

The Role of Ecosystem Services in Holistic Conservation within Protected Areas: A Case Study of the Song Thanh National Park, Vietnam

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ABSTRACT

Vietnam has made a strong commitment to biodiversity conservation, as evidenced by its extensive network of protected areas. However, environmental issues persist in protected areas. Often, the resulting violence complicates the situation, making it more challenging to analyze and manage. We studied the perceptions of people in the buffer zone of the Song Thanh National Park, Quang Nam province, regarding the current status of ecosystem services (ES), the importance of ecosystem services, their changes over time, and people's participation in protecting ecosystem services. We employed a mixed-methods approach, combining qualitative and quantitative data. We conducted semi-structured interviews, focus group discussions, key informant interviews, and household surveys. We found that local communities were aware of the current status of ecosystem services they used and the importance of prominent selected services, such as swidden agriculture and water resources, in their lives. The study also showed how current people perceived the improvement of regulatory services since the establishment of the national park, while the extraction of forest ecosystem services led to legal violations. People's dependence on the provisioning services provided by protected areas often leads to environmental conflicts in their management. This study provides strong evidence that conservation is essential; however, an ES approach is needed to manage protected areas effectively to meet conservation objectives.

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KEYWORDS

Ecosystem services; Conservation; Protected areas; Perception of ecosystem services at the community level; Provisioning services; Conflicts in protected areas.

1. INTRODUCTION

Protected Areas (PAs), including national parks, nature reserves, wilderness areas, and community conserved areas, are established for natural conservation purposes and have a role in contributing to people's livelihoods (IUCN, 2008). Different types of PA provide various categories of ecosystem services (Ivanić et al., 2020). Strictly protected PAs tend to have more regulation services than provisioning services, while protected landscapes generally provide more services (Alix-Garcia et al., 2015). Yet, the challenge remains that local people may not share a common vision of the importance of PAs with those who issue and implement the protection policies (Turnbull et al., 2021). The designation of protected natural areas without equitable engagement with local communities and indigenous groups can result in conflict (Folke et al., 2005).

Conflicts in the buffer zones of PAs are diverse and often arise between communities in the buffer zone and PA management authorities. For example, the number of recorded violation cases in 2024 was 22 in Cat Tien National Park (NP) (Lam Dong newspaper, 2024 [anecdotal evidence]), 06 cases in Bu Gia Map NP (Bu Gia Map NP website, 2025 [anecdotal evidence]), and 19 cases in Easo NP (Tuan Anh, 2024 [anecdotal evidence]). The root cause of such conflicts is often the loss of benefits and

opportunities to access resources by buffer zone communities due to the establishment of the PA. As shown in the cases of Indonesia and Uganda, conflicts arose from the resettlement of upland people to expand protected forests and conservation areas, as well as the conservation of forest resources for national parks, which deprived local people of opportunities to utilize forest resources (Castro & Nielsen, 2003). When access to PA resources for communities in the buffer zone is prohibited, while their livelihoods are not replaced sustainably, conflicts emerge. In such situations, clearly defined boundaries of PAs are crucial in mitigating conflict (Nguyen Ba Long, 2002; Phan & Nong, 2024).

Bontempi et al. (2023), based on an analysis of 474 cases, demonstrated that different types of PA lead to distinct environmental conflicts. Conflicts due to resource extraction are the most common in PAs. The causes of conflicts in PAs often result in the displacement of indigenous people from their land, the separation of species diversity conservation values from cultural conservation values, influence from elite groups (rather than population growth), and the inflows and outflows of materials and energy within the PA. Another study found that when people live at a subsistence level and depend on natural resources in national parks, it can hurt the conservation of the ecosystem (Wang et al., 2021).

There has been a recent shift towards considering Ecosystem Services (ES) and human well-being in the design and management of PAs, beyond traditional conservation approaches that only focus on the strict conservation of biodiversity due to the value of species (Hummel et al., 2019).

ES are the direct or indirect benefits that people derive from ecosystem functions. They are also considered aspects of ecosystems that are actively or passively utilized to create human welfare, providing benefits to people through direct or indirect use (Fisher et al., 2009). How ecosystem services are perceived and utilized affects the tendency and intensity of people's behaviors in acquiring and using these services. Understanding human motivations for using ecosystem services is essential to help mediate people's responses to ecosystem management policy. Various studies have confirmed differences in the use and perception of ecosystem service benefits, depending on ecological and economic conditions (Kisiwa et al., 2021; Ouko et al., 2018). Differences in people's awareness and behavior regarding the use of ecosystem services, as well as their responses to the management of these services, remain poorly understood and are not reflected in ecosystem services-related policies (Asah et al., 2014). Due to this lack of understanding, beneficiaries of ecosystem services in Vietnam and other developing countries are often not reflected in the complexity of relationships between livelihoods and ecosystem services that provide intangible value in regulating, supporting, and cultural services.

The application of ecosystem services in the management of PAs is still limited (Pu et al., 2023). This is because the value of ecosystem services is difficult to assess, especially the socio-cultural services. Thus, it is difficult to decide how much can be extracted from the PA or how to manage a PA cost-effectively. As a consequence, government agencies tend to close PAs for conservation purposes only. This argument is of significant importance in addressing the challenges of PA management of conflicts.

Vietnam committed to biodiversity conservation at an early stage. The first national park, Cuc Phuong, was established in 1966. *In situ* conservation is the most common form of biodiversity conservation in Vietnam. As of 2022, Vietnam has established 179 PAs (Table 1), including 34 national parks, 59 nature reserves, 26 species and habitat conservation areas, and 61 landscape protection areas (MONRE, 2023). PAs have a role in protecting biodiversity. As a consequence of the establishment of the PA network,

forest ecosystems are being preserved and restored, forest areas have increased, and forest genetic resources have been collected and preserved. Although the system of PAs has expanded and forest cover has increased, the tendency of biodiversity degradation and loss has been recorded for all types of ecosystems, including terrestrial, wetland (including inland and coastal wetlands), and marine ecosystems. The shrinkage of natural ecosystems resulted in decreased species heterogeneity and undermined their ability to provide ecosystem services.

Table 1. The system of PAs in Vietnam

Legal designation of PA	Number of PAs	Total area (ha)
National Park	34	1,265,181
Nature reserve	59	1,153,277
Species and habitat conservation area	26	102,112
Landscape conservation area	61	93,493
Total	179	2,697,073

[Source: Ministry of Natural Resources and Environment, 2023]

In the Vietnamese context, conflicts arise when local authorities face challenges in identifying the best ways to manage the PAs while struggling to meet conservation requirements and sustain local livelihoods. Valuing ecosystem services for both their economic and non-economic benefits, even in a limited scope, has been considered in formulating regulations to manage the PAs. However, the perspectives of authorities and local communities are not always aligned, and existing conflicts persist in complex aspects.

The buffer zone is the area surrounding or adjacent to the core area of a national park, playing a crucial role in safeguarding the ecosystem and biodiversity. Strict legal regulations manage it. Under Clause 25, Article 2, Forestry Law (No. 16/2017/QH14), the buffer zone is designed to support the protection of special-use forest resources and mitigate the negative impacts of human activities on the national park's core area. The law clearly defines permissible activities within the buffer zone, including sustainable agricultural practices, ecotourism, and scientific research projects focused on conservation. Conversely, activities such as illegal resource exploitation, wildlife hunting, and the discharge of pollutants are strictly prohibited. Decree 156/2018/ND-CP on forest management provides further detailed regulations on controlling resource extraction within the buffer zone, ensuring that such activities do not harm the forest ecosystem. Additionally, the Law on Biodiversity (2008) mandates the protection of rare plant and animal species in these areas, while Decree 35/2018/ND-CP on nature reserve management outlines measures to protect natural resources and promote sustainable livelihoods for local communities. Collectively, these regulations form a comprehensive legal framework aimed at preserving the integrity of buffer zones while encouraging local community involvement in conservation and sustainable development.

Permitted activities in buffer zones include sustainable agricultural practices such as tree planting and organic farming that do not harm the ecosystem; responsible, planned, and environmentally friendly livestock farming; ecotourism, which must be carefully regulated and implemented according to established procedures to protect natural resources and raise environmental awareness within the community; and scientific research projects that support conservation efforts and enhance resource protection. Restricted or prohibited activities include the illegal exploitation of forest resources (such as unlicensed logging, stone, and mineral extraction within the buffer zone), hunting and capturing of wildlife, and the discharge of pollutants (including

wastewater and hazardous waste) into the forest environment.

