the Organic Law of the Villagers' Committees of the P. R. of China (revised and implemented on 4 November 1998), most PAs involving collective land ownership were established in the absence of formal procedures that required the unanimous consent of a majority of villagers. By not initiating a comprehensive forest tenure reform at that time, the ownership of some forest lands was ambiguous. In many cases, village cadres demarcated forest land into PA without informing villagers, leaking unanticipated land acquisition and insecure tenure. This practice has changed since 2000, but has made it more difficult to establish new PAs or adjust the size of existing ones. With residents' increased awareness of their rights and the lagging refinement of administrative procedures, increasing challenges of past top-down biological conservation patterns are reaped. During the upgrade of Taining Emeifeng NNR from a provincial to a national PA, the local government expended a large amount of human, material and financial resources to sign an estimated 80,000 agreements with local residents to double its size between 2013 and 2015, mentioned by an official of the Fujian Provincial Department of Forestry (Interview No. 1).

Article 26 of the current Regulations on the Nature Protection Regions of the P. R. of China stipulates that logging, grazing, hunting, fishing, medicine collection, reclamation, wasteland burning, mining, quarrying, sand excavation, and other activities are prohibited in PAs. Articles 27 and 28 stipulate that tourism, production, and business activities are prohibited in PA buffer zones; however, there are a large number of residents and productive infrastructure in PAs. Residents in PA have suffered economic losses mainly due to: (i) severe restrictions on the use of local natural resources, (ii) strict control over the construction and renovation of infrastructure, and (iii) a lack of compensation for human-wildlife conflict.

Most PAs are located in economically underdeveloped areas, where local residents are heavily dependent on natural resources for their livelihoods and lack alternative sources of income.

For example, the compensation for ecological public welfare forest⁴ is about 18 yuan⁵ per mu per year. If that forest is not included in [a PA] and can be used for commercial purposes, the average profit could reach 100 yuan per mu per year [compared with the current ecological forest compensation of 18 yuan per mu per year]. They (local people) do not like to accept [such low compensation]. (Official of Fujian Provincial Department of Forestry, Interview No. 24).

According to PA management regulations, all construction activities are forbidden in PAs. If construction activity in a PA is required, it must go through rural construction planning and an Environmental Impact Assessment (EIA) by professional institutions. Due to these restrictive conditions, rural construction planning has not been carried out in PA villages as local communities cannot afford costly EIAs. Constructing or renovating roads, houses, and even duck sheds in a field are regarded as "illegal construction activities", to the great dissatisfaction of PA residents. Moreover, Fujian does not provide compensation for human-wildlife conflicts.

3.1.2.2. Conflicts between conservation and local governments. The Tiao-Kuai relationship, which is known as a combination of "leadership relations" in which the personnel appointments, staff salaries, financial budgets and material resources of PAs are controlled by territorial local governments, and "professional relations" in which the functional performance of PA management administrations is supervised by superior

⁴ An ecological public welfare forest is defined as a forest for public ecological purposes with government compensation for forest owners.

⁵ 1 yuan = 0.157\$ currency on 5 December 2021.

³ 1 mu = 666.67 m².

