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Revealing Changes in the Management Capacity of the Three-River-Source National Park, China: An Application of the Best Practice-Based Evaluation Method

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Abstract: Management evaluation is increasingly required for national parks worldwide as it is an essential mechanism for improving management levels and achieving management objectives. The management capacity evaluation (MCE), an integral component of management evaluation, emphasizes the suitability of management measures. It helps identify the deficiencies in existing management measures and form feedback to improve them, thus increasing the overall management level of national parks. However, the existing MCE methods from international programs suffer from limited adaptability and are difficult to promote in other countries. In this research, we apply the best practice-based (BPB) method to the Three-River-Sources National Park (TNP), the first national park in China, to reveal the changes in its management capacity during the pilot period. The BPB method is new compared with other MCE methods, but is more adaptable to the current situation of China's national parks. Results show that TNP's comprehensive management capacity and the five aspects of management capacities improved effectively, which means the management measures adopted during the pilot phase were generally appropriate and practicable. Some management capacities, such as management organization, legal system construction, management planning, and natural resources confirmation and registration performed well or improved significantly during the pilot period, providing beneficial lessons for other national parks in China. Some management capacities, such as the ecological compensation scheme, monitoring and early warning system, and management team, are still deficient and should be prioritized for future improvement. The effectiveness and operability of the BPB method are validated in this research, as it provides a rapid and accurate diagnosis of TNP's management capacities and useful feedback for improving them. We submit that the BPB method not only contributes to the theoretical improvement of MCE methods, but also shows wider adaptability to different protected area types and countries.

Keywords: management capacity evaluation; management measures; national park; protected area; best practice; indicator system; Three-River-Source National Park

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1. Introduction

Protected areas (PAs) are defined as an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, managed through legal or other effective means [1]. They are of great significance in mitigating biodiversity loss, maintaining the crucial services provided, enhancing community health, and safeguarding national ecological security [2–4]. Since the first protected area was established in 1956, China built a system of PAs covering forest, grassland, wetland, marine, and desert ecosystem types, aiming to preserve rare and endangered species, natural relics, and natural landscapes [5]. As of 2018, there are more than 10 types of PAs in China, with more than 11,800 sites, covering a total area of about 18% of the land area and 4.6% of the sea area [6,7]. However, due to the unclear rights and responsibilities, the replication of administrative efforts, and the fragmentation of conservation expertise, these PAs suffer from varying degrees of management inefficiency [8]. To this end, China conducted the institutional reform in March 2018, and established a new protected area system comprised of three types: national parks, nature reserves, and natural parks [9].

National parks, comprising areas that showcase ecosystems characteristic of China, are defined as the mainstay of this new protected area system. National parks are important components of the global protected area system, not only having the function of providing high-quality ecological products, but also providing human society with public services, such as research, education, and recreation [10–12]. Since the Yellowstone National Park was established in the U.S. in 1872, more than 200 countries around the world participated in the construction of national parks, and a great amount of financial and non-financial resources are continuously invested in their construction [13]. However, it is increasingly questioned whether the input of various resources enhanced the management capacity and effectiveness of national parks and whether the management objectives of national parks were achieved as expected. Since the fourth World Parks Congress in 1992, these issues are featured prominently on the national park management agenda and became common concerns [14]. China also confronts these questions in the construction of national parks. Ten national park pilots were established since 2016, and the first batch of five national parks was officially recognized in October 2021 at the 15th meeting of the Conference of the Parties (COP15) to the United Nations Convention on Biological Diversity. During this period, the construction of national parks received extensive attention from governments at all levels, as well as obtained strong policy support and a large amount of capital and technology investments. However, whether and to what extent these investments improved the management capacity and efficiency of the national parks is not credibly answered.

In the management of PAs, management evaluation is recognized as an important mechanism to improve management practices, promote transparency for reporting, and create proper accountability [15]. International attention was drawn to the management evaluation of PAs since the 1970s [14]. After nearly 50 years of development, a composite management evaluation system that includes evaluations of effectiveness, capacity, threats and stresses, impacts, and biophysical characteristics was established [13,16–19]. The most widely used management evaluations are the management effectiveness evaluation and the management capacity evaluation. The management effectiveness evaluation (MEE) primarily refers to the responsiveness of management results to desired objectives [14,15]. The management cycle-based evaluation framework proposed by the International Union for Conservation of Nature (IUCN) became the cornerstone of a series of MEE methods. Several of these methods, such as rapid assessment and prioritization of protected area management (RAPPAM), the management effectiveness tracking tool (METT), and enhancing our heritage (EOH), are widely used in many PAs around the world [20–24]. MEE tends to reveal the effectiveness of management and conservation by measuring changes in the state of PAs, therefore being more applicable to mature PAs and mainly being used to make comparisons between PAs. Compared to MEE, the management capacity evaluation (MCE) focuses on the suitability of management measures, that is, whether management measures respond effectively to management needs [25]. The Parks in Peril Program, initiated by The Nature Conservancy (TNC), evaluates the management capacity of national parks from the perspectives of primary conservation action, long-term management, financial support, and local guarantee. This method was applied in 17 countries in Latin America and the Caribbean [26,27]. The Proyecto Ambiental Regional de Centro America program (PROARCA) proposed an MCE method with an indicator system comprised of social relations, administration, natural and cultural resources, political law, and finance. This method was applied in Panama, Honduras, El Salvador, Nicaragua, Guatemala, and Costa Rica in Central America [28]. MCE helps diagnose the soundness of management practices in an individual PA and is often used in the early stage of the PA's construction.

