



Comparative Analysis of Conservation Strategies and Outcomes in Simen Mountains National Park (SMNP), Ethiopia and Qianjiangyuan National Park (QNP), China

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Abstract

The comparative analysis of conservation management of Simien Mountains National Park (SMNP) and Qianjiangyuan National Park (QNP) in China provides deductions that can be successfully implemented as conservation strategies and replicated in other protected areas. QNP benefits from a tiered administrative framework with strong provincial leadership and stakeholder collaboration yielding versatile conservation strategies. Effective land-use regulations and zoning have kept more than 81.7% of the 252 km² QNP in China as forest. QNP's formalized zoning of traditional-use areas has decreased conflicts and improved local livelihood integration. The watershed protection and carbon storage have been enhanced as a result of the coordinated reforestation of former farmland. The ecotourism industry has been flourishing at the same time as these measures. The formalization of the local population's living and production areas through QNP's zoning has been crucial in increasing community engagement in park organizing and assisting in striking the right balance between local livelihoods and sustainability. These integrated management techniques have therefore improved the protection of QNP's flagship fauna (such as the black muntjac and white-necked pheasant) and subtropical broad-leaved woodlands. SMNP places equal emphasis on community-led conservation practices. Significant growth can be seen in tourism-related revenue and community beneficiaries rose steadily from about 2500 in 2007 to more than 11,000 by 2016. By 2026, projection models predict that there will be over 19,000 beneficiaries (averaging an income of approximately \$1123). Significant growth in endangered species has accompanied the existing conservation initiatives, for instance, under current administration, the number of Ethiopian wolves and Walia ibex have steadily recovered. However, SMNP continues to deal with

growing rural settlements and customary territorial disputes at its boundaries with grazing and agricultural encroachment (caused by approximately 129,000 livestock units in the region) resulting in the loss of an estimated 33,084 ha of forest by the year 2020. Efficiency gaps have been attributed to SMNP's disjointed administration structure, which is still centralized under Ethiopia's federal wildlife authority, making coordination difficult. The findings of this research study suggest significant implications for practice and policy. This cross-regional comparison of conservation strategies has the potential to inform the evolution of better conservation outcomes of ecosystem management by rallying the implementation of more empirical conservation strategies. Conservation strategies must be tailored locally and aligned with social and cultural factors. However, policymakers in Ethiopia and China can refine conservation strategies by adopting proven practices from each other's experience (for example, integrating QNP's community-zoning approach in SMNP, or expanding SMNP's ecotourism revenue-sharing in QNP).

Subject Areas

Urban and Planning

Keywords

Conservation, Simien Mountain National Park, Qianjiangyuan National Park, Ethiopia, China

1. Introduction

Ecosystems serve as critical components of the natural world, fostering biodiversity and supporting the sustainability of plant and animal life, which sustains human populations. They provide essential ecosystem services such as food, clean water, air, and climate regulation, all fundamental to the well-being of humanity [1]-[3]. However, these ecosystems, some of which harbor unique and endangered species, are under increasing threat from environmental changes and human activities. These threats include climate change, deforestation, poaching, invasive species, and human-wildlife conflicts, all of which have devastating impacts on biodiversity [4]-[6]. Such pressures necessitate urgent conservation actions to protect these vital ecosystems and the species that depend on them.

Protected areas, such as national parks and nature reserves, have long been central to conservation efforts, providing sanctuaries for endangered species and helping to preserve biodiversity in the face of growing human pressures. However, the challenges faced by ecosystems are diverse, and conservation strategies need to be tailored to specific regional and ecological contexts [7] [8]. While biodiversity conservation is a global priority, approaches to conservation often differ across countries and regions. This variation is influenced by unique environmental, economic, social, and cultural factors that shape the way conservation strategies are developed and implemented [9]-[11]. A comprehensive understanding of

these diverse conservation approaches is essential to inform policy-making and enhance the effectiveness of conservation efforts across different geographies.

Numerous studies have explored the strategies and policies implemented to conserve biodiversity in various parts of the world. Research has consistently highlighted the importance of understanding local ecological conditions and community dynamics in formulating effective conservation strategies [12]-[15]. In Ethiopia and China, for instance, national parks like Simien Mountain National Park (SMNP) [16] [17] and Qianjiangyuan National Park (QNP) [18] [19] have become focal points of biodiversity preservation. These parks provide valuable case studies for understanding the effectiveness of protected area management, particularly in regions with unique ecological and socio-cultural contexts.

Existing literature on conservation strategies in Ethiopia and China points to several common themes, such as integrating local communities into conservation activities, the role of ecotourism in providing economic benefits while promoting conservation, and the need for strong policy frameworks to support sustainable management of protected areas. For instance, studies have shown that the involvement of local communities in conservation decision-making can enhance the success of conservation efforts by fostering a sense of ownership and responsibility [16]-[20]. Furthermore, the success of ecotourism as a conservation tool has been well-documented, with several parks leveraging tourism to generate revenue while raising awareness about the importance of biodiversity conservation [21]-[25]. However, comparative analyses of conservation strategies between Ethiopia and China are scarce. Although both countries have made significant strides in establishing protected areas, there remain gaps in understanding these regions' specific challenges and successes. For example, while China has expanded its network of nature reserves, challenges remain in balancing conservation efforts with the needs of local communities and the pressures of rapid economic development [26]-[28]. Similarly, Ethiopia faces challenges related to land use conflicts, poaching, and human-wildlife conflict, which complicate efforts to protect biodiversity in national parks like SMNP [29]-[31]. Thus, a comparative analysis of the conservation strategies employed by SMNP and QNP is crucial for identifying best practices and understanding the complexities of biodiversity management in these two regions.

This study compares the effectiveness of biodiversity conservation strategies in SMNP in Ethiopia and QNP in China, examining their ecological, economic, and cultural dimensions. Its aims are 1) to assess how regional and geographical factors influence conservation outcomes, 2) to identify strengths and weaknesses in current strategies, and 3) to analyze the unique conservation needs and interventions addressing biodiversity fragmentation in both parks. This research advances biodiversity conservation by comparing strategies in Ethiopia's SMNP and China's QNP, examining ecological, economic, and cultural influences. It enriches existing theories and provides practical recommendations for policymakers, conservationists, and local communities. The study aims to enhance conservation effectiveness and contribute to global biodiversity preservation by emphasizing con-

text-specific strategies, community engagement, ecotourism, and adaptive policies.

Research Objectives

Threats to protected areas constantly exist even in the face of formidable policies and conservation strategies. This emergence and evolution of conservation challenges give rise to novel conservation needs which require updated policies and strategies. This research aims to provide a solid understanding of conservation outcomes and challenges of SMNP in Ethiopia and QNP in China. The research aims to address the following objectives:

1. The geographical location and habitat composition necessitate the adoption of conservation strategies specific to the needs of the park. This research compares the existing conservation policies and strategies of SMNP in Ethiopia and QNP in China.
2. As research is an indispensable avenue for evaluation of responses to intervention(s), this research therefore seeks to analyse the effectiveness of different conservation strategies implemented in SMNP in Ethiopia and QNP in China, and their outcomes.
3. Finally, the research compares evolution of conservation strategies in SMNP in Ethiopia and QNP in China to provide insight into how conservation strategies have changed to meet the changing conservation needs.

