Sustainable Forestry (2021) Volume 4 Issue 2
doi:10.24294/sf.v4i2.1607

ORIGINAL RESEARCH ARTICLE

Optimization strategy of national park resource utilization system—Take Bawangling Zone of Hainan Tropical Rain Forest National Park as an example

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ABSTRACT

The national park with Chinese characteristics is the highest level of protection of a kind of natural protection, its establishment marks the park will implement the strictest ecological protection means. It is of great value to construct the utilization system of national park resources under the new natural protected area system in the new era to avoid the misunderstanding of "ecological protection only" and explore how to carry out the sustainable utilization of resources in the reform of national park system and mechanism. According to the analytic hierarchy process (AHP) and Delphi method, the evaluation framework, indicators, reference standards and weights of resource utilization under the national park system were determined in combination with the requirements of constructing the protected natural area system and the total value of resource ecosystem services (including harvest value, existence value and future value). Based on the application research of Bawangling zone of Hainan Tropical Rainforest National Park, the optimal resource utilization system in the future was proposed, and two optimization strategies of ecological adjustment of resource utilization system and construction of suitable resource utilization system were put forward.

Keywords: National Park; Resources Utilization; Ecosystem Service Value; Industrial Structure; Sustainable Development

ARTICLE INFO

Received: 21 May 2021
Accepted: 13 July 2021
Available online: 19 July 2021

1. Introduction

The national park with Chinese characteristics is a kind of natural protected area with the highest level of protection[1], and the establishment of the national park marks that the strictest ecological protection measures will be implemented in the park. Since 2013, China's national parks have started various protection modes, but there is little mention of resource utilization. Due to the uncertainty of the concept of "strictest", each pilot area administration dare not easily open up production activities and human activities. However, different from the large-scale high-quality wilderness with sparse population in the United States and Canada, China's national parks are often accompanied by human settlements, and it is necessary to preserve human settlements and corresponding livelihoods within the general control areas of national parks[2]. However, in the current pilot situation, the interest demands of all parties are not completely consistent with the ecological protection and management objectives of the national parks, among which the significant conflicts are the socio-economic development needs of community residents and concessionaires, the recreation needs of visitors, and the protection needs of the National Park Administration on the in-

tegrity and authenticity of the ecosystem[3,4]. Therefore, it is necessary for China's national parks to build an appropriate resource utilization system to maximize the value of ecosystem services, that is, resource protection, sustainable resource utilization and coordinated development of local society[5].

For the first time, since 2013, the third plenary session of the 18 proposed national park system, Chinese national park has been carrying on the relevant system pilot actively explore, in the top-level design and maintain the original true and completeness of the natural ecological system has achieved results stage, but there are still many underlying difficulties, including resource utilization and coordinated development between human and nature. At present, there are two main viewpoints on the utilization of national park resources in academia and national park builders: (1) national parks contain precious natural heritage, which should adhere to the strictest conservation concept and avoid exploitation as far as possible; (2) the view that conservation and utilization can develop in harmony is gradually dominating[6]. Under the high-pressure situation of "the strictest protection" in the national park policy of the central government, on the one hand, the legitimacy of the utilization of national park resources in China is questioned, falling into the misunderstanding of "ecological protection only"[7]. On the other hand, the destruction of ecological environment caused by the production and living of aborigines in national parks has been repeated, and the effect of ecological compensation and resource protection is not good[8]. It can be seen that the balance between conservation and utilization is the core issue of scientific development of national parks. Through combing the literature related to the construction of pilot areas of national parks in China, the author finds that the existing literature mainly focuses on the following aspects: (1) in view of the nature of national parks, it is necessary to prevent national parks from being simply transformed into country parks, tourist resorts or the most strictly protected nature reserves. The primary function of national parks is to protect the ecosystem, and at the same time, it should meet the restricted and standardized contact of citizens[9]. (2) according to the particularity of China's national parks, in order to guarantee the production and living conditions of indigenous people in China's national parks, the balance between traditional utilization and nature conservation should be found[10]. For example, resource users in the park are transformed into ecological conservators[11], community participation and interest sharing mechanism are implemented[12], and functional zoning is carried out to find differentiated resource utilization measures[13], etc. (3) in order to give full play to the comprehensive functions of scientific research, education, recreation and other functions of national parks, ecological tourism can be developed, the mechanism of paid utilization of resources can be innovated, and franchising can be explored[14], etc.