China started management evaluation practices in the 1990s, focusing on the MEE of nature reserves. Xue and Zheng explored the indicators and standards of MEE for nature reserves in China, and proposed an indicator system containing management conditions, management measures, a scientific research base, and management effectiveness [29]. Since then, several mature international methods were introduced to China, of which RAPPAM and METT are widely used. According to incomplete statistics, by the end of 2019 there were 2081 nature reserves with a total area of 1,238,500 km^2, which accepted MEE, accounting for 66.37% of the total PAs in China [30]. In addition, the management authorities developed specifications for the MEE of nature reserves, such as the *Technical regulations for the management effectiveness evaluation of nature reserves (LY/T 1726-2008)* and the *Standard for assessment of nature reserve management (HJ 913-2017)*. At this time, a mature MEE evaluation system for China's nature reserves is formed. However, due to the differences in conservation objectives and management needs, the existing MEE methods of nature reserves cannot be directly applied to national parks. Furthermore, the national parks of China are at the early stage of construction, so the MCE that emphasizes the suitability of management measures is more appropriate for them. It will help identify the deficiencies in existing management measures, improve the management processes, and increase the overall management level of national parks. Although the existing MCE methods from international programs can provide some references, their indicator systems and evaluation standards lack wider adaptability, making them difficult to promote in other countries, such as China.

In this research, we apply the best practice-based (BPB) method to the Three-River-Sources National Park (TNP), the first national park in China, aiming to reveal the changes in its management capacity during the pilot period. The BPB method summarized the best practices of national park management in different countries and proposed an indicator system and a set of evaluation standards for evaluating the management capacity of national parks, therefore having wider adaptability and a larger potential for promotion [31]. Compared with other MCE methods, this method is more adaptable to the current management situation of China's national parks, and is able to quickly identify the shortcomings in the management and the gaps at the international best level. However, the BPB method was rarely applied since it was proposed. Thus, its effectiveness and operability are lacking in validation. We submit that this research will not only help improve the management capacity of TNP and provide guidance for the management of other national parks in China, but will also test and validate the BPB method and contribute to the theoretical innovation and improvement of MCE methods.

2. Materials and Methodology

2.1. Best Practice-Based (BPB) Evaluation Method

As mentioned earlier, the MCE is an important component of protected area management evaluation and is particularly essential for current national park management in China. However, the existing MCE methods from international programs suffer from limited adaptability and are not well suited to the management needs of China's national parks. To this end, we apply and test the BPB method proposed by us in 2019 [31]. The most important feature of this method is that the evaluation indicators and standards are selected and determined based on the best practices of existing national parks in the world. To design the indicator system, we firstly made a systematic review of national park management practices in various countries, such as the U.S., Canada, the U.K., South Africa, Japan, South Korea, and Argentina, and obtained a summary of the best practices in worldwide national parks. Then we developed an indicator system with a total of 18 indicators in the five aspects and designed five criteria accordingly: institutional construction, guarantee mechanism, natural resources and ecosystem management, community management, and popularization and education (Table 1).

Table 1. Evaluation indicators of the best practice-based (BPB) method and their best standards.

Criterion	Indicator	Best Standards
Institutional construction	Management organization	An independent management organization is established in the national park with well-organized departments and a clear division of duties, which allows for efficient and orderly operation.
	Management team	The management team has excellent professional knowledge and comprehensive capacity and frequently participates in professional skills training.
	Management planning	The management planning can integrate multiple plans of the national park to meet its management needs to the largest extent and form a mechanism for dynamic adjustment and regular revision.
Guarantee mechanism	Financial support	The national park has sufficient financial investment, diversified and stable financing channels, and a sound capital management system.
	Legal system construction	The national park has a sound legal system, clear legal hierarchy, and professional enforcement team.
	Scientific research support	A dedicated team conducts long-term and steadily based scientific research, and the research results serve to construct the national park.
	Multi-stakeholder participation	The enterprises, social organizations, community residents, and other parties are involved in the management of the national park.
	Audit mechanism	An audit mechanism system that acts as a constraint has effective results.
Natural resources and ecosystem management	Natural resources inventory	The national park completed comprehensive natural and resource inventories and formed a complete resources database.
	Natural resources confirmation and registration	The national park completed the confirmation and registration of its natural resources.
	Ecosystem restoration	The national park implemented scientific and long-term ecological restoration initiatives, which resulted in significant effectiveness.
	Monitoring and early warning system	The national park has a complete monitoring and early warning mechanism, as well as the necessary facilities to monitor complete ecological elements and accurately warn of natural disasters.
Community management	Community organization construction	There is a community organization with a complete structure and standardized management, in which the community residents' interests can be covered and their recommendations can be presented regularly.
	Resident participation	A well-established community co-management mechanism allows community residents to participate in managing the national park in various ways.
	Ecological compensation scheme	The ecological compensation scheme is diversified and stable, providing flexible and diverse compensation methods that are satisfactory to the recipients.
Popularization and education	Recreation management	There are comprehensive recreation management regulations and standardized visitor management systems to meet the recreation needs of the public.
	Science popularization	By providing rich and colorful popular science activities, comprehensive science popularization facilities and exquisite science popularization materials, the national park realized an extensive publicity.
	Environmental education	The national park conducts a wide variety of environmental education activities to raise the environmental protection awareness of the community, visitors, and the general public.

Source: reference [31].