2. Materials and Method

2.1. Study Area

2.1.1. Simien Mountains National Park (SMNP)

The Simien Mountains National Park (SMNP), located in the northern highlands of Ethiopia, was designated a UNESCO World Heritage site in 1978, following its establishment in 1969. Covering approximately 22,000 hectares, the park is situated at an altitude ranging from 1900 to 4430 meters above sea level [32]. Several towns and natural features, including Zarema town to the north, Debarke town to the southwest, and the Tekeze River basin to the east border SMNP. The park experiences two rainy seasons, from February to March and July to September, with an annual rainfall of approximately 1550 mm and temperatures ranging from -2.5°C to 18°C . The rugged landscape is characterized by precipitous cliffs, deep gorges, and fast-flowing streams, making it an exceptional natural site [33] [34]. This information is provided in **Figure 1**, consisting of a map of SMNP.

Since its establishment, efforts to preserve the biodiversity of the SMNP—particularly the Gelada baboon, Ethiopian wolf, and Walia ibex—have been supported by ongoing collaboration at both international and national levels to manage the park's resources effectively. However, increasing human settlement and land-use changes pose challenges to conservation efforts, particularly in the form of encroachment for agriculture and grazing, leading to conflicts between wildlife and human populations [32] [34] [36]. However, despite decreasing agricultural

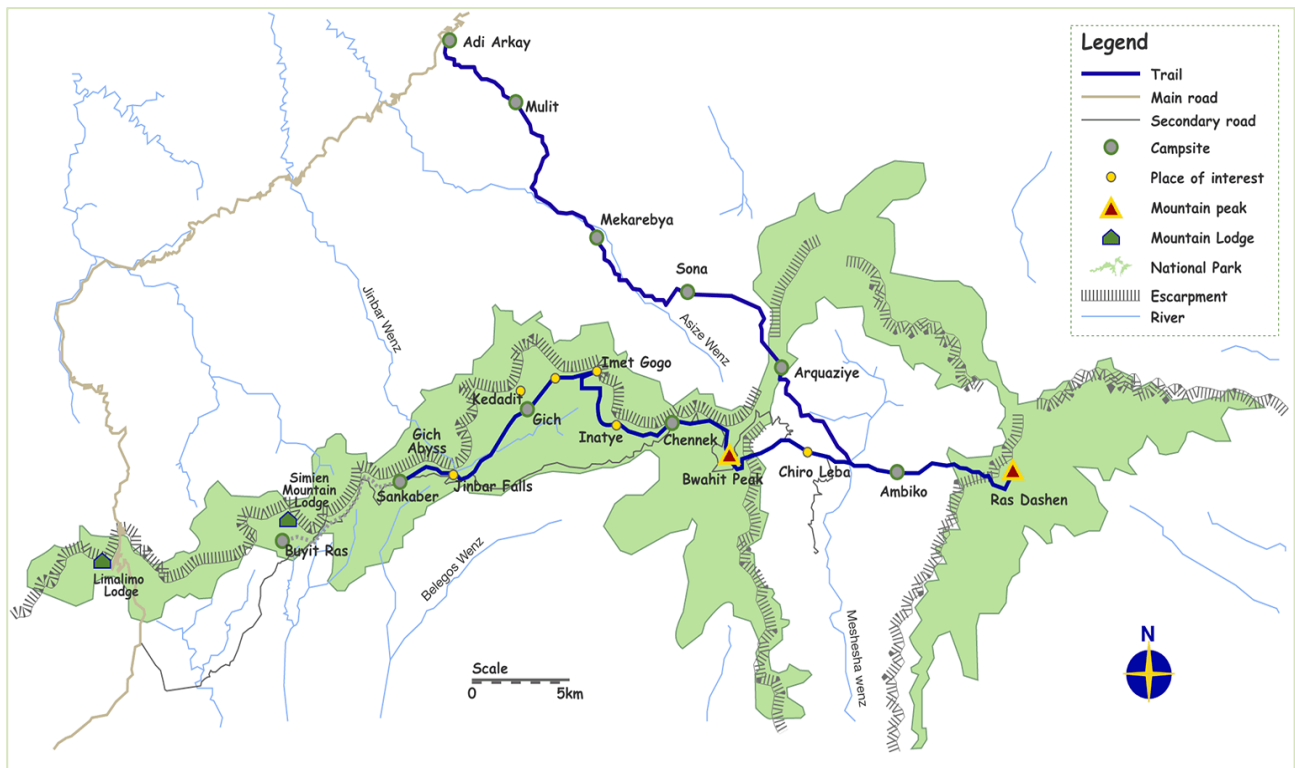


Figure 1. Map showing the location of Simien Mountains National Park [35].

productivity, agriculture remains the primary livelihood for communities near SMNP. The park's designation as a protected area limits livestock grazing and agricultural expansion. However, the growth of eco-tourism has provided alternative income sources for local communities. Tourism has led to job creation, especially in hospitality services such as tour guiding, catering, and crafts, and has improved infrastructure such as roads, healthcare, and accommodation. Notably, over 2000 employment opportunities have emerged in tourism-related sectors, contributing to local economic development [37]. Moreover, demographic data from SMNP in **Table 1** shows a fairly even gender distribution, with a large proportion of the population under 15 years old. Most residents (70%) are engaged in agriculture, and the annual income is low, with a significant portion of the population earning under 2000 Birr annually.

2.1.2. Qianjiangyuan National Park (QNP)

Mountainous areas host exceptional biodiversity due to their isolation and habitat diversity [38]. One such region is Qianjiangyuan National Park (QNP), which is a crucial habitat for the white-necked pheasant and black muntjac, both globally threatened and nationally protected species in China [39] [40]. A map of QNP is presented in **Figure 2**. The map indicates that QNP lies in Kaihua County, China, and spans 252 km² near the Zhejiang, Jiangxi, and Anhui borders. It includes the Gutianshan National Nature Reserve, Qianjiangyuan National Forest Park, and Qianjiangyuan Provincial Scenic Area. Most of the park is forested, protecting endan-

gered subtropical broad-leaved forests. Along with the map, **Table 1** displays that QNP consists of four townships—Suzhuang, Changhong, Hetian, and Qixi—along with one state-owned forest farm and 21 villages, supporting a population of 9744.