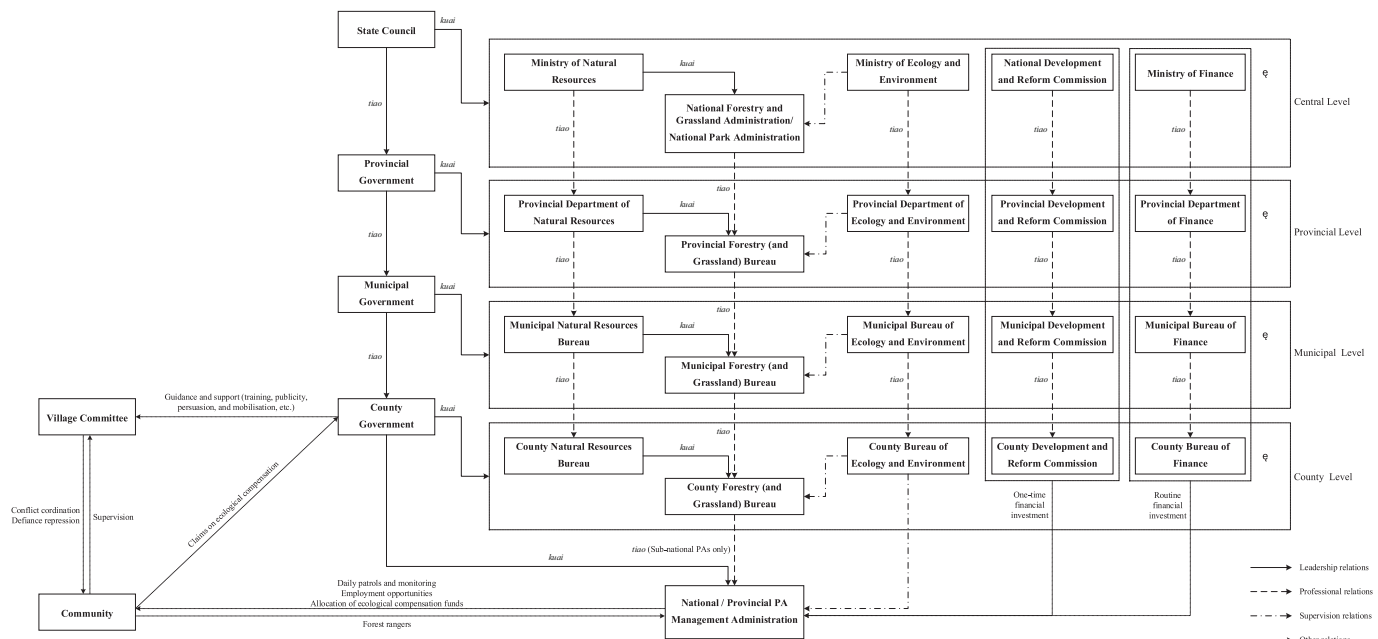


Fig. 3. Bureaucratic structures and interactions between multiple actors involved in the implementation of conservation policies.

Note: (i) In 2018, the institutional reform of the State Council proposed the establishment of the Ministry of Natural Resources (formerly the Ministry of Land and Resources) and the State Forestry and Grassland Administration (formerly the Forestry Bureau) under the unified leadership and management of the Ministry of Natural Resources; accordingly, most sub-national Forestry (and Grassland) Bureaus are under the unified leadership and management of the sub-national Department (Bureau) of Natural Resources. Fujian Province still retains the Forestry Bureau. (ii) National and provincial PAs are all independent legal persons with independent management administrations, while sub-provincial PAs are not. Sub-national PAs are under the management of the local Forestry Bureau, while national PAs are not.

agencies, such as the forestry bureau at the upper level (Mertha, 2005; Ma, 2017), interweaves China's biodiversity conservation and governance system (Fig. 3). There thus forms a dual leadership of forestry bureau and local governments over PAs. Ambiguous or conflicting regulations resulting from institutional fragmentation inevitably trap conservation management in confusion. Although leadership relations are normally superior to professional relations (Ma, 2017), sometimes the authority of local governments might be diverted by forestry bureau for its professionalism.

Among the three arguments attempting to accommodate local defiance in China (Mei and Pearson, 2014), implementation paradox is robust to explain local governments' deviation from ecological conservation objectives. In multi-task principal-agent (MTPA) model, local officials, acting as agents, weigh up multiple competing tasks and prioritise the implementation of instructions with fast-acting and quantifiable goals (Holmstrom and Milgrom, 1991; O'Brien and Li, 1999). Distortions in the incentive structure of local officials have driven a shift in governments' policy focus and resources from biodiversity conservation, such as the establishment and support of PAs, to economic growth. This has caused a stark divergence in preferential objectives between the forestry bureau and local governments.

At the operational level, after the establishment of a PA, the local government has the responsibility to arrange a workplace, cover daily office expenses (e.g., capitation fees), pay staff salaries, and fill job categories. Conservation agencies heavily rely on the support of local governments, but prevent local government exploitation in turn, thus contributing to the unpopularity of PAs. However, it must be pointed out that while local governments have a strong instinct for exploitation, a great majority of local governments support conservation. For example, the 80,000 agreements signed by farmers to upgrade Taining Emeifeng NNR from a provincial to a national PA, would have been unprocurable without strong local government support.

3.2. Problems in the conservation inputs and process of protected areas

We understand the management effect of PA and the current situation of PA management organisation in terms of conservation inputs and process, including the input and effect of human, financial and intellectual resources, science and education, monitoring, evaluation, personnel training, and capacity building. Among them, the problems related to human resources and staffing, funding, and PA monitoring are the most prominent. This section focuses on these aspects.