Based on the above indicator system, we applied the hierarchical analysis method and participatory evaluation process to determine the weight of each indicator. A total of 30 experts from the fields of ecology, environment, management, and planning were invited to make a judgment on the importance of each criterion, and the weights of the five criteria were then calculated (Table 2). The weights of institutional construction, guarantee mechanism, natural resources and ecosystem management, community management, and popularization and education were 0.380, 0.179. 0.212, 0.067, and 0.162, respectively. Next, the weights of each indicator under each criterion were calculated in the same way (Table 2).

Table 2. Weights of the evaluation indicators of the BPB method.

Criterion	Indicator	Weight
Institutional construction (0.380)	Management organization	0.354
	Management team	0.426
	Management planning	0.220
Guarantee mechanism (0.179)	Financial support	0.376
	Legal system construction	0.240
	Scientific research support	0.194
	Multi-stakeholder participation	0.122
	Audit mechanism	0.068
Natural resources and environment management (0.212)	Natural resources inventory	0.313
	Natural resources confirmation and registration	0.273
	Ecosystem restoration	0.193
	Monitoring and early warning system	0.221
Community management (0.067)	Community organization construction	0.422
	Resident participation	0.289
	Ecological compensation scheme	0.289
Popularization and education (0.162)	Recreation management	0.383
	Science popularization	0.217
	Environmental education	0.400

Source: reference [31].

To evaluate the management capacity of a national park, participants will be invited to score each indicator by judging the extent to which the corresponding management capacity meets the best standard. Each indicator is scored through a five-grade scale; 5, 4, 3, 2, and 1 represent fully compliant, relatively compliant, largely compliant, not very compliant, and not compliant, respectively, with the score of 100, 75, 50, 25, and 0 on a percentage scale. When calculating the comprehensive management capacity score for each national park, the scores in each aspect should be calculated first. The score of the management capacity in one aspect is calculated by summing the weighted score of each indicator (Equation (1)). Then the comprehensive management capacity score of the evaluated national parks is obtained by weighting the management capacity score in each aspect (Equation (2)).

$$S_c = \sum_{i=1}^{m} P_i S_i \quad (1)$$

where S_c represents the management capacity score in one aspect, P_i represents the weight of the i-th indicator in this criterion, and S_i represents the management capacity score of the i-th indicator in this criterion.

$$S = \sum_{c=1}^{j} P_j S_{jc} \ (j = 5) \quad (2)$$

where S represents the comprehensive management capacity score of the evaluated national park, P_j represents the weight of the j-th criterion, and S_{jc} represents the j-th S_c.

Both the single and comprehensive management capacity of the national park can be categorized into four grades of excellent, good, regular, and poor based on their scores (Table 3).

Table 3. Grades of the management capacities of national parks.

Grade	Excellent	Good	Regular	Poor
Scores	$90 \leq S \leq 100$	$75 \leq S < 90$	$60 \leq S < 75$	$S < 60$

Source: reference [31].

To make better use of the BPB method, we suggest following the below procedures: (1) defining the spatial and temporal scopes of the evaluation, (2) gathering background data and information, (3) applying the evaluation method, (4) analyzing the evaluation results, and (5) forming feedback to the park management.

- The first step is to identify the spatial and temporal scopes of the evaluation. The spatial boundary of the evaluated national park needs to be clarified, which is usually the entire area or a sub-zone. The time point of the evaluation needs to be determined, which is usually a specific year. If the changes in the management capacity within a certain period need to be evaluated, the baseline year and the evaluation year need to be selected.
- The second step is to gather and organize background information and data for each indicator, which is essential for preparing the evaluation and serves as a support for the subsequent phase of analyzing the evaluation results.
- The third step is to apply the evaluation method. The application of the BPB method needs such evaluation tools as questionnaires and scorecards, and the evaluation results are obtained through statistics.
- The fourth step is to analyze the evaluation results and look for the reasons behind the changes. This step helps to identify the reasons for high or low management capacity, as well as why it is improving or deteriorating.
- The final step is to provide feedback to the national park management. The findings are used to propose appropriate actions in order to enhance better management, including additional rectification of management measures, and adjustments to management priorities and resource allocation ratios.

2.2. Study Area

The Three-River-Source National Park (TNP) (89°45′–102°23′ E, 31°39′–36°12′ N) is located in the southern part of Qinghai Province, China, and covers an area of 123,100 km^2. TNP serves as the source catchment area of the Yangtze River, Yellow River, and Lancang River, so it consists of three zones: the Yangtze River Source Zone, the Yellow River Source Zone, and the Lancang River Source Zone. The mountainous terrain in the park extends to an average altitude of over 4500 m, and alpine meadows and alpine grasslands are the primary ecosystem types [32]. TNP includes Zhiduo County, Qumalai County, Maduro County, Zaduo County, and the Hoh Xil nature reserve, comprised of 12 townships and 53 administrative villages (Figure 1). There are a total of 16,621 households and 64,000 residents in the park, most of whom are Tibetan. The economic development within the park is backward, and the industrial structure is single, primarily relying on traditional animal husbandry, with limited employment and income generation channels. Thus, there is a great incongruity between ecological conservation and economic development in the park.

In April 2016, TNP became China's first national park pilot, and in October 2021, it was formally certified as a national park. TNP became one of China's most nationally representative national parks by optimizing the conservation boundaries, coordinating the conflicts between conservation and development, etc. To evaluate its management capacity thoroughly, we define the entire area of TNP as the spatial boundary. We choose 2017 and 2021 as the baseline and evaluation years to quantify the changes in its management capacity.