Understanding villagers' perceptions of ES provided by PAs in their vicinity is crucial for effective conservation and sustainable management. These perceptions offer valuable insights into local knowledge, values, and priorities, which can inform decision-making processes and improve the design of conservation strategies. By elucidating the benefits that local communities recognize and value, policymakers and protected area managers can develop more inclusive and culturally sensitive approaches to conservation. Furthermore, understanding these perceptions can help identify potential conflicts between conservation goals and local needs, allowing for the development of strategies that balance ecological protection with community well-being. This knowledge can also facilitate better communication and collaboration between protected area administrators and local populations, potentially increasing support for conservation efforts and enhancing the long-term integrity of PAs.

The study aimed to understand the local people's perceptions about ES, which reflects how they view their relationship with the PA, in accordance with the PA's role in biodiversity conservation, by examining how they access, use, and value these services in their daily lives. Our goal is to demonstrate the importance of the ecosystem service approach and its translation into ecosystem service valuation to promote holistic conservation in PAs.

The existing literature highlights a disconnect between biodiversity conservation policies and the local community's perceptions and use of ES, especially in the buffer zones of PAs (Folke et al., 2005; Turnbull et al., 2021). While Vietnam has extensively expanded its PA network, conflicts persist due to limited consideration of how local livelihood needs intersect with conservation objectives, particularly in terms of access to forest resources (provisioning services) such as agriculture and timber extraction (Hoàng, 2012; Iwanaga, 2019). Furthermore, there is a recognized but poorly understood link between how communities perceive and utilize ES and their behavioral responses to conservation policies, which influences management effectiveness (Stanley et al., 2014; Kisiwa et al., 2021). Despite increasing attention to the ecosystem services framework in PA management globally, its practical integration in Vietnamese PA management, especially in terms of socio-cultural valuation and community participation, remains limited and under-explored (Pu et al., 2023). This research addresses these gaps by examining local community perceptions of ES, their changes over time, and the resulting implications for conflict management and sustainable conservation in the Song Thanh National Park, Vietnam. The research contributes to understanding the perception of ecosystem services in the buffer zone of protected areas and how it affects the conservation of the protected area.

2. RESEARCH SITES

We conducted a study in 03 communes (Ta Bhing, Ta Poo, La Dee) of the buffer zones of Song Thanh National Park, northwestern Quang Nam province (Figure 1). The area represents typical montane forest ecosystems of Vietnam. The park covers an area of more than 76,500 hectares, stretching across 12 communes bordering the Lao PDR and Kon Tum Province (Figure 1). The Park is located in a complex and steeply sloping terrain, and is the watershed of the Vu Gia-Thu Bon River system formed by two branches of the Bung and Cai rivers, which flow from west to east into the sea at Cua Dai (Hoi An city).

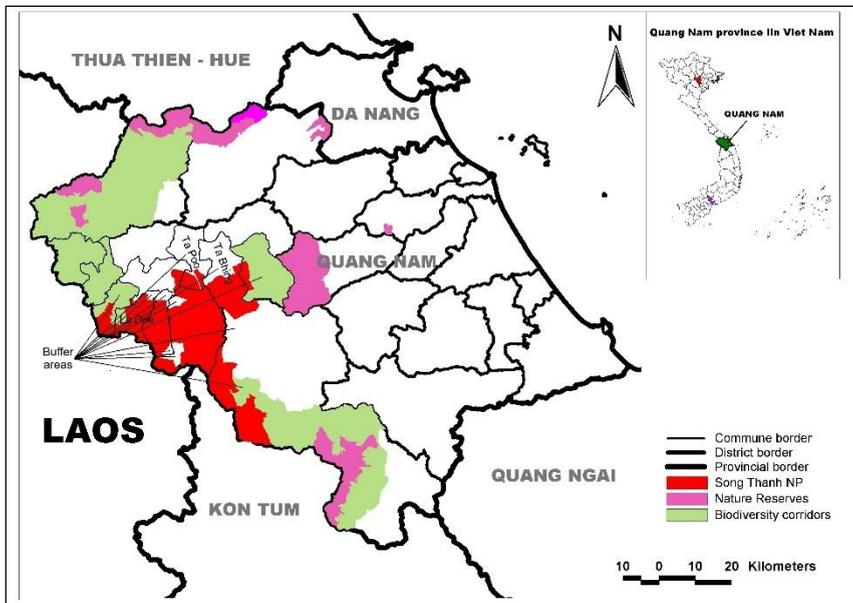


Figure 1. Location of the study sites

Song Thanh National Park was established in 2000 as a nature reserve and upgraded to a national park in 2021. Song Thanh National Park is a strictly protected area dedicated to preserving biodiversity and ecosystem integrity for scientific research, education, training, entertainment, and tourism activities. To preserve species, populations, and landscapes, no commercial exploitation is allowed in the national park. The buffer zone of Song Thanh National Park is designated to conserve rare and endangered species of flora and fauna, protect biodiversity, and promote sustainable socio-economic development for local communities. It encompasses 40 villages and hamlets across 13 communes in the Nam Giang and Phuoc Son districts, which border the national park. This buffer zone is managed by the general regulations governing buffer zones of national parks.

It has national and global conservation values, boasting a vibrant and diverse flora of more than 899 species of higher plants, of which 101 are listed in Vietnam's Red Book (IEBR, 2024). In particular, the National Park has several rare and precious species including *trâm hương* (*Aquilaria malaccensis*), *lan kim tuyến* (*Anoectochilus*), Laotian chò chí (*Parashorea chinensis*), mây Sông Thanh (*Calamus crispus*), and lá nón Trung Bộ (*Licuala centralis*). Song Thanh National Park is also an area of mixed forest with hundreds of hectares of *Pomu* (*Fokienia*) species. Song Thanh National Park is home to 53 species of mammals, 44 species of reptiles, 21 species of amphibians, 25 species of fish, and numerous invertebrates. Of these, there are 23 species of mammals, 12 species of birds, 16 species of reptiles, and three species of amphibians listed in Viet Nam's Red Book. The Park has rare and endemic species of animals, such as the Brown-shanked douc langur, the gray-shanked douc langur, the giant muntjac, and the Truong Son muntjac, which was discovered in Quang Nam in 1997. In addition, the populations of douc langurs, lorises, and gibbons in the Song Thanh National Park are one of the most concentrated primate populations in Vietnam and the world. Song Thanh National Park's habitats are linked to several other nature reserves, creating one of the regions with a large continuous natural forest area, up to 500,000 ha in the central region of Song Thanh (National Park, 2021).

The buffer zone of the Song Thanh National Park covers 13 communes, including Dac Pring, Dac Pre, Dac Toi, La Dee, Ta Poo, Cha Val, Ta Bhing, Ca Dy (Nam Giang District), and Phuoc Cong, Phuoc Xuan, Phuoc My, Phuoc Duc, Phuoc Nang (Phuoc Son District). The population in the buffer zone of Song Thanh National Park comprises different ethnic groups, including the Co Tu and Ta Rieng (also known as Gie Trieng) people. The total number of households living in the buffer zone is 5,618 (Nam Giang and Phuoc Son district People's Committee, 2019). Unlike the majority of Kinh people in this area, who primarily rely on service and trade for their livelihoods, ethnic minority groups depend mainly on agricultural and livestock production activities. Their income is principally derived from forestry sources, including payments for environmental services, the sale of forest trees such as acacia planted on their allocated land, and the sale of vegetables and fruits selected from the forest, such as ươi (*Malva nut*) (*Scaphium macropodum*). Most of these households participate in forest protection contracts and received payments for forest protection until the end of September 2019. In 2020, the Song Thanh National Park Management Board began signing contracts with professional individuals for forest protection. By 2023, the National Park Management Board had signed agreements with 219 people, mostly healthy local young people who had been trained in silvicultural skills. This is the core force responsible for carrying out tasks such as patrolling, checking, and monitoring biodiversity in the forest area (*"Improving forest conservation capacity from forest environmental services"*, 2023). The people contracted to protect the forest act as local rangers, who patrol and check the forest, and set up checkpoints at forest management and protection stations located in the communes.

3. METHODS

The research team conducted field surveys in three communes of Nam Giang district (La Dee, Ta Poo, Ta Bhing) in the buffer zone of Song Thanh National Park in March 2022. The team organized consultation meetings with the management of the park and the district's People Committee to select the communes that were then "hotspots" in the management and protection of the PAs. Based on the consultations, we selected six villages from three communes in Nam Giang District. The selected villages were Cong To Ron and Dak Ooc of La Dee commune; Ga Lee and A Lieng of Ta Bhing commune; and Pa Tooi and Vinh of Ta Poo commune. The team conducted key informant interviews involving a total of 15 key informants, focus group discussions with six groups (60 people) in the community, and 100 household interviews. The research team applied the knowledge-attitudes-practices (KAP) approach to develop questions for household and key informant interviews, as well as focus group discussions (FGDs). Household interviews employed a set of prepared questionnaires with multiple-choice, yes-or-no, and open-ended questions.