3.2.1. Organisation of protected areas

Personnel shortages in the current personnel structure of PAs are reflected in: (i) shortage of staff to carry out daily tasks, (ii) insufficient trained staffs, and (iii) a significant ageing trend. The situation can be attributed to: (i) an imperfect management staffing mechanism, (ii) the remote location of PAs, (iii) low job status, and (iv) poor treatment. The lack of human resources is regarded as the biggest obstacle for many PAs.

The conditions in PAs are relatively tough, PAs are relatively remote, and the work is very difficult. Moreover, the people working in PAs bear great responsibility under the pressure of the ecological and environmental inspections by the central government, and face great work stress. The job package for PA staff is not attractive and society does not recognise their worth, so it is very difficult for PAs to hire employees. (Official of the Fujian Provincial Department of Forestry, Interview No. 24).

Obviously, accountability with high political pressure stifles the enthusiasm of grassroots managers. Economic incentives, such as fieldwork subsidies, are also not well designed in line with the intensity of fieldwork. It can therefore be expected that there is great difficulty in retaining grassroots managers in PAs.

While conducting interviews in Xiongjiang Huangchulin NNR, staff mentioned the difficulties faced in recruitment. This reserve has 25 job

positions, but only 12 are filled, of which several are filled by staff seconded from other departments. Only three are professionals and are able to engage in PA management and forestry management activities. The PA recruited only one person between 2017 and 2019. Many PAs such as Meihuashan NNR face similar challenges.

Insufficient staffing does not only happen at a grass-roots level, but also in provincial PAs, such as the Conservation Centre of the Fujian Provincial Department of Forestry, where only two people are working for PA management at present. In addition, the ageing problem of staff in PAs cannot be ignored. At the Xiongjiang Conservation Station of the Huangchulin NNR the ageing of grass-roots forest rangers is a serious problem. At present, the youngest of 12 active forest rangers is 54 years old.⁶ These rangers come from the previous forestry system and have been engaged in forest protection for decades. Once they retire, there will be a structural gap in grass-roots stations.

In our interviews, 63.3% of PAs reported facing professional staff shortages, 36% are insufficiently staffed, 26% experience a high turnover in young people, and 23% face recruitment difficulties. These are due to low salaries, poor incentives, and difficult working conditions.

PA jobs are high in work pressure but low in social recognition. Many PA managers say that working in a PA is “only pressure, but no encouragement”. PA staff are also subject to regular inspections from upper-level government. Additionally, front-line conservation staff are themselves caught in the middle between the conflicting demands of their conservation work and the development needs of local residents.

3.2.2. Funding structures of protected areas

The financial support obtained by different PAs in Fujian varies greatly. The funds allocated to national PAs are sufficient in terms of quantity and structure to meet their normal operational needs, such as Yunxiao Zhangjiangkou Mangrove NNR (Table 2). In contrast, provincial PAs are severely underfunded and insecure, as in the case of Anxi Yunzhongshan PNR (Table 3), where the total funding received in seven years (RMB 2.835 million) was only 1/4 of the total funding received by the former in 2019 (RMB 10.95 million). For PNRs, there is also a serious imbalance in the intensity of conservation funding when further considering the size of PAs. The area of Yunxiao Zhangjiangkou Mangrove NNR and Anxi Yunzhongshan PNR are 2360 ha and 4095 ha, respectively. Larger PAs generally deserve more funding to employ more forest rangers to meet the greater demands of daily patrols for forest fires prevention, pest control and monitoring of biodiversity and illegal activities. We thus establish that PA hierarchy significantly distorts funding allocation, and gives rise to potential discrimination against sub-national PAs in funding competition and the failure of sub-national PAs to achieve desired conservation targets. Obtaining equitable treatment and sufficient funds to ensure routine management is a key reason why lower-level PAs seek upgrades.

Staff salaries and office expenses of Fujian PAs above the provincial level are financed by the local governments. Funding for PAs mainly comes from two channels: the Development and Reform Commission (DRC) and the Financial Department (FD). The DRC funds infrastructure, including the construction of management stations, patrol roads, publicity and education halls, and sentry posts, usually with an initial one-off grant; the FD focuses on capacity building, such as the practice of scientific research and monitoring, and the purchase and allocation of educational and promotional instruments and equipment. PAs have to reapply every year because there is no guaranteed allocation from an operating fund.