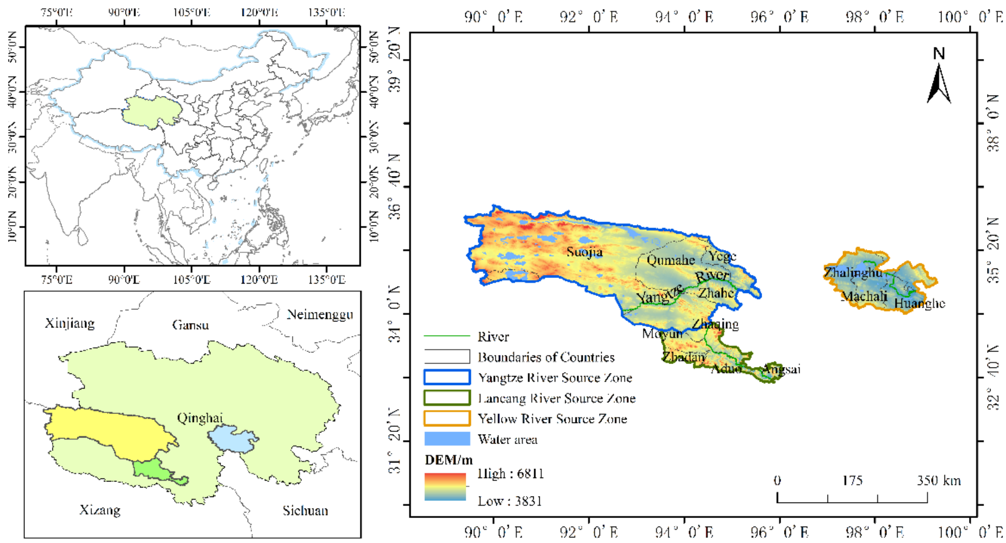

Figure 1. Location of the Three-River-Source National Park (TNP), China.

2.3. Data Collection

To collect background data and information, we conducted a field survey in TNP from 18 to 29 August 2018, and paid a return visit to the interviewees from 11 to 14 January 2022. The survey route in 2018 passed through the whole area of TNP, beginning in Xining City and continuing through Xinghai County, Mado County, Yushu City, and finally Zaduo County. Along the survey route, we conducted key person interviews and organized workshops with the staff of the TNP management authority, the three zone management committees, and some ecological protection stations.

Through interviews, we got first-hand information about management measures in management organization, the management team, scientific research support, community organization construction, science popularization, and environmental education in 2017. We also obtained statistical data, policy, and technical documents on management planning, financial support, monitoring and early warning system, natural resources inventory, and resident participation in 2017. In January 2022, we returned to the above interviewees to update these data for 2021. Furthermore, we collected information on legal system construction, ecosystem restoration, and environmental education between 2017 and 2021 by searching literature and websites. Based on the above process, we sorted out the major management measures taken by TNP according to the management criteria (Table 4).

We completed "the MCE Questionnaire of TNP" by inviting managers of TNP, including the staff from the National Park Authority, the management committees of three zones, and the ecological protection stations. We also distributed the questionnaire to experts who were engaged in soil and water restoration, ecological compensation and community co-management of TNP for a long time. A total of 79 questionnaires were returned for this research. Forty questionnaires were returned in 2018, of which, 30 were from managers and ten were from experts. Thirty-nine questionnaires were returned in 2022, of which 28 were from managers and 11 were from experts. During the data processing phase, the score for each indicator was calculated, with managers scoring 40% and experts scoring 60%. TNP's management capacity score of five aspects and comprehensive score were calculated by weighting and adding the scores for each indicator.

Table 4. Management measures adopted by TNP during the pilot period.

Criterion	Management Measures
Institutional construction	The TNP management authority was established in 2016 with a four-tier management structure: the management authority, the management committee of three zones, the management office, and the ecological protection station.
	The TNP management authority consists of ten departments with a staff number of 402 at the initial, which increased to 409 in 2022.
	A two-tier planning system was established, with an overall plan and several special plans.
	Once officially certified, the TNP adjusted its boundary in a timely manner by including the headwaters of the three rivers into the conservation scope.
Guarantee mechanism	The main funding source of TNP is the financial allocations at all levels. TNP also accepted several financial and in-kind donations from enterprises and social organizations.
	The regulations on the management of TNP promulgated by the Standing Committee of the Qinghai Provincial People's Congress became the primary basis for management.
	The TNP management authority established the "Legal Research Association of TNP", introduced a legal advisor system, and formulated 13 management measures.
	The National Park Police Headquarters was established, which is directly under the leadership of the TNP management authority, to carry out the investigation and prosecution of natural resources in national parks.
	An exclusive research support team, the Research Institute of TNP, was established to cooperate with renowned universities and research institutions at home and abroad to carry out scientific research from multiple perspectives.
Natural resources and environment management	The off-office auditing of natural resource assets of leading cadres of TNP was completed.
	The investigation and publication of the region's water, grassland, wetland, and forest resources in the region were completed.
	The integrated confirmation rights registration of water, forests, mountains, grasslands, wastelands, and mudflats resources of TNP were completed.
	Ecological protection works were implemented to achieve large-scale ecological restoration.
	TNP continuously increased the strength of enforcement and community popularization, raising the conservation awareness among community residents.
	A "sky-ground-air" monitoring platform was established, and the number of monitoring points was significantly increased.
Community management	TNP implemented a community eco-guard system, and improved the grant funding reward and performance appraisal mechanisms.
	A livestock insurance fund was established, and the accident compensation system was implemented.
	TNP carried out franchise management and drove herders to participate in ecological experience work.
Popularization and education	TNP adopted three strategies of science popularization: designing and using image logos, organizing various science popularization activities based on anniversaries and special festivals, and creating and publishing diversified science popularization works.
	TNP authorized Mado Yunxiang Nature Tours Company to carry out ecological experiences in the Yellow River Zone. By managing visitors strictly and conducting a booking and assessment mechanism, the ecological experiences achieved good results.
	The TNP management authority conducted environmental education activities for the community residents.