To sum up, there are still some problems in the protection and rational utilization of national parks in China, and a new resource utilization system is urgently needed to improve the relationship between man and nature in the region, so that both can benefit. This requires the pursuit of development on the premise of conservation, and the realization of human well-being while maintaining harmony with nature, in order to maintain the sustainable development of the entire ecosystem and society.

Bawangling area is the only gibbon habitat and typical tropical forest distribution area in Hainan Tropical Rainforest National Park. The present situation and problems of resource utilization are typical in the pilot exploration of national parks in China, including: (1) unclear nature positioning. Hainan tropical rain forest national park after the establishment, the Bawangling area management department—The Bawangling Management Branch also continues the forest resource management thinking of the original Bawangling State-owned Forest Farm. The Bawangling Management Branch and its subordinate Bawangling Forest Development Co., Ltd. have overlapping and dislocating the government and enterprise functions, and there is a phenomenon of arranging the social functions of the area. (2) Lack of top-level design. Due to the short period of establishment of national parks, more appropriate and detailed regulations on resource utilization have not been formulated. (3) contradiction between protection and development. Due to

long-term economic underdevelopment, the core industries and community production activities in Bawangling, which is located in the core protection area of the national park, cannot be stopped immediately. In this context, resource utilization system will become an important management tool to solve the conflicts between resource protection and social and economic development in Bawangling area. Therefore, based on the application experience of the resource utilization system reconstruction in Bawangling area, this study constructed the resource utilization evaluation system under the new natural protected area system in the new era, and explored the optimal strategy of sustainable resource utilization under the multi-objective management of the entire national park ecosystem.

2. Overview of the study area

According to the GIS vector data of Bawangling Area provided by Bawangling Sub-Bureau of Hainan Tropical Rain Forest National Park in October 2020, Bawangling Area of Hainan Tropical Rain Forest National Park is located in the southwest of Hainan Province, straddling Baishan Li Autonomous County, Changjiang Li Autonomous County, Dongfang City and Ledong Li Autonomous County (**Figure 1**–**2**). The area covers a total area of 88,000 hm^2, including 69,000 hm^2 core protection area and 19,000 hm^2 general control area. Bawangling area is the best preserved of pristine tropical forest of Hainan Province, is a tropical rain forest in Hainan national park in the only gibbon habitat in seven area, important eco-function areas of Hainan Province, in the protection of regional ecological security, climate change, the construction of ecological province in Hainan international tourism island has an irreplaceable role.

Ecological construction has been the key work since the reform of Bawangling area. The implementation of ecological protection and sustainable utilization of resources has been the heavy experience of Bawangling area after nearly 40 years of predatory logging. Bawangling Area has undergone three historic reforms (see **Figure 3**) from the birth of Bawangling Forest Management Site in 1955 to the establishment of Bawangling Sub-Bureau under the vertical management of Hainan Tropical Rainforest National Park Administration in 2019. At this point, with the end of the second phase of Tianbao engineering (2020), Hainan tropical rain forest national park was set up will bring more strict ecological protection and top-down system update, prompting Bawangling area onto the road of a new stage of transformation, how to achieve the goal of national park ecosystem value maximization under construction suitability resource utilization system. It will be the key point of future transformation of Bawangling area.