At present, although the funds for national PAs in Fujian can meet their basic operational needs, they are still stretched to cover effective biodiversity conservation. In 2019, the capacity building fund for

national PAs in Fujian was 16 million yuan; as there are 17 national PAs in Fujian (15 forest and wetland ecosystems and two marine ecosystems), each PA received less than 1 million yuan. Moreover, each PA has to apply for funds annually and there is no guarantee of allocation. This means that PAs lack sufficient and stable financial flows for routine scientific research and resource investigation activities, leading to a paucity of quantitative data and consistent observation records in most PAs in Fujian.

In addition, the existing capital structure is unreasonable. First, most project funds require coordinating funds from local finance. In practice, this means that if a PA receives project funding from an upper-level DRC or FD, the local government needs to provide money as coordinating funds. However, most PAs are located in poor regions, making it difficult for local governments to afford such funding:

We dare not ask for these project funds. The funds are not 100% allocated to you, and you have to pay some of it yourself. How can we afford them? Generally, the county finance department pays the money, but [it] is unwilling to pay. Can the PA pay by itself? [If not,] why do you apply for it without money? (Manager from an NNR, Interview No. 15).

Second, funds used for fire prevention, pest control and road repair in PAs come from ecological public welfare forest subsidies. If the proportion of state-owned forests in PA is high, funds for forest protection and fire prevention are relatively abundant; if the proportion of collective forests, which usually belong to local people or communities, is high, a considerable portion of the subsidies need to be provided by the forest right owners (i.e., farmers or village collectives), which may imply a funding gap in these services in PAs.

In some PAs, more state-owned forest means more funds, and less means less. The main source for salaries for this part [forest rangers] is the compensation for ecological public welfare forests. At present, our [Yong'an Tianbaoyan NNR] forest protection funds are relatively sufficient. Our state-owned forests account for 40%, and the people recruited are generally local village residents [as forest rangers]. (Yong'an Tianbaoyan NNR, Interview No. 31).

3.3. Problems in the conservation outputs and outcomes of protected areas

3.3.1. Insufficient service-oriented functions

In the IUCN's evaluation model, the service staff, nature education, scientific research services, and tourism services in PA are regarded as an important part of the PA's output. In Fujian, there are two reasons for the incomplete service function of PAs. First, due to the strict conservation and management system, tourism activities are attempted in a few experimental areas. Less than a third of Fujian PAs engage in tourism activities. Second, due to the lack of trained staffs, facilities, and environmental constraints only a few PAs have built science and education museums and carried out science and education activities, such as Fujian Jianning Minjiangyuan NNR and Sanming Castanopsis kawakamii PNR. In recent years, the construction of science and education museums has accelerated with the support of social organisations. For example, the Fujian Bird Watching Society has signed a cooperation agreement with Dehua Daiyunshan NNR to support nature education. Regarding scientific research services, most PAs have established tie-ups with universities and research institutions to provide research objects.

3.3.2. Conservation monitoring and results

The regular monitoring of species in PAs is an important part of evaluating the effect of conservation and provides a scientific basis for PA management and conservation strategies. PAs in Fujian have successively carried out some monitoring projects, such as the general survey of orchids and birds, an annual task organised by Fujian Provincial Department of Forestry. In 2018, the Fujian Provincial

⁶ Forest rangers need to buy insurance to patrol the mountains, but insurance companies do not provide insurance services for people over 60, so forest rangers over 60 are not allowed to work in PAs.

Table 2
Funding structure of Yunxiao Zhangjiangkou Mangrove NNR (2019).

Funds from	Total amount (RMB 10,000)	Funds named	Amount (RMB 10,000)	Funds used for	Amount (RMB 10,000)
Central financial special funds for forestry	700	Biodiversity Conservation Fund	100	Trestle maintenance monitoring	70
				Pest and disease monitoring	30
		Wetland Eco-Efficiency Compensation Fund	600	Ecological compensation for farming clearance	600
Local financial funds	395	Conservation Management Fund	195	Daily patrol and management	60
				Integrated remediation	135
		Research and Education Fund	90	Construction of educational facilities	40
				Research and education activities	50
		Ecological Restoration Special Fund	110	Pest control, including <i>spartina alterniflora</i>	60
				Biodiversity monitoring	50

Table 3
Funding structure of Anxi Yunzhongshan PNR (2013–2019).