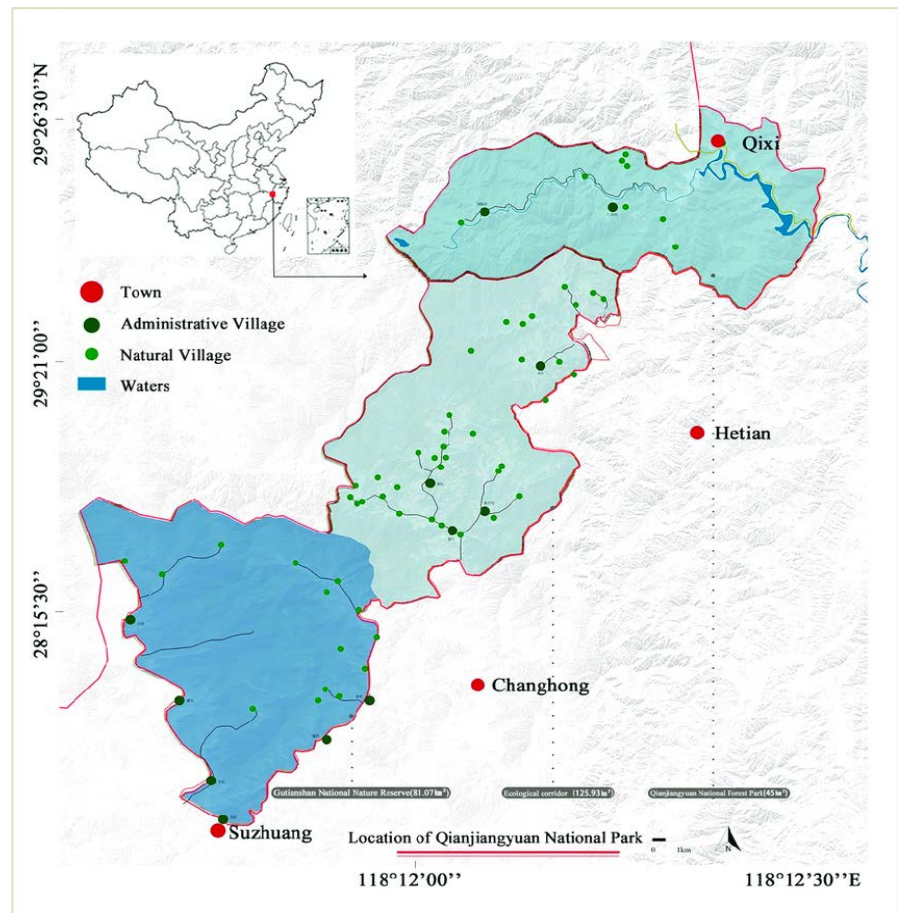


Figure 2. Map showing Qianjiangyuan National Park and nearby towns [41].

Table 1. Table showing basic information about the four towns in Qianjiangyuan National Park.

Town	Village	Population in the QNP	Forestland (ha)	Land (ha)
Suzhuang	7	928	7564.68	8404.89
Qixi	7	1398	7898.14	8433.53
Hetian	3	837	2356.35	2684.73
Changhong	4	3672	4983.64	5768.41

Source: Documents from the Qianjiangyuan National Park management bureau (2021) [18].

The average local income is around 11,000 CNY, which is lower than the county's average of 13,124 CNY [42]. The local communities primarily rely on forestry, farming, tea production, fishing, and cash crops such as rice and corn for their livelihoods. However, declining agricultural land productivity has forced residents to cultivate crops in mountainous areas, leading to deforestation and envi-

ronmental degradation [43]. **Table 2** shows that the population in the QNP area is relatively balanced in gender, with males comprising 50.33% and females 49.67%. The majority of residents are older, with 72.2% over the age of 40. Educational attainment is relatively low, as 80% of the population has only primary or junior high education. Farming remains the dominant occupation, employing 62.58% of the population. Economic challenges persist, with over 41% of residents earning less than 20,000 CNY annually, reflecting the region's dependence on agriculture and limited alternative income opportunities.

2.2. Research Methods

2.2.1. Comparative Approach

Conservation comparative studies assess the relative merits of various conservation strategies. Despite the absence of a control group and a formal experimental design, a comparative analysis study allows for identifying the most helpful intervention(s). Comparative studies take it further by comparing outcomes simultaneously between several conservation strategies [44]. These studies differ from natural experiments in that their interventions result from artificial conservation measures rather than natural ones. Given that several conservation initiatives or implementation methods could be considered, it is crucial to compare various management interventions directly [45]. Consequently, the efficacy rate of management initiatives can be ranked using comparative studies.

According to Smith and Sutherland, comparative analysis helps assess how well conservation efforts work [44]. Analyzing conservation actions can inform us just as much as natural and quasi-experiments. Scientific approaches are favored because they yield more decisive conclusions than any other type of study. However, in conservation, investigations are not always possible [46] [47]. The observation method used in comparative research is successful because it compares many interventions or conservation measures, allowing the evaluation of efficacy rates while contrasting the various outcomes. One advantage of this method is that although a control might be helpful in some cases, it is unnecessary. Additionally, comparative studies examine conservation initiatives already put into practice, facilitating quick understanding and the creation of recommendations.

2.2.2. Systematic Review

The research approach for the comparative analysis of biodiversity conservation strategies in Ethiopia and China combines qualitative and quantitative research methods. The qualitative arm of this study is grounded in a systematic literature review. This method involves a comprehensive and structured examination of existing literature to synthesize knowledge and insights relevant to the study's objectives. Gonçalves *et al.* emphasized the importance of systematic literature reviews in bridging the gap between theoretical intentions and practical implementation in conservation [48]. By analyzing a wide range of publications, this approach allows for a thorough understanding of the current state of biodiversity conservation, the challenges faced, and the effectiveness of various strategies. This

perspective is integrated into the research approach by critically examining scientific literature and identifying hidden assumptions that may influence conservation practices. The review process involves categorizing literature based on themes, methodologies, and outcomes, providing a nuanced understanding of the interplay between scientific research and conservation efforts. Tessnow-von Wysocki and Vadrot demonstrated the importance of a systematic literature review in untangling complex conservation negotiations and linking science, policy, and practice [49]. This approach is particularly relevant for this study, as it aims to bridge the gap between scientific understanding and practical conservation efforts in Ethiopia and China.

2.2.3. Thematic Analysis

The conservation datasets observed between the two national parks underwent analysis using thematic analysis, a widely recognized method in qualitative research. This approach is designed to identify and interpret patterns of meaning within the data, offering insights into the research question(s) under investigation. Thematic analysis is particularly useful for capturing both similarities and differences in data and is guided by systematic steps for coding and theme identification [50]. The process involves an in-depth engagement with the literature, followed by systematic categorization into themes and subthemes. Works such as Guest *et al.* provide practical guidance on applying thematic analysis effectively [51]. Coding techniques were used to find and mark the underlying ideas in the study data. The valid analysis was immensely aided by data displays that are focused enough to permit viewing of a full data set in one location and are systematically arranged to answer the research question at hand. Emergent codes were utilized as opposed to a prior code (pre-set) to give room for ideas, concepts, actions, relationships, meanings, etc. that came up in the data and are different than the pre-set codes. These eventually underwent the refining process by adding, collapsing, expanding and revising the coding categories. Through this deductive analysis, the study aims to provide a comprehensive understanding of the similarities and differences in the protection strategies employed by the two parks.