3. Results

3.1. Analysis of Single Management Capacity

We applied the BPB method to evaluate the management capacity of TNP in 2017 and 2021, respectively. Table 5 shows the scores of each management capacity of TNP in the two years.

Table 5. Scores of single management capacity of TNP in 2017 and 2021.

Criterion	Indicator	Scores	
		2017	**2021**
Institutional construction	Management organization	69.52	92.62
	Management team	76.38	84.30
	Management planning	66.76	89.04
Guarantee mechanism	Financial support	71.87	85.06
	Legal system construction	65.13	87.46
	Scientific research support	75.81	83.82
	Multi-stakeholder participation	62.52	77.64
	Audit mechanism	69.14	89.42
Natural resources and ecosystem management	Natural resources inventory	53.95	85.38
	Natural resources confirmation and registration	51.87	88.18
	Ecosystem restoration	69.53	90.02
	Monitoring and early warning system	66.33	73.36
Community management	Community organization construction	52.33	74.24
	Resident participation	69.07	83.96
	Ecological compensation scheme	69.67	76.62
Popularization and education	Recreation management	53.43	64.22
	Science popularization	68.52	89.58
	Environmental education	66.33	77.30

From Table 5, we can see that the scores of each management capacity of TNP were generally lower in 2017 compared with those in 2021. Among the 18 management capacities, only the management team and scientific research support, scoring 76.38 and 75.81, reached a good level; the four management capacities, namely natural resources confirmation and registration, community organization construction, recreation management, and natural resources inventory, were relatively poor, with scores of 51.87, 52.33, 53.43, and 53.95; and the remaining 12 management capacities were at a regular level (Figure 2). This indicates that the interviewees generally considered that the management capacities of TNP in 2017 were insufficient, and only the management teams and scientific research support were satisfactory.

The scores of each management capacity of TNP were generally higher in 2021 than those in 2017, with no management capacity performing poorly. Among the 18 management capacities, the management organization and ecosystem restoration reached an excellent grade with scores of 92.62 and 90.02, respectively; the three management capacities of recreation management, monitoring and early warning system, and community organization construction were relatively weak, with scores of 64.22, 73.36 and 74.24; and the remaining 13 management capacities were of a good grade (Figure 3). This suggests that the interviewees were generally satisfied with the management capacities of TNP in 2021, especially for the management organization and ecosystem restoration, while they considered the performance of recreation management, monitoring and early warning system, and community organization construction slightly inferior.

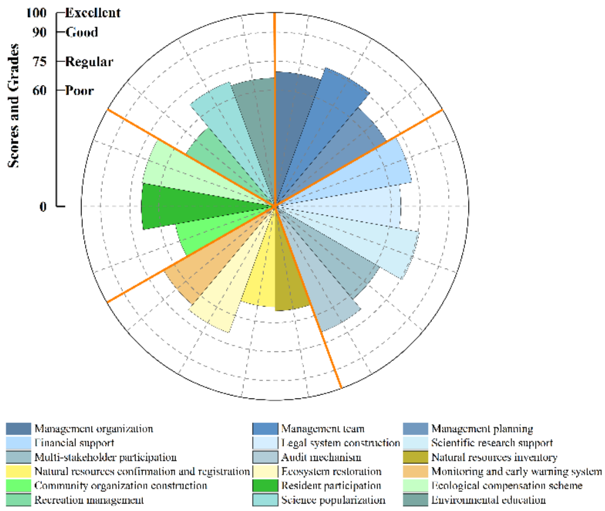

Figure 2. Grades of single management capacity of TNP in 2017.

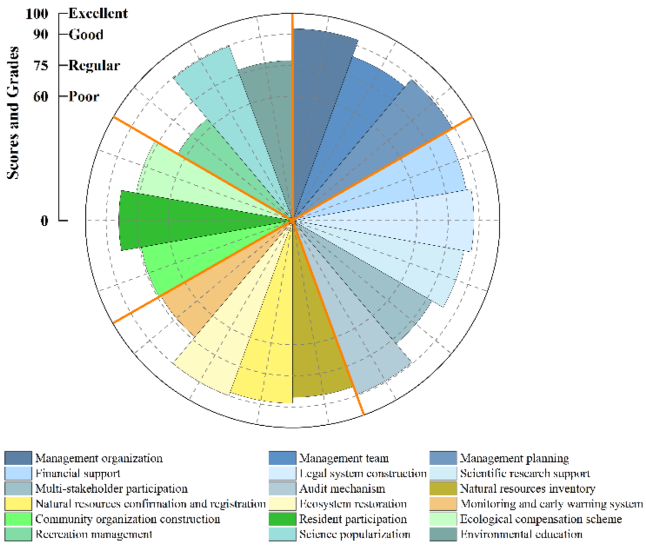

Figure 3. Grades of single management capacity of TNP in 2021.