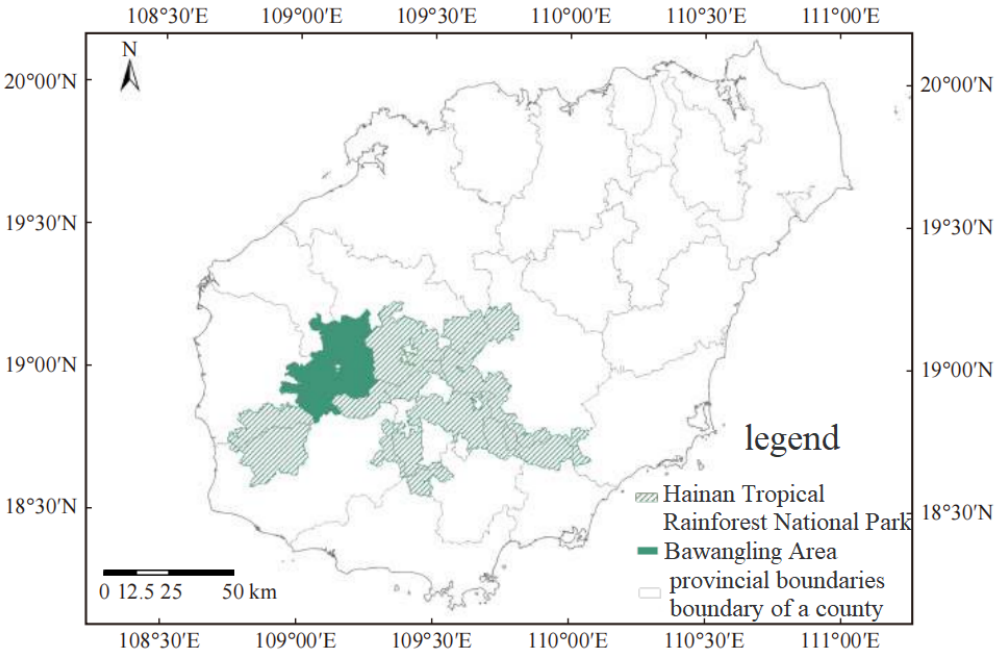

Figure 1. Location map of Bawangling Area.

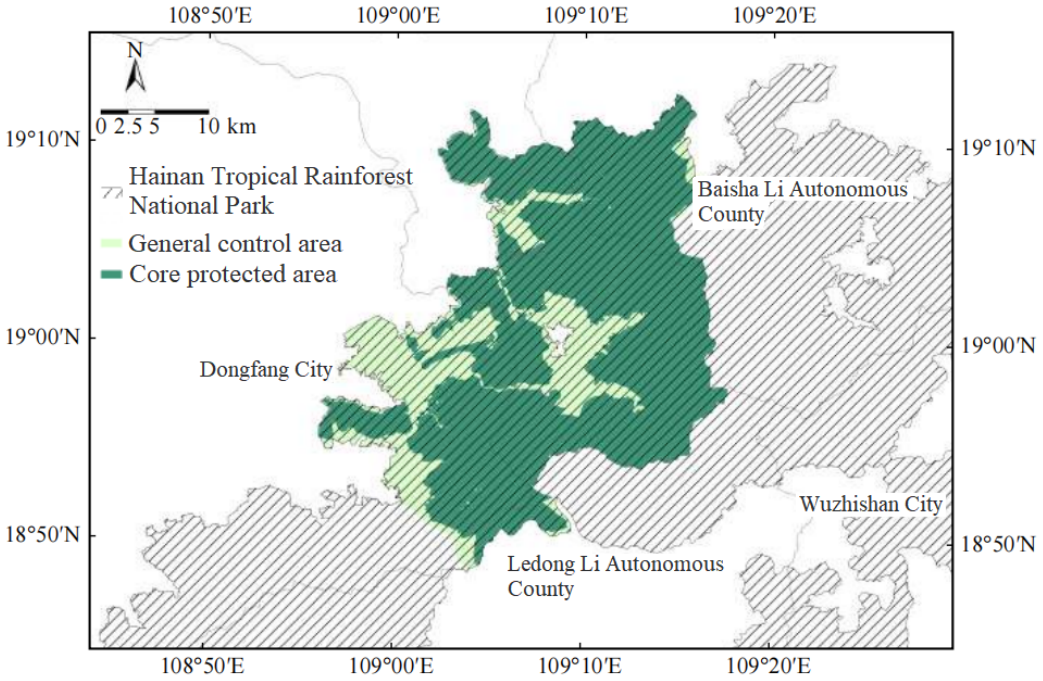

Figure 2. Zoning map of Bawangling Area.