3.1 Key informant interviews

The research team consulted with 15 key informants, including representatives from the commune People's Committees, the provincial department of Natural Resources and Environment, the department of Agriculture and Rural Development (Office of Forest Protection), and members of the management boards of Song Thanh National Park. The interviews aimed to understand the historical context, current biodiversity conservation management plans, and interventions for the PAs.

3.2 Focus group discussion

The research team organized a focus group discussion in each village. Each group consisted of 10 people from social organizations (Women's Union, Fatherland Front, Youth Union, Farmers' Union, and Veteran Association), as well as wealthy and poor households, and village chiefs.

The focus group discussions aimed to learn about the current status of ecosystem service use and the reasons for changes in ecosystem services. Sketch maps were used to identify and locate the local ecosystems, then sketch out the ecosystem services they provide. The participants were asked to list the benefits they receive from the ecosystems (e.g., from forests, rivers, coastal mangroves, etc.) presented on the sketch map.

Based on the information collected from FGDs, we analyzed three questions: (i) what services are being used; (ii) which services are considered most important; and (iii) how have ecosystem services changed since the establishment of the protected area? We rely on the Knowledge-Attitude-Practice approach to identify the link between awareness and ecosystem service use, which in turn leads to conservation impacts.

The ecosystem services identified based on people's perceptions were categorized into the four groups first identified by the Millennium Ecosystem Assessment (MEA, 2003): provisioning, supporting, regulating, and cultural services. However, as most people think that supporting and regulating services are "indirect and hard to observe", we put them into the same category of "support-regulation" services. Based on the list of ecosystem services identified through FGDs, a set of questionnaires was developed for household interviews.

3.3 Household interviews

Interview questions focused on the identification of ecosystem services (Table 2) accessed frequently by households, the frequency of access, and the importance of such services in household livelihoods. Households were asked to value each ES on a scale of 1-5. Additionally, they were also asked to rank the four most important ESs in descending order of priority. The questionnaire also investigated local awareness of changes in the availability of ecosystem services and management policies and interventions. The questionnaire was pre-tested to ensure that the majority of local people could answer the questions.

Table 2. List of the ecosystem services used in the household survey

ES Category	ES used in the survey
Provision	Swidden farming
	Wet rice cultivation
	Livestock keeping and fishery
	Non-timber forest products (honey, medicinal plants, nipa palm leaves, and trunks)
	Forest resources (gold mining)
	Timber
	Fresh water
Regulating/supporting services	Energy (firewood)
	Pollination
	Increasing soil fertility
	Species conservation
	Improving air quality
	Microclimate regulation

ES Category	ES used in the survey
	Water regulation
	Water filtering (water quality)
	Preventing erosion and protecting soil
	Disease control (Covid)
Cultural services	Entertainment and relaxation
	Contribution to art and literature
	Environmental education
	Sport and health
	Local identity and history
	Local knowledge
	Spiritual values

This study employed a non-random sampling method, selected based on the research team's experience and understanding of implementing KAP on forest protection and management, as well as risk assessment. The survey subjects were selected using a combination of quota sampling and convenience sampling. Based on the understanding of factors affecting people's awareness and behaviors in forest management and protection, the research team proposed criteria (similar to stratified random sampling) to select households to participate in the interviews, including: (1) working age, (2) activities related to forest use, exploitation and protection management, (3) gender, (4) occupations/livelihoods relation to forest resource use, and (5) representative of wealthy and poor households.

3.4 Data analysis

We conducted descriptive statistical analysis and tests of the significance of differences in means (t-test and one-way ANOVA) on the quantitative data obtained through structured household interviews using SPSS version 29.0.0.0 software (IBM Corp.).

4. RESULTS

4.1 Demographic and socio-economic characteristics of survey samples

As shown in Table 3, 76.9% of the households interviewed belong to the Co Tu ethnic group. The remaining 23.1% include Ta Rieng (18.3%), Kinh (2.9%), and Thai (1.9%). Most households in this area have lived there for over 20 years and are presumably knowledgeable about the local situation regarding natural resource use. Most households interviewed were poor (64.5%), with income mainly coming from agricultural production (68.3%) and forestry production (20.1%). Approximately 10% of households have members who receive monthly salaries from the government, such as commune officials and teachers. Field observations and interviews showed that agricultural production activities here are mainly shifting cultivation and raising pigs and chickens (mainly for household consumption). Forestry production in this area is mostly acacia growing. In addition, the household's forestry income comes from the REDD program and from selling forest products such as wild vegetables, bamboo shoots, and malva nuts. It is obvious that ecosystem services are an important component of the livelihoods and well-being of people and the rural economy. Livelihood activities were highly dependent on natural resources and included rice farming, fishing and aquaculture, and forest product extraction.

Table 3. Socio-economic characteristics of survey respondents (%)

Age	< 20	2.9
	21 - 60	96.1
	> 60	1.0
Gender	Male	55.8
	Female	44.2
Ethnicity	Co Tu	76.9
	Ta Rieng	18.3
	Kinh	2.9
	Thai	1.9
Education	Illiterate	15.8
	Secondary school	43.2
	High school	20.0
	Vocational school and college	13.0
Income (based on classification by the commune)	Well-off	1.0
	Medium	34.6
	Poor/Near poor	64.5
Main livelihood	Agriculture	68.3
	Forestry	20.1
	Hired labors	1.0
	Government sector	10.6

Note: all values are in percentage (%) [Source: Field survey, 2022].

4.2 Land ownership

Among the 63 households that owned swidden agricultural land in the past and at the time of the survey, the amount of land decreased by 28% (statistically significant based on a paired t-test; $p < 0.05$, $t = -1.973$). The average current holding was 12197 m². Among the 36 households that owned paddy agricultural land in the past and at the time of the survey, the amount of land decreased by 52% (statistically significant based on paired t-test; $p < 0.10$, $t = -1.641$). The average current holding was 1664 m². Among the 11 households that owned cash crop land in the past and currently, there was no statistically significant change in the amount of land under cash crops. The average holding was 8591 m². Among the 67 households that owned residential land in the past and currently, the amount of land decreased significantly by 11% ($t = -1.727$, $p < 0.10$). The current average was 197 m² of residential land.

There were 97 households that owned any type of agricultural land (swidden, paddy, or cash crops) in the past and/or at the time of the survey. The average amount of agricultural land owned was currently 16041 m² – a 20% increase from the past.

In the past, 61% of the sample owned any amount of swidden land, and at the time of the survey, it was 84%. For paddy land ownership, the numbers were 36% and 44% respectively. A significant increase was observed in the percentage of households that owned any cash crop land rising from 11% to 27%. There were 28 households that had any amount of land under cash crops, either currently or in the past. The current average amount of land under cash crops was 12930 m² – a 400% increase from the past (paired t-test: $t = 3.716$, $p < 0.001$).

There is a reciprocal relationship between land ownership and ES, and it is expressed in the way land is used. The farmers who are poor, in need of food and income, will focus on “provision services” from their land, farming intensively to get high yields. They often use short-term varieties and fertilizers and do not care much about issues such as soil fertility, biodiversity, which degrade the land, and result in degraded ecosystems – which lead to degradation of regulation, support, and cultural

services.

4.3 Forest protection and ecosystem strengthening programs

To encourage people to protect the forest, Quang Nam province has implemented various forest protection programs with funding from the National Forest Protection and Development Fund or international funding, while maximizing the number of forest protection contracts to gradually reduce the number of deforestation cases (Do Vinh, 2023). All villages surveyed participated in implementing at least one forest protection program.

The Community Forest Development Program for sustainable poverty reduction of ethnic minorities is implemented in old swidden areas that have been converted for protection and are not allowed to be cleared for farming. In the La Dee commune, swiddens over 10 years old were converted into community forests. Community forests are managed by the District Department of Agriculture and Environment and assigned to the Commune People's Committee. The Commune People's Committee, in turn, assigns forests to the villages for management. The villages are supported with 400,000 VND/ha/year and hold meetings to discuss how to use these payments.

The program "Investment and development of special-use forests for the period 2011-2020" was implemented in 2013-2015, 2018, and 2019. Buffer zone communes were supported with 30-40 million VND/village. However, only 24/41 villages in the buffer zone received this support. In La Dee commune only 3 villages (Dak Penh, Ha Loi and Cha Dai) received support in 2018. PA officials organized meetings with villagers to get community opinions (tree planting, animal husbandry, etc.), then provided them with saplings and breeding stock. Dak Oc village (La Dee commune) was provided with duck breeding stock.