2.2.4. Remote Sensing and Geographic Information System (GIS)

This method utilizes high-resolution satellite data to capture, store, analyze, and manage spatially referenced data on the Earth. GIS has proven highly effective in conservation investigations, particularly for monitoring land use and land cover changes, such as agricultural encroachments and deforestation. For example, Lu *et al.* discuss the applications of GIS and remote sensing in tracking land-cover dynamics for environmental impact assessments [52]. Additionally, GIS is a vital tool for biodiversity mapping and habitat analysis. It aids in understanding how ecological corridors are maintained within a region and provides a foundation for generating models to assess biodiversity conservation outcomes. Pettorelli *et al.* demonstrated that integrating remote sensing data with GIS offers unprecedented insights into habitat dynamics and biodiversity patterns [53].

3. Evaluation of Conservation Strategies

An interdisciplinary qualitative comparison of the conservation strategies employed in SMNP and QNP was conducted through a comprehensive data synthesis and thematic analysis of the extant literature, integrating concepts and perspectives from ecology, tourism, policy analysis, and community development. As presented in **Table 3**, the qualitative main themes and their associated subthemes

Table 2. Comparative analysis of conservation and development strategies in Simien Mountains National Park and Qianjiangyuan National Park.

Aspect	Simien Mountain National Park	Qianjiangyuan National Park
Biodiversity Conservation	Focus on highland ecosystems, endangered Ethiopian Walia Ibex, and Gelada Baboon.	Focus on temperate forests, lowland ecosystems, White-necked pheasant, and Black Muntjac.
Primary Conservation Goals	Habitat restoration, poaching legislation, ecosystem monitoring.	Habitat restoration, poaching legislation, ecosystem monitoring.
Management Agency	Ethiopian Wildlife Conservation Authority (EWCA) under the federal government.	Zhejiang Provincial Forestry Bureau, with a management committee.
Economic Development	Significant revenue from foreign tourism (90% of total income).	Ecotourism contributes significantly, with major tourism numbers (~1.2 million visitors by 2020).
Revenue Sources	Entrance fees, homestay fees, tourism-related charges.	Entrance fees, tourism activities, with significant income from surrounding agricultural products.
Tourism Benefits	Local residents engaged as tour guides and service providers (estimated average household income: 511 USD).	Major sources of income: tea production, fishing, and cash crops (average household income: 7000 USD).
Climate Change Adaptation	Habitat restoration (e.g., reforestation) and community awareness on climate-friendly practices.	Focus on climate-resilient measures such as reforestation and promoting environmentally-friendly farming.
Research and Monitoring	Research on Gelada baboons, Walia Ibex, and habitat protection.	Comprehensive scientific studies on biodiversity and ecosystem services.
Community Engagement	Local community involvement in conservation but conflict over expanding populations and agricultural needs.	More integrated community involvement with defined living and production boundaries for local residents.
Landscape Connectivity	Focus on creating and restoring corridors, monitoring wildlife migration.	Similar focus on connectivity, including landscape restoration to mitigate fragmentation.
Technology Innovations	Surveillance systems could benefit from GIS and satellite imagery.	Use of GIS, satellite imagery, and modeling for environmental monitoring and decision-making.
Environmental Education	Emphasis on building environmental awareness and sustainable practices in the community.	Environmental education efforts aimed at local engagement and sustainable park management.
Ecotourism Development	Focuses on ecotourism as a key driver of the local economy, emphasizing sustainability, community engagement, and equitable benefit distribution.	Highlights the economic contributions of ecotourism while promoting ecological awareness, sustainability, and the integration of recreational services to enhance visitor well-being.

emerged from this process, providing a framework to categorize and organize the existing conservation strategies of both parks. The findings of this comparison, organized according to the identified themes and subthemes, are summarized in **Table 2**, with a comprehensive discussion provided thereafter.

Conservation in Simien Mountains National Park (SMNP) and Qianjiangyuan National Park (QNP) focuses on preserving unique ecosystems and endangered species. SMNP prioritizes highland ecosystems and species like the Ethiopian Walia Ibex and Gelada Baboon [31] [54], while QNP emphasizes temperate forests and species such as the White-necked Pheasant and Black Muntjac [40] [55]. Both parks enforce poaching laws, restore habitats, and monitor ecosystems. The Ethiopian Wildlife Conservation Authority (EWCA) manages SMNP, strengthening national and regional cooperation, while the Zhejiang Provincial Forestry Bureau oversees QNP. Research-driven policies support conservation, with institutions conducting biodiversity studies and ecosystem monitoring to enhance protected area management [25] [55].

Since its establishment, SMNP has experienced economic growth, with foreign tourist visits averaging 16,000 annually, contributing over 90% of the park's revenue. By 2017, this revenue was projected to exceed USD 53,000, primarily from entrance and homestay fees (**Figure 3(A)**). Incentivized entrance fees for Ethiopian citizens further boost local tourism. Additionally, residents engage in tourism-related activities, such as renting horses and mules, contributing to an average annual household income of USD 511 (**Table 3**). A projection model based on **Table 3** estimates that over 19,000 individuals will benefit from tourism in the next decade, with an expected average income of USD 1123.