Funds from	Funds named	Total amount (RMB 10,000)	Funds used for	Amount (RMB 10,000)
Central Ministry of Finance	2013 Mountain Closure and Afforestation Later Management and Protection Fund of Shelter Forest Project	18.75	Later management and protection of mountain closure and afforestation	18.75
Provincial Department of Finance	2018 Acquisition Cost of Wildlife Infrared Monitoring Equipment	10	Infrared monitoring equipment acquisition	10
	2019 Forest Owner Grant Fund	17.94	Forest tenure owner grants	14.94
Provincial Department of Finance and municipal Bureau of Finance	2018 Forest Ecological Benefit Compensation Subsidy Fund	145.66	Welfare expenses such as staff salaries	3
			Forest tenure owner grants	90.7
			Welfare expenses such as salaries, clothing and insurance for custodians and temporary staff	16
			Labour costs, electricity, printing of promotional materials	1.3
			Remaining in the year	37.66
County Bureau of Finance	General Public Budget Fund	85	Working personnel expenses	78.7
			Goods and services expenditure	6.3
			Wildlife sheltering and plant conservation	3
	Wildlife Shelter Rescue and Plant Conservation Fund	3		

Department of Forestry introduced scientific and technological tools such as remote sensing, video surveillance, and infrared cameras, to conduct inspections and monitoring activities—reversing the historical lack of stable monitoring data. In the past, wildlife monitoring relied on forest rangers' manual observations during patrols. These observations were highly dependent on personnel quality, patrol routes, and patrol time, so it was difficult to obtain stable and effective monitoring data.

Since 2018, infrared monitoring has been installed in all PAs, which is mainly aimed at terrestrial wildlife. We also hope to see the status of terrestrial wildlife through continuous investigation for several years from last year. The data obtained by using infrared cameras to monitor wild animals and plants are relatively objective. At present, 40 cameras have been installed in national and provincial PAs, except 4 marine PAs... The animal videos captured by infrared cameras in Longqishan NNR in Fujian Province have been broadcast often on China Central Television's (CCTV's) Secret Eye.⁷ (Staff of Fujian Provincial Department of Forestry, Interview No. 1).

Despite the continuous progress in monitoring work and technology, problems remain, such as the lack of detailed evaluations and monitoring plans, and an inability to present the resources and changes in the PAs objectively. The lack of monitoring capacity also makes it difficult to carry out scientific research monitoring, as the staff in Yong'an Tianbaoyan NNR said, "At present, there are a lot of scientific research facilities in PAs, but few people are able to use them" (Interview No. 31). Consequently, many PAs rely on external services to conduct the

monitoring, but this also poses problems.

First, there is a lack of sustainable funding for scientific research and monitoring. PAs declare projects on demand, and most funding allocated for projects requires local government subsidies, which makes the monitoring projects uncertain. Cumbersome procedures and insufficient working hours also cause problems.

The procedures are quite troublesome. Originally, I wanted to declare the project this year. It may take half a year for the project to be approved, and then it goes through various procedures, including planning and scientific research bidding. By the end of the year, the financial department urges the implementation process, and you certainly cannot keep up. If money can be allocated according to the budget at the beginning of the year, we can start to do it. It will be smoother. (Manager of an NNR, Interview No. 22).

An ecology expert from the School of Life Sciences of Xiamen University noted that he has become more reluctant to accept scientific investigation and monitoring projects in PAs.

This kind of project is now done through bidding and I am very reluctant to participate in the bidding, as it has to find someone to accompany the bidding. This set of procedures is very troublesome. If you want to do these things in PAs, it may take a long time for a project, and you may not get these projects at last. (Interview No. 33).

Second, it is difficult to find suitable institutions because in addition to the complicated bidding process, the research demands of scientific research institutions are not necessarily consistent with the monitoring demands of PAs. It is therefore more difficult for PAs to find an

⁷ A wildlife protection show.

institution to realize long-term cooperation and continuous monitoring.