Under the REDD+ program, the Green Truong Son project supported by the United States Agency for International Development (USAID) implemented REDD+ activities to reduce CO₂ and create forest carbon credits. The project also supported sustainable livelihood improvement for ethnic minority communities through developing the value chains of rattan, bamboo and medicinal plant products. With support from the project, buffer zone communes have planted 100 hectares of rattan, and sustainably harvested 50 hectares of rattan under the natural forest canopy. One commune in the study area (La Dee commune) was supported to grow rattan under the forest canopy. This project also implemented the model of planting large timber forest areas to provide wood for house construction, regulate water sources, and restore ecological diversity (Phung Thi Quynh Trang, 2022).

The Payment for Forest Environmental Services (PFES) program was started in this area in 2013. Villages established forest protection groups consisting of households, mostly with young men. The main task was to patrol and prevent people from clearing the forest for swidden. Forest protection groups are responsible for patrolling the forest 1-3 times/month. Forest rangers went on forest inspections (every 2-3 months) together with forest protection groups. The allowance rate was 200,000 VND (USD80/ha/year). In 2019, the PA management board proposed to increase the rate to 400,000 VND (USD160/ha/year). This was divided equally among households. However, the household and village community groups who detected violations when patrolling and inspecting forests could not enforce penalties on the violators or confiscate illegal items. The Park Management Board realized that the effectiveness of forest protection was low, so they ended the forest protection contracts signed with the household groups in September 2019. From October 2019, contracts were signed with 78 specialized forest protection staff. Most of the staff are local people, have professional degrees, finished grade 9 or higher, or are demobilized soldiers with

knowledge about the forest. As of 2023, Song Thanh National Park has signed contracts with 219 people to perform patrolling, forest inspection and biodiversity monitoring tasks in the forest areas (Tran Nguyen, 2023 [anecdotal evidence]).

In Quang Nam province, there are 80 entities using forest services, including 31 for hydropower, 11 for clean water, and 38 for industrial water. In 2024, the Provincial People's Committee will add 10 entities using forest environmental services who must pay for forest environmental services in the province, including 7 industrial establishments that use water for industrial production and 3 clean water production and supply facilities (H Quan, 2022 [anecdotal evidence]). As of 2023, the forest owner Song Thanh National Park Management Board has used money collected from PFES to lease and protect more than 45,775 hectares of forest. The PFES payments received by the Management Board from the Forest Protection Development Fund are used to pay for specialized forces and to plant special-use forests (Tran Nguyen, 2023).

To better protect the forest, in December 2020, Quang Nam province upgraded the Song Thanh Nature Reserve to Song Thanh National Park. The Park has the functions of preserving natural values, biodiversity, endangered and rare flora and fauna species, protecting the environment, promoting adaptation to climate change, and developing tourism. To perform these functions, the Park is divided into three zones, which are: (1) Strict protection zone (76% of the total area) with the function of protecting the integrity of forest resources, forest landscape and biological resources to ensure the natural succession of ecosystems. In this zone, only scientific research and ecotourism supporting activities are allowed; (2) Ecological restoration zone (23% of total area) with the function of protecting landscape and forest resources, restoring forest ecosystems, and restoring biodiversity and other values of the forest. In this zone, research and ecotourism development activities are allowed; (3) Service - Administrative zone (1% of total area) is where the management board office is located. There is also a botanical garden and the Forest Flora and Fauna Research Center building. In this area, scientific research, sightseeing, and service facilities can be organized (Lan Anh, 2020).

4.4 Water resources

In addition to NTFP and land exploitation activities at the household level, another notable activity is water exploitation for hydropower generation. Bung River, which originates in Laos and flows through Song Thanh National Park, provides water for hydropower plants. Since 2009, the Bung River began to be dammed for 5 hydropower plants. Each plant is only a few kilometers apart, so the reservoirs and power generation capacity are not large; ranging between 29-155 MW. On the Bung River and other river systems, Quang Nam Province has approved 46 hydropower projects with a total capacity of 1,726 MW and average electricity output of 6,530 million kWh/year (Dac Thanh, 2018 [anecdotal evidence]). Of these, 20 hydropower plants are already in operation, including 8 large and 12 small plants. Hydropower earns approximately 800 billion VND in revenue for the province each year. To build hydropower plants, Quang Nam has reclaimed and converted more than 12,000 hectares of forest and production land. As a result, more than 1,000 households were resettled, and 688 households migrated. Interviewees reported that since the establishment of hydropower plants, the main channel of the Bung River has become dry while its tributaries have become closed reservoirs liable to flooding nearby villages.

In one of the two districts in the buffer zone of the PA, people and businesses illegally extract placer gold. To mine gold, people dig deep into the mountain, deforming an entire hill for dozens of hectares. These mining activities pollute water sources and affect the health of local people. In addition, widespread gold mining in

high mountainous areas exacerbates the risk of landslides and flash floods (Do Vinh & Le Huy, 2024).

4.5 Knowledge, attitude, and practice of ecosystem services in the Song Thanh National Park

Of the 24 ES we asked about, the respondents reported using or benefiting from 19 services on average. Local people in the study area revealed that they did extract forest resources, but mostly non-timber forest products (NTFPs) for their essential needs, including harvesting bamboo shoots, medicinal plants, firewood, bamboo for house repairing, timber to build houses, and clearing forest for swidden farming. Poor households tended to carry out the most extractive activities, including (1) cutting timber for house construction (85.7%), (2) gathering firewood from dried/fallen branches (76%), and (3) clearing forest area for swidden farming (73.3%). It is clear that forest products extracted by poor households, such as bamboo shoots, medicinal plants, small wild animals (fish from springs, porcupines, etc.), and wild orchids (*Anoectochilus*), are essential to their lives. Many poor households extract timber from the forest to build their houses. Medium and well-off households engage the most in livestock grazing (Table 4).

Table 4. Forest products extracted by households' economic status

Extraction activities	WELL-OFF (%)	MEDIUM (%)	POOR (%)
Firewood from dried/broken branches	6.0	18.0	76.0
Bamboo, bamboo shoots	5.5	28.8	65.8
Medicinal plants	9.1	36.4	54.5
Timber for house construction	7.1	7.1	85.7
Livestock grazing	20.0	50.0	30.0
Hunting, trapping forest animals	0	33.3	66.7
Wild orchids	0	50.0	50.0
Clearing the forest for swidden farming	13.3	13.3	73.3

Approximately 20% of respondents shared that they own swidden land in the PA. According to them, they inherited these lands from their grandparents and parents, but without land certificates. Some people said they worked on borrowed swidden areas. Swiddens in the PA are currently only used to grow upland rice for family consumption. Planting crops such as acacia for sale is not allowed.

According to the Millennium Ecosystem Framework, forest resource exploitation activities in buffer zones can be considered provisioning services. Table 5 shows services under the provisioning service category that the interviewed households have accessed and used.

Table 5. Provisioning services used by the households

Category	Service	% households
Provisioning services	Swidden farming	97.1
	Livestock keeping and fishery	89.0
	Non-timber forest products (honey, medicinal plants, nipa palm leaves, and trunks)	76.9
	Fresh water	98.0
	Energy (firewood)	17.0
	Timber for house construction	68.8

PA exploitation activities serve two purposes, i.e., income generation and household consumption (Table 6). The local people still carried out exploitation activities in the national park (Table 6). Some activities were carried out on a small scale

and mainly for household consumption, such as: timber for house construction (96.2%) fresh water (to provide water for small fish ponds that supplies some fish for sale) (96%), bamboo, firewood (88.9%), trapping small animals (79.8%), NTFP (60%). The remaining two activities were using swidden land within the national park boundary (right next to the village) to grow rice, cassava, or raising cattle, which had a higher rate of selling for cash income. More than half of the cassava harvested from the upland was sold (58.3%), and the rest was used by the family for livestock. Cattle herders also sold 56.6% of their products for cash. This result is consistent with the fact, which is not stipulated on official documents, that local people are still allowed to enter the national park to harvest some products for household use in small quantities but not for commercial purposes.

Table 6. Purposes of provisioning services

Service	Income generation	% household consumption
Agricultural land (including swidden and wet rice farming)	58.3	41.7
Livestock grazing	56.6	43.4
Trapping small animals (shrimps, fish, porcupines)	20.2	79.8
Non-timber forest products (bamboo shoots, medicinal plants, fruits)	40.0	60.0
Fresh water	4.0	96.0
Bamboo, firewood	11.1	88.9
Timber for house construction	3.8	96.2

Local people in the buffer zone view the forest resources around them not simply as a source of shelter, food, water, or shelter for animals, but also as a source of other values for their well-being (Table 7). Usually, supporting and regulating services are difficult to discern and therefore are not emphasized by local communities when asked about their “use”. During the Covid-19 pandemic, residents particularly emphasized the positive impact of the protected area (PA) on their local climate. They believed that the healthy environment provided by the PA helped shield them from Covid-19 infections. Consequently, they attributed any local Covid-19 cases to transmission originating from outside their area. This means that community members realize and highly appreciate the role of forests in improving human health and preventing diseases. However, many people find it difficult to determine the importance of supporting and regulating services because they are not very apparent.