China's ecotourism network, including QNP, has also seen significant growth,

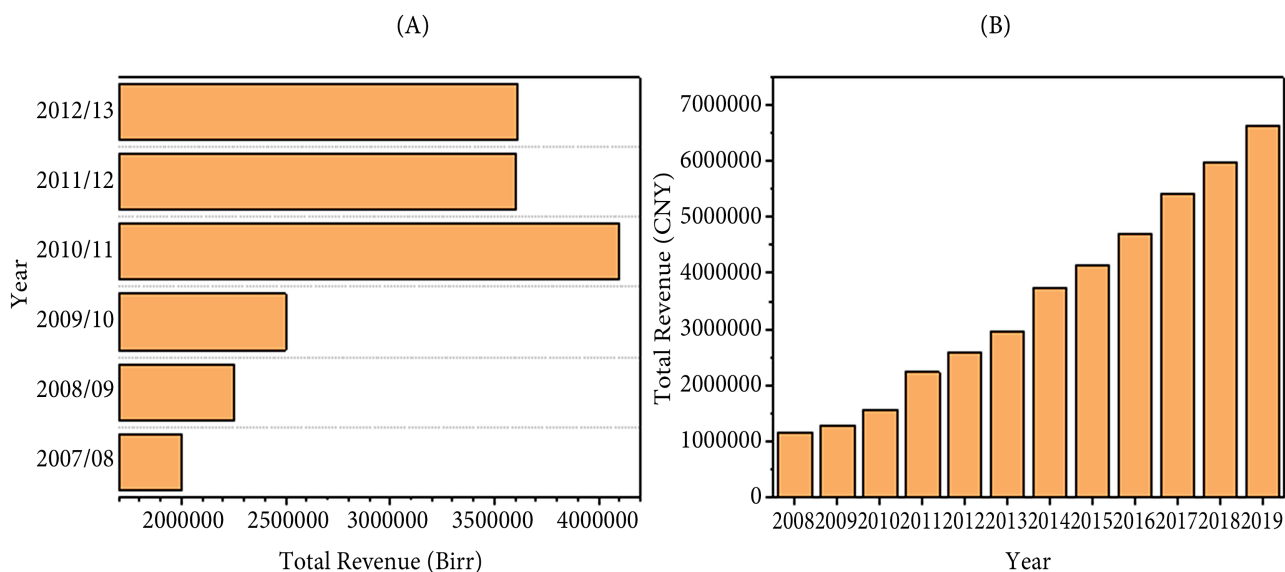


Figure 3. Financial benefits derived from National Park management: (A) total annual revenue for the government and local community from Simien Mountain National Park between 2007 and 2013 [58] and (B) total annual revenue generated from tourism in China between 2009 and 2019 [59].

with tourist numbers reaching 1.2 million in 2020, accounting for 87% of total visits [56]. This contributed to an annual economic value of USD 11.96 million, with most households earning up to 50,000 CNY (USD 7000), while less than 2% earn over 3.1 million CNY (USD 430,000) (Table 3). Unlike SMNP, QNP communities rely on tea production, fishing, and cash crops as primary income sources. Figure 1 illustrates the upward trajectory of tourism-related revenue in China [56] [57].

Table 3. Simien Mountain National Park tourism beneficiaries and related community and average incomes.

Year	No of Beneficiaries	Community Income (USD)	Change (%)	Average Income (USD)
2007	2527	1,161,992	-	460
2008	2663	2,060,200	77.30	562
2009	4937	2,523,484	22.49	511
2010	6102	4,127,423	63.56	676
2011	7693	4,482,860	8.61	583
2012	7565	4,710,999	5.09	657
2013	8426	5,292,111	12.34	690
2014	9287	5,873,223	10.98	724
2015	10148	6,454,334	9.89	757
2016	11009	7,035,446	9.00	790

Source: Simien Mountain National Park Tourist Registry Book [37].

Global temperature changes are a major natural factor contributing to ecosystem degradation in both SMNP and QNP. Climate-resilient measures, including habitat restoration through reforestation and climate-friendly agricultural practices, are implemented to mitigate destabilization. However, differences in conservation approaches are expected due to variations in geography and climate [60]. In addition, research and monitoring play a crucial role in policy formulation and adaptation. Studies on gelada baboons, Walia ibex, and habitat protection have been conducted, with bibliographies documented by Schaerer and Hürni *et al.* [61] [62]. A comprehensive study of SMNP's flora and fauna was completed in 1998 [63]. County authorities closely monitor population growth and agricultural incursions, while the QNP administration collaborates with scientific research institutes to evaluate biodiversity, ecosystem functionality, and landscape connectivity [64]. This has led to the establishment of multiple monitoring platforms to assess conservation outcomes and challenges in QNP's subtropical biodiversity, including forest dynamic sample plot monitoring, whole-park animal diversity monitoring, and remote sensing monitoring, to assess conservation outcomes, address challenges in subtropical biodiversity, and enhance ecological connectivity [65].

Both parks emphasize community participation in conservation but differ in engagement due to socioeconomic and environmental factors, often leading to

conservation requiring local cooperation, with Ethiopia's model granting park administrations legal control despite customary land claims. Communities assist in conservation but lack decision-making power, and conflicts arise between conservation goals and subsistence farming needs [66]. Trained community guards support monitoring and education on sustainable practices. In China, QNP integrates local communities through designated living and production zones, balancing conservation with economic development [64]. Functional zoning (Figure 4) clarifies land use, promoting sustainable livelihoods and eco-friendly livestock production. Community involvement in planning and management is crucial for long-term conservation success [55].

Efficient conservation views biodiversity reserves as interconnected landscapes rather than isolated areas. SMNP and QNP rely on landscape connectivity to sustain ecosystems, enhance adaptation, and support species dependent on external resources. Strategies include corridor creation, wildlife migration monitoring, and sustainable land use to reduce fragmentation [67] [68]. Technological advancements support conservation in QNP, where GIS, satellite imagery, and modeling assess habitat degradation, erosion, and deforestation [41] [69]. Similar surveillance systems must be fully implemented in SMNP to achieve comparable conservation outcomes.

Environmental education plays a vital role in engaging communities in conservation by promoting environmentally friendly practices and fostering stewardship of natural resources. Although education strategies may differ between the two protected areas, the goal is to create communities committed to sustainable management of their environment [43] [70]. On the other hand, ecotourism development is seen as a means to boost local economies by attracting tourists to national parks, benefiting both developed and developing nations. While both parks utilize ecotourism as a tool for sustainable development, SMNP focuses on community engagement and equitable benefit distribution [71], whereas QNP highlights the synergy between recreational services and visitor well-being. Both models offer valuable insights into the multifaceted role of ecotourism in conservation and community development.

While both parks employ ecotourism as a tool for sustainable development, SMNP emphasizes ecotourism as a key driver of the local economy, focusing on sustainability, community engagement, and equitable benefit distribution [71]. In contrast, QNP highlights the significant economic contributions of ecotourism while promoting ecological awareness, sustainability, and the integration of recreational services to enhance visitor well-being [41]. Both models provide valuable insights into the diverse role of ecotourism in conservation and community development.

4. Comparison of Protection Strategies in Simien Mountain National Park and Qianjiang National Park

Conservation strategies have evolved over decades, necessitating research to in-

form policies, theories, and practices in ecosystem management. The geographic and cultural differences between Ethiopia's SMNP and China's QNP enable a thematic comparison of modern conservation approaches and their outcomes. This analysis enhances understanding of ecosystem-human interactions, providing a foundation for evidence-based conservation management. Key implications include informed decision-making, community engagement, and functional zoning to optimize protected area management.

4.1. Similarities and Differences in Approaches, Policies and Results

Protected areas like SMNP and QNP use different conservation approaches shaped by governance, community involvement, and environmental challenges. While both aim to protect biodiversity, SMNP struggles with weak enforcement and human-wildlife conflicts, whereas QNP benefits from structured management and local community integration. **Table 4** highlights key similarities and differences in their protection strategies, which are discussed later.

Table 4. Comparison of protection strategies in Simien Mountains National Park (SMNP) and Qianjiang National Park (QNP).