3.4. Green shield action and the supervision of protected areas

In 2017, the supervision organisation for PA management, Ministry of Ecology and Environment of the P. R. of China launched a special environmental inspection for PAs—Green Shield Action (*Lvdun Xingdong*)—to investigate violations in PAs. It has greatly improved environmental awareness by compelling local governments to commit resources to the planning and design of PAs. However, there are still serious disparities between the planning and the current situation. The Green Shield Action supervises PAs according to these plans, leading to a dilemma for the management departments of PAs.

For example, Yunxiao county began aquaculture development in the 1960s and built a complete beach aquaculture industry chain. Yunxiao Zhangjiangkou Mangrove NNR was established in 1992, and the breeding area within the reserve was preserved. The Green Shield Action found that the PA failed to rehabilitate the wetland of the remaining breeding area according to the Regulations on the Nature Protection Regions of the P. R. of China, Regulations on the Wetland Protection of Fujian Province and other relevant laws and regulations. Billions yuan was needed for the rehabilitation. It not only placed tremendous pressure on local financial resources, but also damaged the breeding industry and upstream and downstream enterprises, inducing social problems such as unemployment. It should also be pointed out that the impact of shellfish aquaculture activities and their ancillary facilities on seabirds and mangrove systems is still unclear. Some experts say that proper intertidal mudflat culture can provide habitat and food for protected birds (especially migratory birds), while the natural beach formed after terminating the breeding industry may not be conducive to the migration of birds.

Some seafood can provide food for birds, but PA needs to communicate closely with farmers to develop a sustainable shellfish culture mode. As long as the management is appropriate, a win-win solution can be found. There should be no competition [relationship] between mangroves [and aquaculture] if mangroves are not cut down... (Conservation biology expert, Interview No. 32).

There are a lot of birds here. Winter is not the peak period for breeding. There are few people and there is no [human] intervention [for birds]. Moreover, in the breeding pond, there are also some bottom stage organisms left that can be eaten [for birds] at low tide. It should be allowed to let farmers carry out green breeding, control their inputs, such as no [investment of] a lot of hormones, and encourage them to carry out ecological breeding, rather than now [quitting all breeding]. (Staff of Fujian Provincial Department of Forestry, Interview No. 24).

4. Discussion

Although the establishment of PAs in China is mainly driven by ecological concerns, economic and political factors also manipulate the development of PAs. We establish that due to the bottom-up declaration system, the strong economic motivations and political concerns of local governments cannot be overlooked in the process of establishing and upgrading PAs; this poses a challenge to the systematicness, integrity and scientificity of PAs. Ma et al. (2019) showed the opposite trend of increasing number and decreasing area of PAs in China during 2007–2014, since PAs in developed areas suffered more boundary adjustment. An intransigent form of PA failure is Protected Area Downgrading, Downsizing or Degazetting (PADDD), widely seen in developing countries with high political vulnerability. PADDD is essentially a drastic government policy change, whereby intensifying human activities within PAs are legally authorized and condoned, spatial extent of PAs is compressed for expanding resource extraction,

and legal protections for PAs are weakened, respectively (Watson et al., 2014; de Oliveira Júnior et al., 2021). Existing studies generally ascribe this to various proximate causes, such as natural resource exploration and development (e.g., oil, gas, and mining) (Osti et al., 2011; Mascia and Pailler, 2011; Diele-Viegas et al., 2020), infrastructure construction (e.g., power generation and transmission) (Bernard et al., 2014), and local land pressures and land claims (Mascia et al., 2014), and so on, instead of the broader social, economic and political context. Symes et al. (2016) is an exception, but still fails to explicitly recognise the underlying complex games between multiple actors, such as forestry bureau, local government, PA management administration, village committee and community. Not only the conflicting interests of actors, but the social processes that guide the negotiation of these conflicting interests emphasized by Nkemnyi et al. (2016), are well considered in Table 4 and Fig. 3. Prior to the enactment of the Organic Law of Villagers' Committees, local governments and village committee denied communities the right to information, participation and decision-making, which exposed indigenous residents to under compensation, tenure insecurity and procedural inequity (Adeyeye et al., 2019). Forestry bureau is in charge of supervision and management of forestry and ecological protection and restoration through strict restrictions on natural resource use, and so on, worsening the livelihoods and well-being of households. The economic development-oriented beliefs of local officials run counter to those of PA management administrations, which are committed to upgrading PAs, not only for equitable treatment and adequate resources, but for national branding, public recognition and reputation. All of these potential conflicts boost the cost of conservation governance and management.