Table 7. Other perceived benefits from the park

Group of services	Benefits/Ecosystem services	% households claiming benefits
Supporting-regulating services	Pollination	87.4
	Improving air quality	99.0
	Microclimate regulation	96.0
	Water regulation	86.2
	Water filtering (water quality)	93.8
	Preventing erosion and protecting soil	83.0
	Increasing soil fertility	84.5
Cultural services	Disease control (Covid...)	91.9
	Entertainment and relaxation	77.4
	Contribution to art and literature	73.9
	Environmental education	92.6
	Local cultural identity and history	92.5
	Spiritual values	96.9

The interviewed villagers ranked the services (Table 8) based on their perception of how important they considered each service to be for their well-being. Of the three groups, provisioning services are the most important due to their direct and significant benefits to household livelihoods. Among the provisioning services, land for agriculture and livestock grazing was identified as the most used and of highest importance to households. They fully realize how these services are vulnerable to droughts and water shortages, which have negative impacts on their livelihoods. The villagers also emphasized the importance of water and its close connection with domestic and agricultural purposes, as well as the spiritual well-being of the villagers. The importance of water is amplified by the increasing scarcity of water due to climate change and the density of hydropower plants.

Table 8. Household perception of the most important ecosystem services

Level of importance	Types of services	Rank	% of households agree
1	Swidden farming	1 (most important)	74
2	Livestock grazing	2 (second most important)	64
3	Freshwater	3 (third most important)	56
4	Air quality improvement	4 (fourth most important)	26

4.6 Awareness of the change in the availability of ecosystem services

In the survey, the research team asked local people to comment on changes in the forest resources they have been patrolling and depending on over the past 10 years. A common comment (over 60%) was that the majority of forest resources have decreased in both quality and quantity compared to the distant past. Most of the people said that currently, some of the valuable trees that used to exist in the Song Thanh National Park, such as agarwood (*trâm*), *Azelia Xylocarpa* (*gõ*), and cloves, and animals such as pangolins, bears, loris, and tigers are now gone or very few of them remain. Some animals, such as tigers and bears, only remain in the memory of middle-aged men. Some people from the forest patrol group in Tabhing and La Dee communes confirmed that they had seen footprints bear on large trees, but that it had been a long time since they encountered any large animals in this forest area. During focus group discussions, the villagers noted that, in the past, firewood, fodder, and timber were available in nearby forests, which were easy to access. Now, they have to go further to obtain goods, and some NTFPs are no longer available.

Table 9. Local people's observation of changes in forest resources (% agree)

Changes in forest resources	Main livelihood			Gender			Income			
	Agriculture	Forestry	Service	Hired labors	Gov. staff	Male	Female	Well-off	Medium	'oor/Near-oor
Decreasing/worse	59.4	50.0		100.0	80.0	56.0	66.0	50.0	68.6	64.7
Increasing/better	25.5	12.5			20.0	26.7	19.1	50.0	17.1	32.6
Unchanged	15.1	37.5	100.0			17.3	14.9		14.3	20.6

Irrespective of gender, source of income/occupation, and economic status, people are highly aware that the decline in forest resources in this area has continued over the past 10 years (Table 9). However, Table 9 and Figure 2 also shows that there were people who commented that “anyway, the forest is in better condition than before the PA was upgraded to a national park, when many people from other places came to exploit it”. More women (66%) than men (56%) noticed a decrease in forest resources over the past 10 years. This is understandable because the daily work of women is often associated with the forest – collecting firewood, bamboo shoots, wild vegetables, and

farming in the swiddens – they therefore live close to nature and can feel the change more acutely.

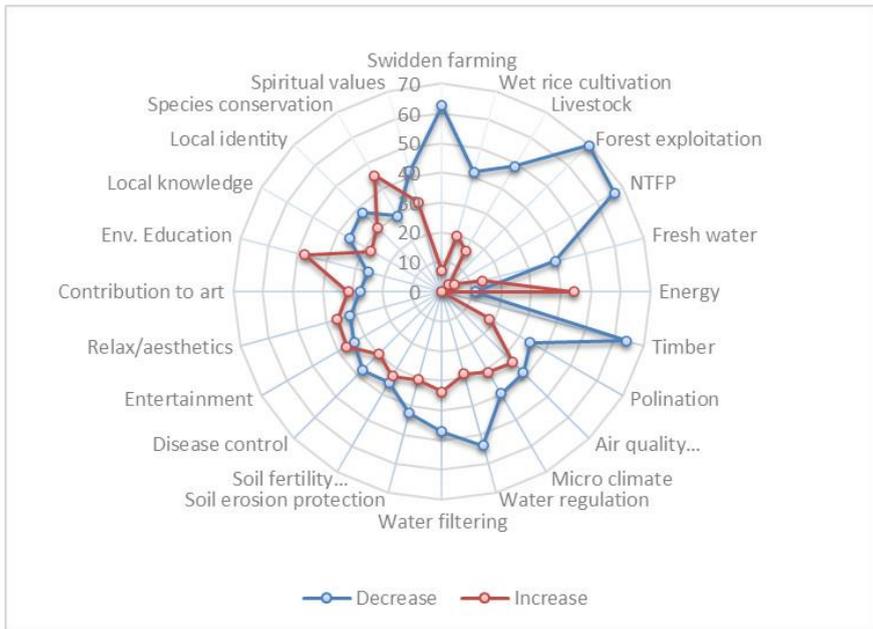


Figure 2. Change in the availability of ecosystem services (Source: Household surveys in 2022)

When asked about the causes of declining forest resources, four main causes were mentioned, including: (1) Illegal logging for commercial purposes (22%); (2) Natural disasters (storms, floods, landslides) (20%); (3) Timber harvesting to build houses (14%); and (4) Deforestation for infrastructure construction (13%). Other causes that were mentioned are illegal encroachment of forest land for farming, illegal hunting of wild animals, illegal and excessive exploitation of forest products, and cattle grazing. The two causes of “natural disasters” and “deforestation for infrastructure construction” are frequently mentioned because people witnessed heavy storms and rain in the locality (e.g., a big storm in 2018), causing erosion and landslides that swept away large areas of the forest. In addition, the construction of hydropower projects, power transmission poles, border patrol roads, and mineral exploitation activities also removed a significant forest area. For the construction of the Song Bung 4 Hydropower plant, 65 hectares of forest were cleared, and more than 300,000 m³ of timber were cut down (Huu Phuc, 2015 [anecdotal evidence]). Particularly for “timber harvesting to build houses”, the high consensus rate revealed the reality that timber to build houses is in very high demand among local people.

The decline in forest quality has discouraged people from going to the forest for exploitation. This has reduced access to forest provisioning services. But a more important reason for the decline in access to forest ecosystem services, especially access to the provision of freshwater, timber, firewood, and high value NTFPs (Table 9 and Figure 2), is due to the enforcement of stricter regulations when the nature reserve was upgraded to a national park, which means people are no longer allowed to access the forest.

The local people considered the above causes to be threats that led to a decline in forest ecosystem services. Through the focus group discussions, we identified the interventions and management measures that were being implemented locally (Table

10). Provincial management units implement these management interventions.

Table 10. Perceived threats to ecosystem services and management interventions by local people

Priority ecosystem services	Perceived threats	Management interventions
Fresh water	Serious shortage of water for farming Increased difficulty in getting water during the dry season Overcrowding hydropower plants	- Establish and upgrade PAs such as nature reserves, biosphere reserves - Implement the payment for forest environmental service (PFES) policy
Timber	Illegal logging for selling, cutting big trees to clear land for the construction of roads	- Apply strict regulations to prohibit/limit access to the forests
Forest resources	Over-exploitation of NTFPs for selling, extinction of rare species, and an increase in bare land	- Strictly prohibit grazing in the forests - Strictly prohibit farming in the forest
Fresh air	Overuse of chemical fertilizers and sprays	- Poor management of forest fires
Cultural values	Changing lifestyle (e.g., fewer traditional houses on stilts due to a lack of timber)	

The focus group discussion with the staff of La Dee Commune People's Committee revealed that the threats occurred due to high socio-economic development and population pressures, which led to the overexploitation of forest services. According to them, it is necessary to block local people from the PA for conservation purposes. Therefore, a practical measure is closing forests and establishing PAs to strictly minimize community access.