Category	Similarities	Differences	
		SMNP	QNP
Management Structures	Both parks aim to conserve biodiversity and protect threatened species.	Managed primarily by EWCA, under the Ministry of Culture and Tourism. No autonomous administrative body.	Well-organized administrative framework extending from federal to park level, with the provincial government overseeing management.
Community Engagement	Both parks establish conservation zones and buffer areas to protect ecosystems.	Limited community involvement, minimal traditional conservation initiatives and a lack of incentives for local populations.	Strong emphasis on integrating conservation with cultural heritage and community development. Functional zoning allows for community participation.
Ecotourism	Both parks promote ecotourism as a conservation strategy.	Ecotourism is not well integrated with conservation aims, leading to imbalances.	Community-based tourism initiatives actively involve locals as guides and educators, fostering community engagement.
Effectiveness of Protection Strategies	Both parks implement conservation strategies to enhance biodiversity protection.	Challenges include overgrazing, deforestation, and conflicts with local populations. Relocation efforts have faced sustainability issues.	Functional zoning supports biodiversity protection, land-use regulation, and ecosystem restoration.
Threats to Conservation	Both parks face threats from habitat destruction, human activities, and governance challenges.	High rates of deforestation, grazing pressure, and human-wildlife conflict due to weak enforcement of conservation policies.	Land-use conversion strategies, such as restoring farmlands to forests, have strengthened environmental regulatory services.

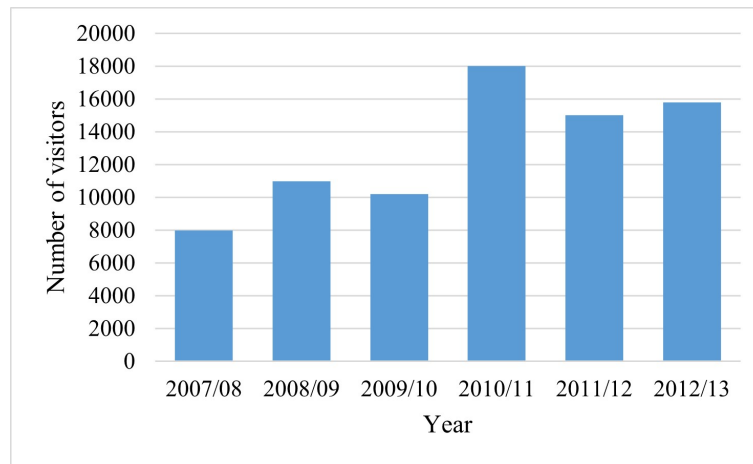
The management of SMNP and QNP is shaped by geography, habitat composition, and national conservation policies, leading to differences in administrative frameworks. SMNP's governance involves national agencies like EWCA, the Ministry of Culture and Tourism, NGOs, and local communities, though it lacks an

autonomous administration [54] [72]. Park rangers under EWCA enforce conservation laws, but weak stakeholder cooperation hinders effective biodiversity protection. In contrast, QNP operates under a structured system where the provincial government leads conservation efforts, with a dedicated administrative committee enforcing regulations. Both parks share conservation goals, protecting species like the Ethiopian Walia Ibex and China's Black Muntjac [54], though QNP prioritizes forest ecosystems in its management plan [73]. Strengthening local administrative capacity and fostering stakeholder collaboration are crucial for improving conservation outcomes.

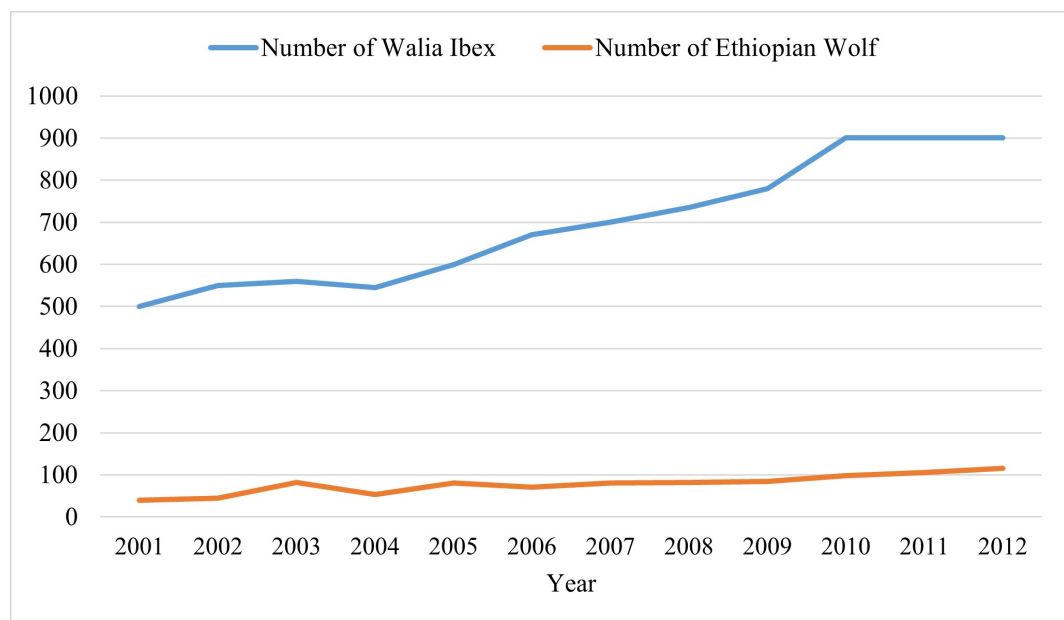
Effective conservation should balance ecosystem preservation with community livelihoods and cultural heritage. QNP integrates conservation with cultural preservation and community development, using a zoning system to manage reserves, restricted-use areas, and tourism zones. This system aids in regulating land use and mitigating landscape disruptions. Conservation easements further protect communal land from misuse during reallocations. In contrast, SMNP, though it designates core and buffer zones, lacks a structured conservation strategy. While involving locals as tour guides fosters a sense of ownership, enforcement prioritizes ecosystem conservation over community needs. Limited traditional conservation initiatives and minimal community incentives highlight the need for a more inclusive, flexible approach that integrates social, cultural, and ecological dimensions [17] [73].

Recent initiatives, including partner projects, capacity building, and EWCA funding, have strengthened SMNP's workforce, employing over 90 personnel annually, including scouts, wardens, and ecologists [74]. The engagement of multiple stakeholders enhances collaboration in conservation efforts. Tourism has significantly contributed to SMNP's revenue, with visitor numbers rising from 14,016 in 2010 to 17,566 in 2011, reaching a 46% increase by 2014 [74]. Improved infrastructure, security, and private sector involvement have further boosted park management and local income. Despite strict conservation efforts, endemic species such as the Walia Ibex, Gelada Baboon, and Ethiopian Fox remain threatened, though their populations show positive trends (Figure 4(A)) [75]. Deforestation and land-use change remain critical challenges. Between 1984 and 2020, approximately 33,084 hectares (31%) of forest were lost, with an annual deforestation rate of 1.02% [76]. Livestock overgrazing, linked to 129,270 tropical livestock units, exacerbates land degradation [74]. While relocations aimed to mitigate human impact, they have led to unintended socio-economic consequences, including food insecurity among displaced communities [77]. Addressing deforestation, enforcing conservation policies, and expanding reforestation efforts are crucial for long-term ecological sustainability.