By comparing the single management capacity between 2017 and 2021, we can see that all management capacities of TNP improved over the past four years. The most significant improvement is found in the management capacity score of natural resources confirmation and registration, which raised from 51.87 to 88.18, with an improvement of 70.00%. The management capacities of natural resources inventory and community organization construction also increased considerably. The management capacity score of natural resources inventory improved from 53.95 in 2017 to 85.38 in 2021, with an increase of 58.26%. The management capacity score of community organization construction increased from 52.33 in 2017 to 74.24 in 2021, showing an improvement of 41.87%. The scores of the other four management capacities increased by more than 30%, which are legal system construction (34.29%), management planning (33.37%), management organization (33.23%), and science popularization (30.74%). A minor improvement is found in the ecological compensation scheme, with the score increasing by 9.98%. Furthermore, three management capacities increased by less than 15%, namely, the management team (10.37%), scientific research support (10.57%), and monitoring and early warning system (10.60%). This indicates that the interviewees felt that the management capacities of TNP improved to different degrees in many aspects after four years of development. They considered that the TNP significantly improved most of the management capabilities. In contrast, the improvement in the management capabilities of the ecological compensation scheme, management team, scientific research support, and monitoring and early warning system is slightly less noticeable.

3.2. Analysis of Comprehensive Management Capacity

By adding up the weighted score of each indicator, we obtained the scores of the management capacities of TNP in the five aspects, and further, we got the comprehensive score. Table 6 shows the management capacity scores in different aspects and the comprehensive management capacity scores of TNP in 2017 and 2021.

Table 6. Comprehensive management capacity scores of TNP in 2017 and 2021.

	Institutional Construction	Guarantee Mechanism	Natural Resources and Ecosystem Management	Community Management	Popularization and Education	Comprehensive Management Capacity
2017	71.84	69.69	59.12	62.18	61.86	67.86
2021	88.29	84.79	84.40	77.74	74.95	84.96

The comprehensive management capacity score of TNP was 67.86 in 2017, which was a regular grade. The scores of the management capacities in the aspects of institutional construction, guarantee mechanism, natural resources and ecosystem management, community management, and popularization and education were 71.84, 69.69, 59.12, 62.18, and 61.86, respectively. The management capacities of TNP in the five aspects were relatively balanced in 2017, of which the natural resources and ecosystem management got the lowest score, but was close to the regular grade, and the other four were all at the regular grade.

The comprehensive management capacity score of TNP was 84.96 in 2021, ranking at a good grade. The scores of the management capacities in the five aspects were 88.29, 84.79, 84.40, 77.74, and 74.95, respectively. The strengths and weaknesses in the management capacities of TNP in 2021 were apparent. The institutional construction had the best performance, scoring close to the excellent grade, while the capacity in popularization and education was inferior, only ranking at the regular level.

By comparing the comprehensive management capacities between 2017 and 2021, we can see that the management capacities of TNP in all five aspects enhanced significantly over the past four years. The largest improvement is found in natural resources and ecosystem management, with its score rising from 59.12 to 84.40, showing an increase of 42.76%, and the grade rising from poor to good (Figure 4). The other four aspects all increased by more than 20%, of which the institutional construction, guarantee mechanism and community management increased from regular to good, and the popularization and education also immediately reached the good level. Specifically, the capacity of community management also improved over the past four years, with its score rising from 62.18 to 77.74, showing an increase of 25.02%. The score of institutional construction was the highest in both years, which raised from 71.84 to 88.29, with an increase of 22.90%, indicating that institutional construction plays a vital role in improving the management of TNP. The score of the guarantee mechanism of TNP raised from 69.69 in 2017 to 84.79 in 2021, showing an improvement of 21.67%. The score of popularization and education scores rose from 61.86 to 74.95, with an increase of 21.16%. As a result, the comprehensive management capacity score of TNP increased by 25.20%, with the performance pulled up from a regular grade to a good grade.

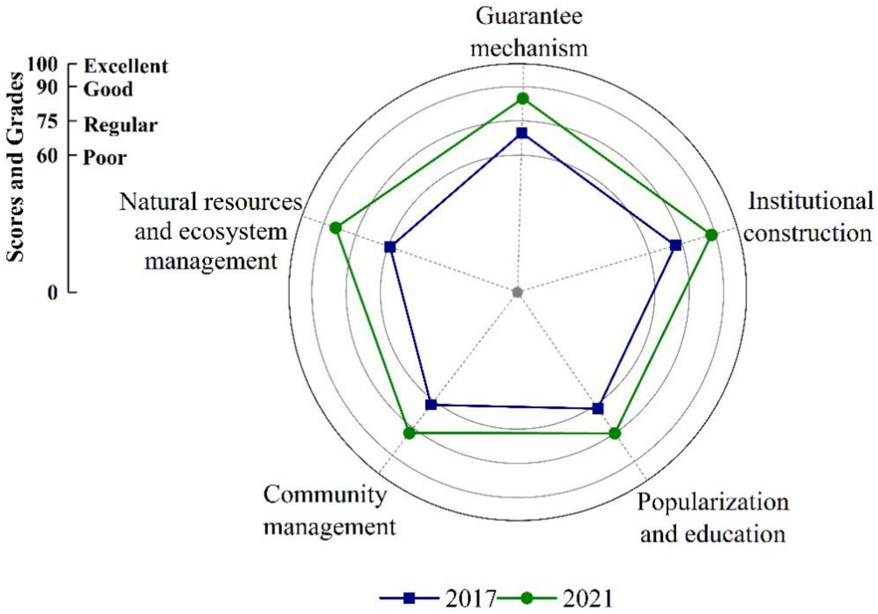

Figure 4. Grades of the comprehensive management capacities of TNP in2017 and 2021.