5. DISCUSSION

5.1 Protected areas decision-making affects ecosystem service access

The local people of the Ta Rieng (Gie Trieng), Mo Nong, and Co Tu minority groups have lived for generations on these lands, even before the PA was established. In the past, they practiced swidden farming in the forest and collected wild animals and NTFPs for consumption. After the PA was established, many aspects of their livelihoods still depend on the forest in the PA. Their livestock is free to graze in the margins of the PA. Logging for building houses, hunting or trapping wild animals, and the collection of NTFPs (wild vegetables, bamboo shoots, honey, medicinal plants, rattan, malva nuts, etc.) for household consumption and income generation inevitably take place. Our research found that the local people recognized and used provisioning services more than regulating and cultural services in Song Thanh PA. Poor households depend on provisioning services more than other groups of households. Provisioning services focus on provisioning raw materials (timber), land for swidden farming, fuels, medicinal plants, etc. This study shares the observation with other studies that, when the lives of local people depend on natural resources, provisioning services are preferred more often than regulating services (Dorji et al., 2019; Kisiwa et al., 2021). Provisioning services are often ranked as most important among the ecosystem services, especially in developing countries (Wangchuk et al., 2021; Gerard et al., 2019). In the research area, most of the ecosystem services used by the local people are under the management of Song Thanh National Park, which was established to prevent extraction activities.

Viet Nam defines PA as a geographical area with established boundaries and functional subdivisions to preserve biodiversity. PAs apply strict regulations to prohibit exploitation and extracting activities. Resource extraction and economic development activities such as cattle raising, firewood collection, and road construction are prohibited in the PA. Livelihood activities such as farming and building infrastructure for transport and tourism can take place in the buffer zone, however all these activities are maintained at a scale that does not compromise the integrity of the ecosystem (Wang et al., 2021). Though the livelihoods of the people living in buffer zone depend on the PA, their access to provisioning services from the PA is considered illegal, causing depletion of biodiversity. However, local communities were not the only one to blame for the forest degradation. The exploitation and conversion of forest land in the PA for hydropower development and the illegal gold mining activities that happened due to ineffective management also contributed to the degradation of forest resources and affected conservation goals.

5.2 Impacts of no legal access

Whilst PAs are established to protect the country's biodiversity, they have complex relationships and conflicts with people living in buffer areas (Ivanić et al., 2020). Conflicts in PAs often reflect the conflicts between human activities and conservation goals and extractivism is the most common driver for conflicts (Bontempi et al., 2023).

We found that the livelihoods of local people depended heavily on forest resources. Hence, they still had to go into the PA to farm, harvest timber and hunt animals. Interviewees stated that not being able to access the forest causes (1) loss of food sources, (2) loss of income, (3) loss of farmland. Survey data show that men are worried about losing their source of income because they directly participate more in exploiting forest resources. Women, with the responsibility of taking care of the family, are concerned about the consequences of losing food sources when they can no longer enter the forest. Women are also more concerned about disputes and disunity than about the consequences of losing income sources. Poor households are more worried about losing food sources, income, and livelihoods because they depend more on forests. Agricultural households worry about disputes due to deforestation and loss of food sources and income. People are worried about not being able to go into the forest to collect NTFPs. This will reduce sources of food, medicinal plants, and income and will therefore affect livelihoods, impacting indigenous communities. When the PA is more strictly protected, it will be more challenging to obtain timber to build houses. Currently, the cost of building a house is too high. A temporary house cost about VND200-300 million (USD8,000-12,000). Bank loan capital is only VND50 million (USD2,000)/household, which is insufficient, and households frequently have no feasible way to repay the debt. Therefore, either there will be an increase in violations or there will be no housing to live in.

This study shows that local people still go to the national park to farm on land areas left by their ancestors. Currently, only upland rice is grown on the swiddens with low productivity. People want to grow acacia to sell, but they are not allowed to. Additionally, their land is not close enough to roads, making product transportation difficult. Even though they know it is against the law, as the population increases and people need land for production, they still go to the forest to farm. The people want the PA management board to allow them to maintain the status quo of their old swiddens, or if possible, to exchange land with them and merge the swiddens into one area. The people also want the PA to allow the villagers to use the land close to the village for farming and growing large wooden trees for building their houses. This finding shares similarities with the research on the perception of the farmer in Mengyin County of

China, who recognized the decline in ecosystem services (which they benefit from) and thereby reduce their demand appropriately (Chen et al., 2017).

The practice of swidden farming and the conversion of forest land to grow acacia for high income gave rise to the encroachment of forest land. Deforestation, forest encroachment, and illegal exploitation of forest products, especially for natural forests, are still taking place in the PA. In the first 6 months of 2024, exploitation of timber and trapping of animals were reported with 12 cases of violation, and the timber, wild animals, and traps were confiscated (Plong Thai & Minh Phong, 2024). Illegal gold mining was also reported in the PA, with 122 violation cases found in 2018 (Quoc Tuan, 2024 [anecdotal evidence]).

The number of violation cases reported in newspapers shows that the local practice of illegally accessing provisioning services in the PA is causing environmental conflicts. Meanwhile, the upgrade of Song Thanh Nature Reserve into Song Thanh National Park is the province's effort to implement the strategy on forest ecosystem protection and conservation of rare flora and fauna (Song Thanh National Park, 2024). As regulated by law, the national park focuses on the restoration of forest ecosystem services and has applied stricter prohibition of exploitation activities. This led to a significant decline in access to provisioning services.

As the PA prevents the community from accessing the provisioning services, local people have had to adapt. Some of the provisioning services are no longer as important as they once were. For example, many households have switched from burning firewood (collected from the PA) to using gas stoves, or they plant trees to collect firewood from their allocated forest land.

In order to cope with restrictions in legal access to the PA for provisioning services, the local people in Song Thanh participated in the Payment for Forest Environmental Services (PFES) program to earn income. But the income from PFES is small and does not make a significant contribution to improving livelihoods. At the study site, the PFES program signed contracts with local households to protect the PA forest. The villages established forest protection groups consisting of households, the majority of which are represented by young men. Their main task is patrolling to prevent people from clearing forest areas for swidden fields. In return, each household received payment. Information from group discussions revealed that the income from PFES was not high (averaging at about 5 million VND/household/year) and therefore not commensurate with their efforts to patrol and protect the forest.

Cochard et al. (2020) found that in Viet Nam, PFES are often applied in mountainous provinces where PFES can be collected from hydropower production. These provinces have natural forests but are faced with illegal logging and the overexploitation of forest resources. The provinces with PFES schemes are populated by the ethnic minority groups whose poverty rates are high. However, the ethnic minorities are not the main beneficiaries of the PFES scheme. They either do not have land titles or only have small land plots, and such a lack of and limited land ownership reduces their abilities to engage in PFES schemes (McElwee, 2012). Insecure land tenure and high transaction and opportunity costs can undermine the long-term benefits of PFES programs for local households, thus potentially threatening their livelihoods, and it's likely that PFES schemes are imposing a threat to local livelihoods in the sense that they cause disruption or cessation to ecosystem services that people in the community are enjoying (Phuc et al., 2012). With limited payment as the local people living in the buffer zone of Song Thanh National Park received, PFES schemes have made the economic benefits inadequate to the cost of compliance, separating poverty reduction from conservation goals (Alix-Garcia et al., 2015).

5.3 Application of ecosystem services for holistic management of protected areas

Conflicts in the buffer zone of the PA are diverse, arising between the buffer zone communities and the PA management authorities. The causes of conflicts include the loss of benefits for local people and a lack of alternative livelihoods for buffer zone communities. This implies that the PA and buffer zone management institutions are falling short, and the management is facing significant challenges in keeping a balance between conservation needs and human development (Wang et al., 2021).

Traditional conservation believes that biodiversity should be strictly protected to preserve the value of species. However, separating species from people to protect is a failure to recognize the ecosystem as a system that plays a crucial role in maintaining the sustainable delivery of ES (i.e., a socio-ecological system). ES represents the potential capacity of PA and serves as a potential indicator for monitoring the implementation of PA management plans. The application of ES can help to identify proper management plans to protect and restore fragile ecosystems. There has recently been a trend to include ES and human well-being in the management of PAs. Instead of focusing only on protecting threatened species, PAs focus on the entire ecosystem and manage it in the face of human pressures. It is argued that when ESs in PAs are managed, it will help stabilize the ES supply for local people in the buffer zone, thereby better protecting ecosystems and conserving biodiversity (Pu et al., 2023). Conflicts at the Song Thanh National Parks are conflicts of interest. Discussing conflict management in PAs, Lewis (1996) pointed out that conflict of interest is the most fundamental conflict, which should be resolved first, and that allowing local people to extract resources in certain areas in the PA designated as community serving areas, or creating alternative livelihoods for them, is better for management than strict conservation.