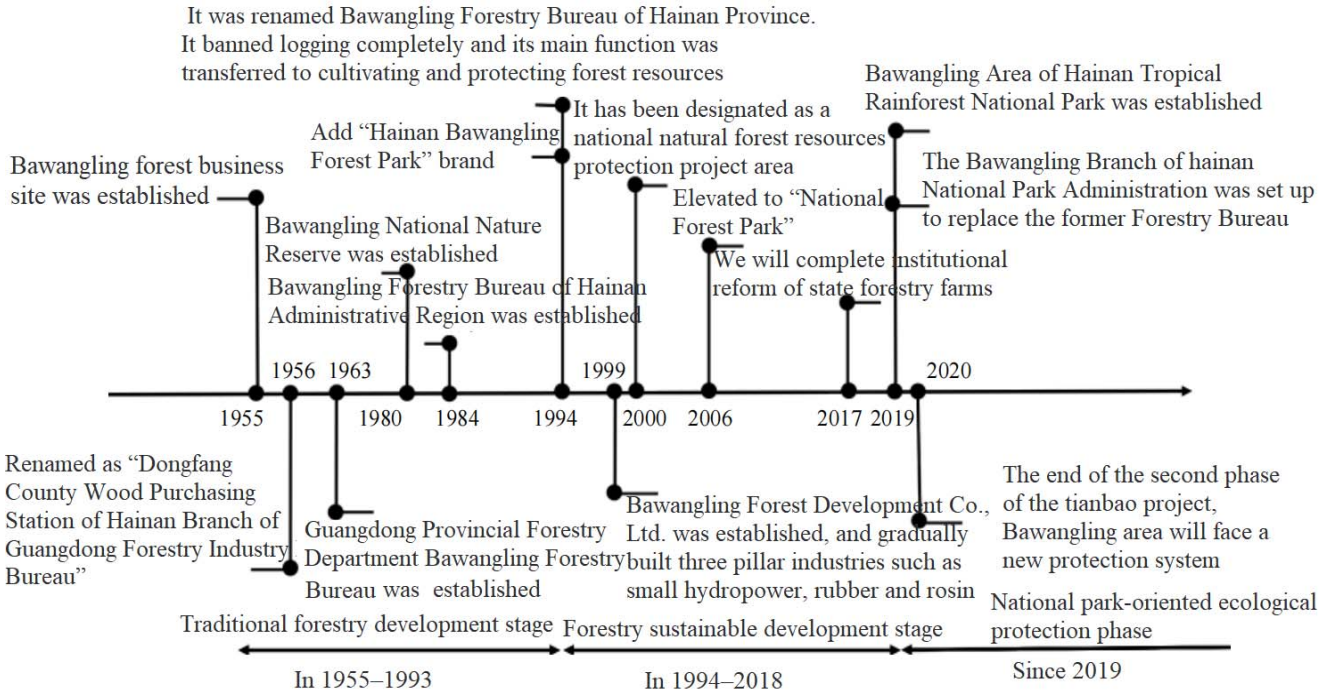

Figure 3. Timeline of historical development of Bawangling Area.

3. Research methods and index system

3.1 Research methods

As for the research on the choice of resource utilization methods, the commonly used methods can be divided into two categories: qualitative analysis, mainly SWOT analysis; quantitative analysis mainly includes entropy method, grey clustering method, deviation-share analysis method, principal component analysis and analytic hierarchy process. Among them, the analytic hierarchy process (AHP) is the most widely used method, which can extract the main value evaluation criteria of complex things and comprehensively evaluate the development value of each utilization mode by relying on the subjective weight of experts' discipline

experience and the objective calculation of computer science algorithm. The most important thing is that the results are simple, clear and feasible in practice, which is conducive to the repeated use of the evaluation system by national park managers, and based on which the regional resource utilization methods are regularly investigated and evaluated.

At present, this evaluation method has been widely used in forest industry screening and has a mature evaluation system[15,16]. However, under the development goal of national parks, there are still some defects in the evaluation of direct use value of natural resources. In the stage of index establishment and weight assignment, this study, starting from the value of ecosystem services, uses protective indicators and weight allocation to guarantee the non-consumption use value and public benefit value of resource utilization[17,18], so as to achieve the transformation goal of priority protection and sustainable resource utilization in all pilot sites under the national park system. Combined with R 3.6.1 software package (R software for short) and hierarchy analysis software, the comprehensive evaluation and ranking of regional resource utilization development ability are carried out to provide data support for the establishment of resource utilization system.