4. Discussion

4.1. The Beneficial Experiences from TNP's Management

All management capacities of TNP improved over the past four years. However, the reasons behind these improvements vary. Analyzing the reasons behind these improvements will help clarify the critical factors for increasing TNP's management capacities and thus provide management suggestions for other national parks.

Several management capacities achieved significant improvements, namely natural resources inventory and natural resources confirmation and registration, with scores increasing by 70.00% and 58.26%, respectively. This is highly due to the significant advancement in relevant work, such as resource surveys, unified verification, and registration. During the pilot period, the background situation of natural resources in TNP was thoroughly investigated, and their rights were uniformly confirmed and registered. In addition, TNP's capacity in community organization construction improved greatly, showing an increase of 41.87% in the score. With the appearance of community inquiries and supervision cards, residents gradually participated in the management of TNP, which may account for the significant enhancement of this management capacity. The capacity of audit mechanism also increased by 29.33%. This is mainly because of the completion of the off-office auditing of natural resource assets of leading cadres. It is demonstrated that the orderly implementation of related work is a vital way to improve the management capacities of national parks, especially in natural resources and ecosystem management.

Five management capacities increased to a certain degree because of the effective management measures taken by TNP. For example, the score of the legal system construction increased by 34.29%. In the absence of high-level legislation for national parks in China, such a marked improvement is partly due to the fact that a team of legal advisers provided strong support for the development of the regulations of TNP; and it is partly because an efficient and independent enforcement team ensured the implementation effectiveness of the regulations [33]. The score of the management plan increased by 33.37%. After analyzing relevant data and information, we argue that the reasons are multifaceted. Firstly, the overall plan of TNP was effectively implemented after the standardized preparation, validation, and approval, and it is now subject to third-party evaluation. Secondly, the social feedback and supervision mechanism for the planning of TNP is greatly improved. Thirdly, the sources of the three rivers were included after TNP was formally certified as a national park, so the boundaries of TNP were perfected in ecological integrity. This laid the foundation for more scientific and rational planning for TNP.

TNP's capacity in management organization greatly improved, with the score increasing by 33.23%. This is mainly because the management authority of TNP integrated related departments of the four counties within its boundary during the pilot period. The bureau for eco-environment and natural resources management and the bureau for natural resources and environmental enforcement were established in 2016 [34]. This realized the unified and efficient law enforcement of natural resources and environment in TNP and solved the problems of overlapped management, different standards, and cross functions to a certain extent. The score of science popularization is also raised, showing an increase of 30.74% in four years. There are three reasons for this: firstly, the image logo was put into use, letting more people know about TNP; secondly, a series of popular science works were created, spreading the values of TNP to the general public; and finally, a variety of publicity activities were carried out for local communities, raising their awareness of conservation. The score of ecosystem restoration also increased largely, with an improvement of 29.47%. Firstly, TNP already took measures to guide the behaviors of the residents, which raised their awareness of environmental protection effectively and reduced the ecological damage by residents fundamentally. Secondly, relying on large-scale ecosystem restoration projects with adequate investment, the ecosystem restoration of TNP achieved considerable progress.

4.2. The Deficiencies in TNP's Management Compared with Best Practices

Some management capacities of TNP, such as ecological compensation scheme, management team, scientific research support, and monitoring and early warning system, improved slightly in the past four years. The reasons are multifaceted. Exploring the factors for the slight improvement of these capacities can provide reasonable suggestions for improving TNP's management strategies and measures.

The score of the management team ranked first in 2017, but the improvement was only 10.37% over the past four years. The slight improvement was perhaps caused by the minor change in the quantity or quality of the management team in those four years. Firstly, the number of management staff did not increase significantly. Although TNP has the largest number of staff among the ten national park pilots, the area managed by each person in TNP is also the largest [35], which means that each person in TNP has more to do in a given time. With the adjustment of the boundary, the total area of TNP expanded by nearly half, so the workload of each person is even greater. Secondly, the number of management staff who have professional skills in grassland protection, as well as flora and fauna monitoring is still small. With the inclusion of river sources into TNP, more issues concerning zoning and management are brought about, requiring more professional teams to manage. To cope with the increased intensity and difficulty of management, we suggest that TNP further strengthen the management team by increasing the number of management staff and improving the quality of the professional team.

The score of scientific research support ranked second in 2017 while only increasing 10.57% during the past four years. As an area with the most concentrated plateau biodiversity and the most sensitive and fragile ecosystem, TNP attracted many scholars to conduct scientific research and produce fruitful scientific results. This is probably the reason why this capacity was outstanding in 2017. During the past four years, TNP formed a specialized research institution, signed cooperative agreements with other research institutions, actively participated in academic conferences and exchanged management practices with other PAs. However, due to a lack of systematic organization, transformation, and application of research results, these research practices are yet to fully exert the function of scientific research support, only bringing a slight increase to the related management capacity. In the future, TNP should strengthen the transformation and application of existing scientific research results and improve the relevance and applicability of subsequent research results.

The management capacities in ecological compensation scheme and monitoring and early warning system were under performing in both years. The score of ecological compensation scheme showed the slightest improvement of 9.98% during the past four years.

The eco-guard system is the main ecological compensation policy of TNP. With the number of eco-guards selected from communities expanded and the management mechanism improved, the capacity in ecological compensation scheme improved to a certain degree. However, two factors might limit the large improvement in this capacity Firstly, the range of compensation is enormous, while the funding is still deficient. As an area with more prominent ecological functions, TNP does not have much higher compensation standards than other areas, which results in the low motivation of protectors. Secondly, the existing compensation scheme is still imperfect [36]. The residents in TNP live in the upper reaches of the three rivers, and make sacrifices for the downstream areas, but they are not compensated by the downstream beneficiaries. To this end, we suggest that TNP seeks more funds from society and the market besides transfer payments from the central government, and establish a horizontal ecological compensation system for the watershed to solve the relationship of upstream conservation and downstream development.