Conflicts and opposing viewpoints in management will emerge when conservation strategies for PAs follow a top-down approach, which excludes local practices or interests. Application of the ES approach to PA management helps the management authorities understand the viewpoint of communities in the buffer zone about the benefits of the PAs. As discussed earlier, the local people recognized the changes in the ecosystem services and their support for the local well-being, and they are willing to participate in PFES schemes. Promotion of a bottom-up approach, which applies the ES concept in PA, can enable holistic conservation of PAs. It means understanding the significance or social values that people attach to ecosystem services. This understanding is essential for making equitable management decisions (Dorji et al., 2019). The PA management community should be incorporated in implementing the ES approach in a way that is practical and suitable for their purposes. Proper management can be developed to ensure that PAs provide people with benefits without harming conservation. The goal of PFES is to mediate an improvement in households' income and a change in knowledge, attitudes, and practices of forest protection. To spur such change, payment from PFES must be able to replace and return the benefits from provisioning services that the local people have obtained from the PA and should be distributed on the basis of time and labor contribution as well, not only on land tenure.

6. CONCLUSION

This study reveals the current status of access to, and use of, ecosystem services by the local people and their views on the importance of ecosystem services to their lives and communities where they live, PFES performance, and potential conflicts between PA managers and buffer zone communities. Unlike studies that focus on the valuation of ecosystem services, which emphasize biophysical models and monetary aspects of

ecosystem services, this study identifies and evaluates ecosystem services from a national park based on people's knowledge, attitudes, and practices. This research found that the PA managers control access to the ecosystem services of the PA, and they act to fulfil the functions of a PA by law. The challenges in the management of Song Thanh National Park are to find a replacement for the provisioning services that the local people used to receive from the PA. The power relationships between the PA managers and the local people living in the buffer zone are set by law. The PA managers have management obligations to prevent access to the provisioning services from the PA.

This study also shows that the management of PAs is faced with the complexity and diversity of resource exploitation forms. There is also large-scale exploitation of ecosystem services in the PA for hydropower generation, besides the derivation of provisioning services by local people. PA governance has been falling short in ensuring equivalent benefits for local people through alternative livelihoods and in controlling illegal resource exploitation by outsiders. The emergence of various (legal and illegal) actors in PAs, while the consequences of their various forms of resource exploitation have not been thoroughly assessed, reflects potential and evident conflicts in PAs.

Most of Viet Nam's PAs are located in areas with high poverty rates, and it is a major challenge to achieve the conflicting goals of conservation and development. The Vietnamese government has sought to overcome these conflicts through policies on benefit sharing and co-management between PA management agencies and local communities related to protecting natural resources, while allowing some extractive activities that sustainably use forest and marine resources.

As a country that has signed the Convention on Biological Diversity (CBD), Viet Nam is making efforts to recognize areas of particular importance for biodiversity and ecosystems through systems of PAs and other effective regional conservation measures (OECMs) in order to enhance biodiversity conservation and recovery. The knowledge obtained from this study can contribute to the development of mechanisms to encourage local communities to participate in establishing and managing OECM.

In conclusion, this study shows just how important it is to understand how local communities view ecosystem services when developing conservation and management plans for protected areas. Our findings make it clear that local people still depend heavily on provisioning services for their livelihoods, and that conflicts often arise when access to these resources is restricted without offering viable alternatives. By looking closely at both the practical and cultural importance of ecosystem services, our research fills a gap highlighted at the start: the need to truly consider local perspectives and the less tangible values that ecosystems provide. Ultimately, our results suggest that successful conservation in protected areas depends on a more holistic approach—one that balances protecting biodiversity with supporting community well-being. This means involving local people in decision-making, ensuring fair sharing of benefits through programs like PFES, and using flexible management strategies that respect both ecological and cultural needs.

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REFERENCES

- Alix-Garcia, J. M., Sims, K. R., & Yañez-Pagans, P. (2015). Only one tree from each seed? Environmental effectiveness and poverty alleviation in Mexico's payments for ecosystem services program. *American Economic Journal: Economic Policy*, 7(4), 1-40. <https://doi.org/10.1257/pol.20130139>
- Bontempi, A., Venturi, P., Del Bene, D., Scheidel, A., Zaldo-Aubanel, Q., & Zaragoza, R. M. (2023). Conflict and conservation: On the role of protected areas for environmental justice. *Global Environmental Change*, 82, 102740. <https://doi.org/10.1016/j.gloenvcha.2023.102740>
- Castro, A. P., & Nielsen, E. (2003). *Natural resource conflict management case studies: An analysis of power, participation and protected areas*. Food and Agriculture Organization (FAO).
- Chen, Y., Zhang, Q., Liu, W., & Yu, Z. (2017). Analyzing farmers' perceptions of ecosystem services and PES schemes within agricultural landscapes in Mengyin county, China: transforming trade-offs into synergies. *Sustainability*, 9(8), 1459. <https://doi.org/10.3390/su9081459>
- Cochard, R., Ngo, D. T., & Kull, C. A. (2020). Vietnam's forest cover changes 2005–2016: Veering from transition to (yet more) transaction?. *World Development*, 135, 105051. <https://doi.org/10.1016/j.worlddev.2020.105051>
- Dac Thanh. (2018). *Quảng Nam lo thủy điện tích nước gây động đất [Quang Nam worries that hydroelectric dams will cause earthquakes]*. VNEXPRESS. Retrieved 27 May 2025 from <https://vnexpress.net/thoi-su/quang-nam-lo-thuy-dien-tich-nuoc-gay-dong-dat-3790687.html>
- Do Vinh and Le Huy. (2024). *Khó khăn trong xử lý vấn nạn khai thác vàng trái phép ở Quảng Nam [Difficulties in handling illegal gold mining in Quang Nam]*. VTV News online. Retrieved 27 May 2025 from <https://vtv.vn/vtv8/kho-khan-trong-xu-ly-van-nan-khai-thac-vang-trai-phep-o-quang-nam-20240502120716185.htm>
- Do Vinh. (2023). *Quảng Nam tăng số tiền chi trả dịch vụ môi trường rừng để giảm phá rừng [Quang Nam increases payment for forest environmental services to reduce deforestation]*. VTV News online. Retrieved 27 May 2025 from <https://vtv.vn/vtv8/quang-nam-tang-so-tien-chi-tra-dich-vu-moi-truong-rung-de-giam-pha-rung-20231023180655469.htm>
- Dorji, T., Brookes, J. D., Facelli, J. M., Sears, R. R., Norbu, T., Dorji, K., ... & Baral, H. (2019). Socio-cultural values of ecosystem services from Oak Forests in the Eastern Himalaya. *Sustainability*, 11(8), 2250. <http://doi:10.3390/su11082250>
- Duong Thanh An & Pham Hanh Nguyen. (2021). *Tiềm năng và cơ hội cho bảo tồn đa dạng sinh học ngoài khu bảo tồn ở Việt Nam [Potential and opportunities for biodiversity conservation outside protected areas in Viet Nam]*. *Environment Magazine*. Retrieved from <https://tapchimoitruong.vn/dien-dan--trao-doi-21/te-m-nang-va-co-hoi-cho-bao-ton-da-dang-sinh-hoc-ngoai-khu-bao-ton-o-viet-nam-23254>
- Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological economics*, 68(3), 643-653. <https://doi.org/10.1016/j.ecolecon.2008.09.014>
- Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, 30(1), 441-473. <https://doi.org/10.1146/annurev.energy.30.050504.144511>