3.2 Establishing an indicator system

3.2.1 Logical framework

According to the "Overall Plan for Establishing a National Park System" (2017), "Guiding Opinions on Establishing a Natural Reserve System with National Parks as the Main Body" (2019) and other documents, national parks can rationally use resources on the basis of protection, Therefore, the effective protection of natural resources, the maximization of ecosystem service value and the sustainable utilization of resources are the important evaluation criteria of national park resource utilization target and resource utilization index system. Ecological protection is always the core connotation of China's national parks, indicating that any resource utilization should be based on environmental carrying capacity and subject to strict regulations[19]. The maximization of ecosystem service value means that resource utilization mode must have ecological, economic and social functions, and shoulder the dual tasks of ecological product supply and ecological environment health protection[5]. Sustainable utilization of resources means promoting economic development, technological progress and highly green industrial structure, that is, enhancing the sustainable development capacity of the industries involved, while sustainable development represents the comprehensive response of the "development degree", "coordination degree" and "sustainability degree" of the complex system of "nature, society and economy"[17,20]. To sum up, the author divides the resource utilization evaluation system under the national park system into three levels: the market value of resources (harvest value), the value provided by unharvested resources in situ (existence value) and the future value of resources.

(1) Harvest value can be further divided into: a. economic value refers to the direct use value and economic benefits brought by harvested products, such as wood, fruit and medicinal materials; b. social value, that is, the social demand for livelihood welfare and products brought by the use of natural resources for community residents. In addition, due to the externality of natural resources, the market cannot fully reflect the costs and benefits of natural products, so the existence value and future value are further used to constrain the market failure of national park natural resources[21].

(2) The existence value includes the ecological benefits brought by the national park ecosystem, such as water purification, pollution control, natural pollination, pest control, soil and water conservation, climate regulation, etc.[22,23]; services or "potential benefits" that can be provided without consuming or destroying natural resources, including indirect use value of ecotourism, recreation, education and scientific research[22,24].

(3) Future value refers to the expected value of resources to human society in the future, such as research and development of new drugs, food and genetic resources, or the value that people are willing to pay in order to protect a species from extinction or an ecosystem from being destroyed and leave natural resources intact to future generations[25].

3.2.2 Screen evaluation indicators and determine the weight of indicators

The resource utilization index system is the formal expression of the industrial structure of national parks[15]. The rationality of industrial structure is the basis of whether the industry can better reflect the service value of regional ecosystem. A reasonable resource utilization system can not only maintain the ecological balance, but also make better use of natural resources. The selection of evaluation system indicators should firstly be based on the harvest value, existence value and future value of each industry to ensure that the effectiveness and potential of resource utilization are reflected from different aspects. Secondly, the index should not only quantitatively evaluate the contribution of the industries involved to the community economic development, but also dynamically reflect the industrial development potential and ecological benefits during the duration, and ensure the accuracy and reliability of the evaluation results. On the basis of listening to experts' opinions, this study first consulted literatures[25], papers[15,26-39], reports[40,41] and statistical yearbooks[42] related to the evaluation of ecosystem resource utilization and industry screening. Combined with the frequency statistical method, the evaluation indexes with high frequency were selected as candidate indexes. The index system of 3 levels is determined, which is composed of 3 dimensions and 23 indicators. Delphi method was adopted, which was scored and evaluated by 15 experts in related fields of national park and forestry research, and analyzed by MicroSilver AHP software. All indicators passed the consistency test. According to "2019 Bawangling Forest Development Co., Ltd. Production and Operation Management Plan", "2019 Bawangling Management Branch Financial Final Report", and "Bawangling Area Situation Report", combined with background information, interviews and field investigation of Bawangling Area, and speech materials for the sixth meeting of the 18th Workers' Congress of Bawangling Forestry Bureau of Hainan Province (now Bawangling Sub-Bureau), and specific evaluation of indicators, reference standards and corresponding weights (see **Table 1**).