We described the negative impact of obscure and insecure tenure, underfunded and understaffed management, and weak monitoring, on effective biological conservation, resonating with a wide range of literature on PAME and specific management elements, both in China and internationally (Xu and Melick, 2007; Seabrook-Davison et al., 2010; Hu et al., 2020; Zeng et al., 2022; Zhao et al., 2022). Ambiguity of forest tenure induced by incomplete forest tenure reform, and ongoing uncertainty over forest tenure, exacerbated by undeclared and unanticipated demarcation, not only discourages long-term investment in the improvement of land quality, but also cultivates public distrust of local governments (Xu and Melick, 2007), thereby increasing management costs. Funding shortfalls will directly limit PAs' capacity of conducting scientific research to inform conservation policy and management decisions, infrastructure improvement and renewal, and equipment acquisition and maintenance, deprive the training and the employment of skilled personnel, hinder routine patrols and monitoring to prevent forest fires and illegal activities, and lead to failure to implement compensation schemes. The mismatch between low salaries and arduous labour makes work in PAs less attractive, and encourages young people to treat a position in a PA as merely a "springboard" in the promotion system. Expanding the size of PAs without commensurate increases in financial and intellectual resources for management will create "paper parks" and ultimately diminish the quality of biodiversity conservation (Muhumuza and Balkwill, 2013). The lack of funding lies ostensibly in resource scarcity-induced competition between PAs, but fundamentally in China's dualistic funding allocation system and PA hierarchy. The implementation of Natura 2000 also struggles with insufficient funding. Natura 2000 is currently co-funded via the European Agricultural Fund for Rural Development (EAFRD) and other six fund instruments (Geitzenauer et al., 2017). Although better than a "stand-alone fund" (European Commission, 2004), such diversified funding sources are still unable to bridge the funding gap, originating from competition between agricultural and environmental budgets, domestic political power struggles and institutional fragmentation across administrations (Winkel et al., 2015; Geitzenauer et al., 2017), yet the above causes are of limited compatibility with the underfunding of PAs in China.

Beyond a decentralised fiscal system, we seek a linkage of barriers to effective management to deeper political context and institutional

Table 4

The role of actors involved in the implementation of conservation policies.

Stakeholder	Interest	Beliefs	Power
Forestry bureau	<ul style="list-style-type: none"> • Authority from the central government through rigid inspection • Recognition and support from PA management administration 	<ul style="list-style-type: none"> • Loyalty in implementing the conservation policies of central government • Maximisation of conservation gains 	<ul style="list-style-type: none"> • Supervision and management of natural resources, wildlife and plant resources in PAs • Proposing auditing and approval of the establishment, planning, construction, adjustment and franchise of PAs • Promoting forestry reform, contract management of rural forest land, Sloping Land Conversion Program, and Natural Forest Protection Project
Local government	<ul style="list-style-type: none"> • Political achievements such as economic growth, and biodiversity conservation, etc. • Promotion 	<ul style="list-style-type: none"> • Economic growth as a direct guarantee for promotion • Durability and complexity of biodiversity conservation • Selectiveness and retractability of sanctions from the central government • Reasonability of collective action with other local officials who selectively implement policies and political directives 	<ul style="list-style-type: none"> • Application for establishment, adjustment and upgrading of PAs • Human, material and financial support
PA management administration	<ul style="list-style-type: none"> • Ecological gains of conservation, such as the recovery of threatened species, etc. • National brands, public recognition and reputation • Human, material and financial resources for effective and efficient conservation management 	<ul style="list-style-type: none"> • Maximising the ecological gains of conservation • Minimising the conservation management costs and efficiency losses • Promoting the upgrading of PAs to obtain national brands and reputation, equitable treatment and sufficient resources 	<ul style="list-style-type: none"> • Application for establishment, adjustment and upgrading of PAs • Daily patrols for forest fires prevention, pest control and monitoring of illegal activities
Village committee	<ul style="list-style-type: none"> • Village collective income • Stable community order 	<ul style="list-style-type: none"> • Sustainability of natural resource use • Village collective economy, industrial development and economic growth • Villagers' self-governance 	<ul style="list-style-type: none"> • Management of land and forests collectively owned by villagers • Coordination of interest conflicts, human-animal conflicts and tenure disputes • Repression of community defiance
Community	<ul style="list-style-type: none"> • Access to information • Rights to engagement and decision-making in the conservation process • Livelihoods and well-being • Ecological compensation • Tenure security and clarity 	<ul style="list-style-type: none"> • Legality and transparency of conservation practices • Equality and non-discrimination in conservation engagement • Commensuration of ecological compensation and economic loss 	<ul style="list-style-type: none"> • Supervision of the legality and transparency of conservation practices • Pursuit of equal conservation engagement • Bargaining and claims on ecological compensation and well-defined tenure arrangements