The protection strategies implemented in QNP have enhanced environmental regulatory capacity through land-use initiatives such as converting farmland back to grassland and woodland. Functional zoning is a key conservation strategy facilitating ecosystem protection while promoting sustainable land use. This zoning



(A)



(B)

Source: SMNP Office.

Figure 4. Trends in tourism growth and wildlife population in SMNP: (A) Changes in the number of tourists in SMNP between 2007 and 2013 [78] and (B) Walia Ibex and Ethiopian Wolf population trend from 2001 to 2012 [78].

system reduces conflicts over resource exploitation, supports biodiversity conservation, and ensures sustainable tourism and scientific research opportunities [79] [80]. QNP's functional zoning contributes to water and soil preservation, carbon sequestration, and forest regrowth, benefiting biodiversity and ecosystem integrity. However, optimizing the extent of biological conservation zones and traditional land uses would enhance the park's conservation effectiveness. The zoning system allows for environmental education, research, and community development, further strengthening conservation efforts [57].

Ecotourism is a key conservation strategy in both parks, promoting sustainable

development through revenue generation, infrastructure improvement, and environmental awareness. QNP has successfully integrated community-based tourism, engaging locals as guides and educators, strengthening park-community relations, and fostering a sense of ownership. In contrast, SMNP exhibits an imbalance between tourism and conservation, highlighting the need for strategic management to optimize ecotourism benefits. Differences in biodiversity, management structures, and cultural significance influence the effectiveness of ecotourism in both parks [17] [81]. Effective implementation requires expertise and structured administration to maximize conservation gains.

Ecotourism is a central strategy in QNP, supporting sustainable tourism growth and economic development. In 2015, tourism in natural areas reached 795 million visitors, increasing by 11.97% from previous years, contributing significantly to GDP and generated over 800,000 jobs [82]. Ecotourism complements conservation by funding protected areas, reducing land-use conflicts (e.g., logging), and creating employment opportunities for local communities. It also fosters environmental awareness and cross-cultural knowledge exchange, enhancing public understanding of conservation issues [83]. Landscape connectivity is crucial in species conservation, particularly as climate change alters species distributions. Enhancing connectivity supports species persistence and biodiversity by facilitating mobility across habitat patches. Ongoing surveillance and scientific research in QNP provide valuable insights into species conservation. For instance, infrared monitoring has improved the understanding of black muntjac distribution, while ecological studies have linked factors such as altitude and water availability to long-tailed pheasant habitats [84]. Additionally, studies using dynamic forest monitoring platforms have revealed that topographical factors, such as altitude and slope, influence the reproductive capacity of broad-leaved forests as they mature [85]. These findings emphasize the importance of evidence-based conservation policies in modern national park management. Strengthening research, adaptive management, and policy optimization will be essential in improving the effectiveness of QNP's protection strategies.

Local governments, NGOs, cooperatives, park management, EWCA, and local communities are some of the players participating in the operation of SMNPs in Ethiopia [72] [86] [87]. The overall administration of the SMNP lacks distinct, autonomous administrative institutions [88]. Historical power was centralized, agency and donor initiatives (park expansion, relocations, and protected-area finance) set the agenda. The past few years have seen a modest shift toward local involvement via ecotourism projects, but legacy imbalances (land disputes, unequal revenues) still exist. These dynamics yielded tangible biodiversity gains (endemic species rebounding) but have left some communities resentful and only partially integrated into park planning [36] [89]. In contrast, QNP exemplifies China's top-down yet "whole-society" park model. Government agencies hold decisive power, but by design they have co-opted communities through jobs, contracts, and shared branding. This has aligned conservation with rural development; village incomes and infrastructure have improved markedly while ecosys-

tems enjoy strict protection [90]. The Chinese model still subordinates local decision-making to state plans, but the outcomes so far show fewer community conflicts than in Simien.

Overall, the power structures affect outcomes in each park. Where SMNP's governance put wildlife first at the expense of community agency, it achieved WWF-recognized conservation success but at socio-political cost. QNP's governance put a strong government hand on the tiller of participatory rhetoric, achieving both environmental and social goals more concurrently. In both cases, dominant power (state agencies) has steered the park's fate, but the Chinese approach built in mechanisms that deliberately redistributed influence and benefits, whereas the Ethiopian approach only belatedly conceded local participation. These contrasts have tangible impacts on sustainable tourism (benefit-sharing and visitor policy) and on how community welfare is tied to conservation. In short, smaller, more cooperative stakeholder roles in QNP have fostered a balance of biodiversity and development outcomes, while SMNP's more hierarchical power dynamics have yielded strong species recovery but uneven community gains.

Both SMNP and QNP exhibit indigenous knowledge and traditions, able to reinforce conservation strategies if rightly esteemed, but that conservation policies often collide with customary land use. The administration in both national parks have endeavored to blend local practices, with SMNP's grazing strategy shaped by community mapping, and QNP unequivocally framing folk taboos (Fengshui, festivals) as conservation asset [65]. QNP leverages indigenous norms to prevent logging and overharvesting. For example, the annual Gutian Seedling Protection Festival mobilizes communities to plant seedlings and guard forests, reinforcing collective stewardship. In each case, engaging local people through jobs and information-sharing has built trust (such as employing village rangers in QNP and using community guides in SMNP) [65] [91].

Notwithstanding, conflicts also ensue. SMNP's local communities such as those from Gich were relocated without consultation, demonstrating how top-down policies strained indigenous rights [89]. Similarly, QNP's relocations (though coupled with compensation) have challenged traditional community life [65]. The Chinese government has implemented conservation easement policies in QNP and encouraged the isolated local communities to relocate to nearby towns. Compensation is offered, but relocation has largely been viewed as a disruptive undertaking to disruption in ancestral ties, with the potential to erode propagation of native heritage and ancestral ties. Additionally, a sect of the local population tends to perceive new regulations (e.g., limiting timber or non-timber harvest) as threats to long-practiced rights. In particular, QNP's approach comprehensively validates cultural customs in conservation policy, whereas SMNP has but recently embraced the inclusion of traditional conservation knowledge in its conservation policies. These cases underscore the value of recognizing and formalizing cultural practices (from sacred groves to communal festivals) to align conservation with community values, but that without genuine participation even well-intentioned

policies can spark resistance [65] [89].