- Gouwakinnou, G. N., Biauou, S., Vodouhe, F. G., Tovihessi, M. S., Awessou, B. K., & Biauou, H. S. (2019). Local perceptions and factors determining ecosystem services identification around two forest reserves in Northern Benin. *Journal of Ethnobiology and Ethnomedicine*, 15(1), 61. <https://doi.org/10.1186/s13002-019-0343-y>
- H Quan. (2022). *Quảng Nam có 80 đơn vị sử dụng dịch vụ môi trường rừng [Quang Nam has 80 units using forest ecosystem services]*. Quang Nam Newspaper. Retrieved 27 May 2025 from <https://baoquangnam.vn/quang-nam-co-80-don-vi-su-dung-dich-vu-moi-truong-rung-3019217.html>
- Hoàng, V. C. (2012). *Sustaining conservation of protected areas and local livelihoods in northern Vietnam through collaboration between protected area authorities and local people* [Master's thesis]. The Australian National University.
- Hummel, C., Poursanidis, D., Orenstein, D., Elliott, M., Adamescu, M. C., Cazacu, C., ... & Hummel, H. (2019). Protected Area management: Fusion and confusion with the ecosystem services approach. *Science of the Total Environment*, 651, 2432-2443. <https://doi.org/10.1016/j.scitotenv.2018.10.033>
- Huu Phuc. (2015). *Cửa rừng vẫn mở [The forest gate is still open]*. Quang Nam Newspaper. Retrieved 17 May 2025 from <https://baoquangnam.vn/cua-rung-van-mo-3019888.html>
- IEBR. (2024). *Sách đỏ Việt Nam [Viet Nam Red Book]*. IEBR. Retrieved from <https://iebr.ac.vn/vi/thu-vien/an-pham/sach-do-viet-nam-8.html>
- IUCN. (2008). *Effective protected areas*. IUCN. Retrieved from <https://www.iucn.org/our-work/topic/effective-protected-areas>
- Ivanić, K. Z., Stolton, S., Figureueroa Arango, C., & Dudley, N. (2020). *Protected Areas Benefits Assessment Tool+(PA-BAT+): A tool to assess local stakeholder perceptions of the flow of benefits from protected areas*. IUCN. Retrieved from <https://portals.iucn.org/library/sites/library/files/documents/PATRS-004-En.pdf>
- Kisiwa, A., Langat, K., Gatama, S., Okoth, S., Kiprop, J., Cheboiwo, J., & Kagombe, J. (2020). Community perception of ecosystem services and management implications of three forests in Western part of Kenya. *East African Agricultural and Forestry Journal*, 84(1), 80-90.
- Lam Dong Newspaper. (2024). *Cát Tiên: Xử lý 27 vụ vi phạm Luật Lâm nghiệp [Cat Tien: Handling 27 violations of the Forestry Law]*. Lam Dong Newspaper. Retrieved May 27, 2025, from <https://baolamdong.vn/phap-luat/202401/cat-tien-xu-ly-27-vu-vi-pham-luat-lam-nghiep-7712528/>
- Lan Anh. (2020). *Chuyển khu bảo tồn thiên nhiên Sông Thanh thành Vườn quốc gia [Upgrade Song Thanh Nature Reserve to National Park]*. Environment and Natural Resources Newspaper. Retrieved from <https://baotainguyenmoitruong.vn/quan-g-nam-chuyen-khu-bao-ton-thien-nhien-song-thanh-thanh-vuon-quoc-gia-318323.html>
- Lewis, C. (1996). *Managing Conflicts in Protected Areas*. IUCN. Retrieved from <https://www.cbd.int/doc/pa/tools/Managing%20conflicts%20in%20protected%20areas.pdf>
- McElwee, P. D. (2012). Payments for environmental services as neoliberal market-based forest conservation in Viet Nam: Panacea or problem? *Geoforum*, 43(3), 412–426. <https://doi.org/10.1016/j.geoforum.2011.04.010>
- MEA Millennium Ecosystem Assessment. (2003). *Ecosystems and Human Well-Being: A Framework for Assessment*. Island Press.
- Ministry of Natural Resource and Environment (MONRE). (2023). *National Report on Biodiversity 2022*. MONRE.

- Nam Giang and Phuoc Son District People's Committees. (2019). *Statistical yearbook of Nam Giang and Phuoc Son districts 2019*. Nam Giang & Phuoc Son District Statistics Offices.
- Nguyen Ba Long. (2002). *Kinh nghiệm giải quyết xung đột vùng đệm khu bảo tồn thiên nhiên ở một số quốc gia trên thế giới và Việt Nam [Experiences in Resolving Buffer Zone Conflicts in Nature Reserves: Cases from Selected Countries and Vietnam]*. Vietnam National University of Forestry. Retrieved 17 May 2025 from <https://qldd.vnuf.edu.vn/documents/1465312/2808986/B%C3%A0i%20b%C3%A1o%20Xung%20C%91%20E1%BB%99t%20v%C3%B9ng%20C%91%20E1%BB%87m.pdf>
- Ouko, C. A., Mulwa, R., Kibugi, R., Owuor, M. A., Zaehring, J. G., & Oguge, N. O. (2018). Community perceptions of ecosystem services and the management of Mt. Marsabit Forest in Northern Kenya. *Environments*, 5(11), 121. <https://doi.org/10.3390/environments5110121>
- Phan, T. T., & Nong, D. H. (2024). A Pilot Model of Community-based Forest Management in Xuan Nha Nature Reserve, Son La Province, Vietnam. *Forest and Society*, 8(1), 1–15. <https://doi.org/10.24259/fs.v8i1.27487>
- Phung Thi Quynh Trang. (2022). *Quảng Nam phát triển rừng bền vững nhằm giảm phát thải khí nhà kính và tăng cường trữ lượng các bon rừng [Quang Nam develops sustainable forests to reduce greenhouse gas emissions and enhance forest carbon stocks]*. Environment Magazine. Retrieved from <https://tapchimoitruong.vn/giai-phap-cong-nghe-xanh-22/quang-nam-phat-trien-rung-ben-vung-nham-giam-phat-thai-khi-nha-kinh-va-tang-cuong-tru-luong-cac-bon-rung-26544>
- Plong Thai and Minh Phong. (2024). *6 tháng đầu năm, Phước Sơn xảy ra 12 vụ vi phạm lâm luật [12 cases of forestry laws violations in the first 6 months in 2024 in Phuoc Son district]*. Quang Nam Newspaper. Retrieved 27 May 2025 from <https://baoquangnam.vn/6-thang-dau-nam-phuoc-son-xay-ra-12-vu-vi-pham-lam-luat-3136934.html>
- Pu, X., Ding, W., Ye, W., Nan, X., & Lu, R. (2023). Ecosystem service research in protected areas: A systematic review of the literature on current practices and future prospects. *Ecological Indicators*, 154, 110817. <https://doi.org/10.1016/j.ecolind.2023.110817>
- Quoc Tuan. (2024). *Vườn quốc gia và các khu bảo tồn rừng ở Quảng Nam nhiều vướng mắc cần tháo gỡ [National parks and forest protected areas in Quang Nam: Many problems to be resolved]*. Quang Nam Newspaper. Retrieved 27 May 2025 from <https://baoquangnam.vn/vuon-quoc-gia-va-cac-khu-bao-ton-rung-o-quang-nam-nhieu-vuong-mac-can-thao-go-3131599.html>
- Song Thanh National Park. (2021). *Chuyển hạng Khu bảo tồn thiên nhiên Sông Thanh thành Vườn quốc gia Sông Thanh [Upgrading Song Thanh Nature Reserve to Song Thanh National Park]*. Song Thanh National Park. Retrieved May 27, 2025, from <http://gvgqsongthanh.gov.vn/chi-tiet-tin/group/119/nid/10046/chuyen-hang-khu-bao-ton-thien-nhien-song-thanh-thanh-vuon-quoc-gia-song-thanh>
- Song Thanh National Park. (2024). *Giới thiệu Vườn quốc gia Sông Thanh [Introduction about Song Thanh National Park]*. Song Thanh National Park. Retrieved 27 May 2025 from <http://vuonquocgiasongthanh.qti.vn/gioi-thieu>
- Asah, S. T., Guerry, A. D., Blahna, D. J., & Lawler, J. J. (2014). Perception, acquisition and use of ecosystem services: Human behavior, and ecosystem management and policy implications. *Ecosystem services*, 10, 180-186. <https://doi.org/10.1016/j.ecoser.2014.08.003>
- Tran Nguyen. (2023). *Nâng cao năng lực giữ rừng từ dịch vụ môi trường rừng [Improving forest protection capacity from forest environmental services]*. Quang Nam

- Newspaper. Retrieved June 1, 2025 from <https://baoquangnam.vn/nang-cao-nang-luc-giu-rung-tu-dich-vu-moi-truong-rung-3019077.html>
- Turnbull, J. W., Johnston, E. L., & Clark, G. F. (2021). Evaluating the social and ecological effectiveness of partially protected marine areas. *Conservation Biology*, 35(3), 921-932. <https://doi.org/10.1111/cobi.13677>
- Wang, Y., Yang, H., Qi, D., Songer, M., Bai, W., Zhou, C., ... & Huang, Q. (2021). Efficacy and management challenges of the zoning designations of China's national parks. *Biological Conservation*, 254, 108962. <https://doi.org/10.1016/j.biocon.2021>
- Wangchuk, J., Choden, K., Sears, R. R., Baral, H., Yoezer, D., Tamang, K. T. D., ... & Dhendup, T. (2021). Community perception of ecosystem services from commercially managed forests in Bhutan. *Ecosystem services*, 50, 101335. <https://doi.org/10.1016/j.ecoser.2021.101335>
- Iwanaga, S., Yokoyama, S., Duong, D. T., & Minh, N. V. (2019). Policy effects for forest conservation and local livelihood improvements in Vietnam: a case study on Bach Ma National Park. *Journal of Forest Research*, 24(5), 267-274. <https://doi.org/10.1080/13416979.2019.1655129>