The score of monitoring and early warning system only increased 10.60% in the past four years. Although the establishment of the Ecological Data Center improved the capacity of TNP in monitoring environmental elements, wildlife distribution, and ecosystem disasters, there are still several deficiencies in the management and utilization of monitoring data when compared with the best practices. For example, the data from different sources lack a unified storage and management mechanism, and the data are not fully shared with the public. International experiences show that effective data management and utilization are essential for national park monitoring. For example, all standards, background data, and monitoring data in Canada are recorded in the Information Center on Ecosystems Database [37]. In the U.S., the 32 networked eco-region units are required to regularly publish a series of resource summaries, data summary briefs, technical reports, trend analyses, and synthesis reports on the web [38]. Therefore, we suggest that TNP strengthen the management of the Ecological Data Center, including enhancing the collection of data from different sources, improving the organization and collation of data, and facilitating the transformation and integration of data.

Furthermore, some capacities, though increasing greatly in scores, still need further improvement. Take the capacity in community organization construction as an example. Although its score has increased significantly in the past four years, the construction of community organization still has gaps with the best practices, mainly due to the low participation of community residents in national park management decisions. One good practice comes from the Kakadu National Park and Parks Australia where the world's first community co-management agreement was signed in 1978 by residents. Since then, they established a National Park Management Committee with shared decision-making powers [39]. Another good practice is found in the Republic of Macedonia, where community residents became a more influential group in the management of national parks through the involvement of NGOs in environmental protection, educational seminars, field trips, and information dissemination [40]. Therefore, we suggest TNP increase the ways of residents' participation in park management, adopt residents' recommendations more fully, hold joint meetings regularly, and make consultation widely when making management decisions.

4.3. Strengths, Weaknesses and Applicability of the BPB Method

The BPB method is tested and validated in this research, and its application in TNP shows that the evaluation results can reflect the actual changes in management capacities. For example, TNP is significantly improved in institutional construction and natural resources and ecosystem management, and slightly improved in guarantee mechanism, community management, and popularization and education on the whole. It provides a rapid and accurate way for comprehensive management capacity evaluation of TNP and visualizes the management states of TNP in the form of evaluation scores. It also shows the management performance of TNP in the five aspects of institutional construction, guarantee mechanism, natural resources and ecosystem management, community management, and popularization and education. Applying the BPB method achieves a comprehensive diagnosis of TNP's management capacities and identifies the gap between its management status and the international best level. The comparison between the two years reflects the changes in the management capacities of TNP directly. The comparison and analysis of the evaluation results can help explain the reasons behind the changes and provide a reliable basis for improving TNP's management strategies. It is demonstrated that the BPB method can reveal the changes in the management capacities of national parks well and reflect the impact of various management measures on management capacities to a certain extent.

Compared to the existing MCE methods from international programs, the BPB method has broader adaptability. This adaptability is reflected in the indicator system, scoring method, and evaluation form. Firstly, the indicator system comes from a systematical summary of national park management experiences in different countries, which is well-rounded and applicable worldwide. In contrast, the indicator system proposed by The Parks in Peril Program only covers four aspects: conservation action, long-term management, financial support, and local guarantee, and lacks attention to conserving natural resources and ecosystems. Secondly, the BPB method uses a benchmark approach to invite interviewees to score each indicator, which improves the anchoring mechanism of the evaluation. Finally, compared with the objective quantitative evaluation with a long period and large resource input, the BPB method has a straightforward evaluation and a simple results processing process, which has advantages in timeliness and low investment. In addition, when applying this method to evaluate each indicator, we can compare the current management states with international best practices and provide feedback on current management measures to further improve management capacities.

The BPB method also has certain shortcomings. Firstly, this is a subjective evaluation method that relies on participants' judgment. Several studies suggest management evaluations that rely on expert knowledge and qualitative judgment may be more accurate than those relying on quantitative data or a mix of data types [41,42]. However, as the quantity and precision of national park monitoring data improves, it will become a future demand to explore accurate evaluation based on ecological monitoring results as evidence. Therefore, the BPB method and the objective quantitative evaluation can be used jointly and complement each other. Secondly, the evaluation indicator system is only two-leveled, which does not fully reflect every aspect of the national park management. How to refine the evaluation indicator system and measure the management capacity of national parks in an all-round way became the focus of future research. It should be noted, when designing the indicator system and setting the standards, we should consider the conservation needs and management objectives of a specific type of PA, and then make adjustments accordingly.

5. Conclusions

This research follows the BPB method and selects TNP, China's first national park system pilot and one of the first batch of national parks, as the case study. By evaluating the management capacity in 2017 and 2021 respectively, the changes in the management capacity of TNP during the pilot period have been explored and the appropriateness of related management measures has been revealed. Some management capacities, such as legal system construction, management planning, and natural resources confirmation and registration, performed well or improved significantly during the pilot period, providing beneficial lessons for other national parks in China. Some management capacities, such as ecological compensation scheme, monitoring and early warning system, and the management team, are still lacking and should be prioritized for future improvement. The BPB method is tested and validated in this research, showing a potential to be promoted to other PAs in China and even other countries. Not only is the effectiveness and operability of this method confirmed in this research, but its contribution to the theoretical improvement of MCE methods is also demonstrated.

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