arrangements. The inherent nuances of interest, beliefs and power between forestry bureau and local governments (Table 4) have shaped their dissonance in functions, objectives and operations. The complex principal-agent relationship between the forestry bureau and local governments has created dual and overlapping leadership over PAs, deriving governance confusion and management inefficiency. Economic concerns, distorted by the existing incentive structures of local officials, will win an overriding priority over biological conservation. Local officials are forced to follow this tacit collective action and synchronise with other local officials who take economic development first as well, or fall behind in this growth competition and career promotion. It then gets easier to understand local governments' baffling reluctance to apply for new PAs, retreat in support for existing PAs, and connivance of illegal development even within PAs. Furthermore, potential accountability triggered by ecological and environmental inspections, i.e., Green Shield Action, may also have a crowding-out impact on management innovation at the grassroots level. Given the selectiveness and retractability of sanctions from the centre (Mei and Pearson, 2014), it may leave opportunities for speculation of local officials, further deviating from ecological conservation objectives. Coinciding with Garcia and Burns (2022), the weaknesses of the domestic bureaucracies pull the expected outcomes away from the formal rules. However, their focus is power projection strategy to strengthen formal jurisdiction of administrative agencies over forest reserve instruments, which is beyond our concern.

5. Conclusion and policy implications

Institutional deficiency is an inconspicuous but crucial factor that explains the conservation failures and conflicts between would-be beneficiaries. Non-conservation factors, such as economic growth, have extensively intervened in and distorted the establishment and upgrading

of PAs. With a one-size-fits-all approach to all PAs, Green Shield Action has intensified conflicts with residents and reduced local governments' willingness to establish new PAs. There is the necessity of optimization of PA governance system and integration of policy sectors across levels, with well-defined responsibility division for the people, objects, and property rights between the central and local governments and administrations. Ensuring the participation of multiple stakeholders in the rehabilitation process, and the respect to local history and conditions is also critical for achieving long-term biodiversity conservation goals.

Management inadequateness is a symptom of institutional weaknesses in biodiversity conservation practice. The abatement of conservation barriers therefore calls for wider adoption of appropriate PA management techniques and identification of conservation priorities. Adequate funding, scientific support, staff trainings and incentives, monitoring shall permeate the whole management process of PAs.

Contentious and insecure forest tenure likewise constitutes an impediment to effective reconciliation of interests between village collectives and conservation and deserves more attention. The key to resolving tenure issues is to obtain effective management rights, realize the funds required for public welfare functions, and pay reasonable fees for those who transfer the management rights when most of the land ownership does not belong to the government (He et al., 2017). Recent reforms of the national park system⁸ have attempted to balance conservation with the livelihoods of local residents without changing land ownership. The system was given priority in the Qianjiangyuan National Park pilot project that attempted to more clearly identify the protected objects, refine the management requirements, judge the impact of

⁸ China proposed to build a national park system in 2013 and launched a pilot national park system in 2015.

production and living conditions of local residents on the protected objects, and establish a list concerning prohibited, restricted, and beneficial behaviours (Wang et al., 2019). However, some scholars have pointed out that the system implemented in Qianjiangyuan exists in name only and cannot be effectively replicated in other collective forest areas, as it only stipulates the general management rules that farmers need to follow in the process of moderate management, without any operable evaluation methods and differentiated compensation criteria. It is essentially no different from the one-size-fits-all ecological compensation strategies of the past (Zhang, 2020). The core principle in addressing this issue should be to refine conservation demands according to local conditions and to formulate a clear list of positive and negative activities of farmers, regarding farmers as important participants and accommodating their reasonable development demands.

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CRediT authorship contribution statement

Weiyi Wang: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Daye Zhai:** Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Bo Huang:** Conceptualization, Methodology, Investigation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

Data availability

The authors do not have permission to share data.

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