4.2. Practical Implications for Conservation Management and Policy: Tailored Approaches for Effective Conservation Outcomes

The comparative analysis of conservation strategies in SMNP and QNP highlights the need for tailored approaches to address each park's unique conservation challenges. While both parks implement functional zoning and community involvement, SMNP faces difficulties with decentralized management and community cooperation, necessitating more adaptive strategies. Xu and Xu J and Melick D emphasize the benefits of strong institutional structures and stakeholder collaboration in achieving effective conservation outcomes [92]. This underscores the importance of strategic conservation planning that leverages existing frameworks for improved management efficiency. In addition, community involvement in conservation management is a global priority, not just for SMNP and QNP. Both parks have policies for community engagement, reinforcing their role in fostering ecosystem stewardship and reducing human-wildlife and administrative conflicts. However, engagement levels and strategies vary due to park designation, local education levels, cultural values, and socio-economic conditions. As noted by Pimbert and Pretty and Wild and Mutebi, effective conservation strategies must remain flexible and adopt mutualistic approaches that respect and integrate community needs and cultural sensitivities [93] [94].

This analysis highlights the need for adaptive management strategies as conservation challenges evolve. Key threats include climate change, human-wildlife conflicts, and ecosystem fragmentation, emphasizing the importance of continuous monitoring and policy flexibility. Policies should address emerging threats and seize opportunities to enhance conservation outcomes. Stakeholders must be well-equipped to implement these strategies effectively. The study also underscores the value of endogenous frameworks, revealing variations in stakeholder involvement and policy enforcement, reinforcing the need for conservation approaches tailored to each protected area. Hence, effective conservation, like all other public endeavors, requires a multisectoral approach, engaging stakeholders from policy formulation to implementation [95] [96]. International collaboration has proven beneficial in cases like SMNP. Global governing bodies, academic institutions, and NGOs can enhance monitoring, scalability, and capacity building. Mutual collaboration in resource sharing and policy development strengthens conservation efforts.

Conservation policies must address the unique challenges of each protected area. Effective policy formulation guides conservation strategies, ensuring adaptability and impact. This comparative study evaluates existing policies, informing their evolution, implementation, and effectiveness. Given the differences in geography, management, and culture between SMNP and QNP, tailored policies aligned with conservation objectives are essential. Therefore, national policies should provide a broad framework, allowing flexible, autonomous management

to accommodate ecological and socio-economic contexts. Locally driven policy formulation fosters stakeholder engagement, community co-management, and culturally sensitive conservation approaches [97] [98].

Implementation and enforcement determine policy effectiveness. Well-structured, adequately funded institutions should oversee policy execution, collaboration, capacity building, and accountability. Sustainable funding from governments and park revenues ensures institutional effectiveness. Regular training, community sensitization, and skill enhancement programs strengthen conservation management. Monitoring and research are crucial for assessing conservation outcomes and addressing emerging challenges. Evidence-based policies require investment in exploratory research, biodiversity data analysis, and socio-economic studies [99] [100]. Governments and park management should support research institutions to ensure conservation strategies remain dynamic and effective.

5. Conclusions and Recommendations

This comparative analysis of conservation management in SMNP and QNP offers valuable insights that can inform successful strategies for other protected areas. The findings emphasize the importance of integrating community-based initiatives, as seen in QNP, and suggest that SMNP requires enhanced stakeholder involvement. The study underscores the need for adaptive, evidence-based conservation strategies that address the unique needs of each park, contributing to long-term ecosystem management. A multisectoral, holistic approach to conservation, focusing on community ownership and stewardship, is essential for effective management. Understanding the relationship between tourism and conservation is key to developing sustainable ecotourism that benefits biodiversity and local communities. The research advocates stronger monitoring and evaluation systems to assess conservation outcomes and guide policy adjustments.

The study lays the ground for knowledge contribution to address the gaps in knowledge in the field of conservation management. The research study therefore forwards the following recommendations to address the ever-changing and emerging conservation challenges.

1. Administration of the SMNP has been massively centralized under the EWCA, lacking local administrative structures. The government can improve upon the administrative structure through the establishment of a more decentralized management framework, which may consist of local government officials, NGOs and representatives of the community. For instance, local capacity and legitimacy can be encouraged through deliberate creation of park management board or conservancy council with recognized roles for cooperatives, local elders, NGOs and local elders. For QNP, which already has recognized tiered administrative structures, the Zhejiang Forestry Bureau can go a step further and designate roles through the official inclusion of village based councils in the decision-making framework. Both national parks should embrace an adaptive management system, with periodical reviews and updates to policies with

stakeholder consultation.

2. Local communities are heavily impacted by policies, as such it is paramount that the needs and knowledge of the local communities are integrated in conservation strategies. Therefore, SMNP should address the escalating conflicts arising from expanding settlements and loss of arable land by putting in place community-centered natural resource programs. Tangible steps may include the formation of cooperatives to superintendent over buffer-zone pastures, and shared revenue from tourism to support local community projects. Local communities are likely to adopt sustainable practices (such as rational grazing, agroforestry, etc.) if conservation awareness and skills among the locals are enhanced. This can be achieved through funding of awareness campaigns and education, for example, periodic workshops and school programs. The exemplified community integration in QNP can further be enhanced by sustaining the zoning system through the formalization of “community parks” or easements on collective land in order for local communities to have usage rights under conservation conditions.
3. Tourism provides myriad economic benefits and opportunities, and should thus be managed to protect biodiversity. Investing in green facilities and setting limits on the number of visitors during sensitive seasons is one of the many ways the governments can encourage this outcome. Training programs for local guides and hoteliers, supported by NGOs or tourism boards, can ensure high-quality, conservation-oriented services. Deliberate policy should be put in place for the redistribution of park revenue (for example, 20%) into community projects and park conservation. Programs that directly involve local communities (such as homestay networks, cultural performance groups, craft/curio cooperatives) will distribute benefits broadly. The two national parks should consider certification of tour guides and operators, as well as conducting periodic audits of the impacts of tourism, in order to align economic development and conservation goals.
4. In SMNP, the research recommends authorities and NGOs scale up anti-poaching patrols (training and equipping ranger teams) and install camera traps along wildlife corridors to monitor populations. Habitat restoration is also needed, for example, reforesting degraded slopes and enforcing limits on cultivation within park boundaries. The Arkuase Corridor project (UNESCO-assisted) could be replicated to connect fragmented subpopulations. In QNP, the park’s grid-based monitoring (with drones and infrared cameras) is a best practice that can guide adaptive management; similar technology should be piloted in SMNP. QNP officials should ensure that core forests and wetlands have strict no-logging status, and launch reforestation of areas degraded by past overharvest. In both parks, governments must promote research partnerships: partnering with universities and international conservation groups to conduct biodiversity surveys and model climate impacts. Research findings should inform regular updates of management plans.

Conflicts of Interest

The authors declare no conflicts of interest.

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