Table 1. Evaluation indexes and reference standards of national park resources utilization

Destination layer	First-level indicator	Second-level indicator	Quantization method	Unit
Harvest value (0.2343)	Economic indicators (0.0879)	Gross industrial output value (0.1438)	Gross output value of the industry	Ten thousand yuan/year
		Local financial support (0.0823)	State or local financial support	Ten thousand yuan/year
		Ability to absorb investment (0.1079)	Social investment	Ten thousand yuan/year
		Market share (0.0619)	Industrial output value/total value of the industry in the province where the national park is located	%
	Social indicator (0.1464)	Average monthly salary of employees (0.0283)	Average monthly income of active employees	Yuan
		Number of employment (0.0344)	Industry annual employment	
		Technical training (0.0281)	Experts assign points, no development, only a little development, general development, more development, and a lot of development 1 to 5 points in order	
		Policy support (0.0250)	Experts assign points, none at all, only a little, average, many, many in order of 1 to 5 points	
Harvest value (0.2343)	Social indicator (0.1464)	Industry relevance (0.0196)	Experts assign points, no correlation, only a little correlation, general correlation, more correlation, strong correlation, 1 to 5 points in order	
		Regional competitiveness (0.0153)	Experts assign points, with no competitiveness, little competitiveness, general competitiveness, greater competitiveness, and strong competitiveness in the order of 1 to 5 points	
		Market demand (0.0190)	Experts assign points, no demand, only a little demand, general demand, more demand, and great demand 1 to 5	

Table 1. (Continued).

Existence value (0.4586)	Ecological indicators (0.4586)	Ecological integrity value (0.0270)	Experts assign points, industrial development has a serious negative impact on ecological integrity, a large impact, a general impact, only a little impact, and no impact on the order of 1 to 5 points	
		Carbon fixation and oxygen release value (0.0139)	Area area × carbon sequestration coefficient of ecosystem	T/year
		Protect biodiversity[40] (0.0309)	Experts assign points, no protection, only a little protection, general protection, more protection, and very good protection in order of 1 to 5 points	
		Protect local culture (0.0155)	Experts assign points, no protection, only a little protection, general protection, more protection, and very good protection in order of 1 to 5 points	
		Pleasant value (0.0199)	Experts assign points, unpleasant, somewhat pleasant, generally pleasant, somewhat pleasant, very pleasant, 1 to 5 points in order	
		Education and science value (0.0203)	Experts give points, no educational and scientific projects, only a little educational and scientific value, certain educational and scientific research significance, great educational and scientific value, and many educational and scientific projects, 1 to 5 points in order	
Future value (0.3071)	Potential evaluation index (0.3071)	Protected area (0.789)	Protect the area	hm^2
		Proportion of technical personnel (0.0405)	Total number of skilled persons/employed persons	%
		Industrial R&D density (0.0415)	Annual investment in R&D	Ten thousand yuan
		Ecological constraints[33] (0.0739)	Experts assign points, no constraints, only a little constraint, a certain constraint, a large constraint, and a large constraint, 1 to 5 points in turn	
		Management ability of industrial environmental protection (0.0446)	Experts assign points, none at all, only a little, with certain management, more management, and sound management in order of 1 to 5 points	

Note: the weights of indicators are in brackets.

4. Reconstruct the utilization system of National Park resources

4.1 Current situation of resource utilization in Bawangling Area

At present, the resource utilization in Bawangling Area covers primary, secondary and tertiary industries: the primary production mainly includes the planting industries of rosin, rubber, areca nut, oil tea, scented rosewood, phyllotrium, Agarwood and Shanlan rice, as well as the breeding industries of beekeeping, overking pheasant and black pig; the secondary production is mainly small hydropower stations (referred to as small hydropower); the three industries mainly include ecological resource management and conservation, forest cultivation and other nature conservation industries, forest tourism, ethnic village tourism and other tourism services, and property management services.

The revenue status of each industry is shown in **Figure 4**, and the specific analysis is as follows: (1) the financial revenue of ethnic village tourism and natural protection project in Wangxia Township is the main economic source of Bawangling Area, accounting for more than 90% of its total revenue. However, with the end of the second phase of the Tianbao Project (2020) and the establishment of the national park, the resources and structure of nature conservation of Bawangling will be greatly adjusted, and the restrictive development strategy of the national park will certainly affect the further development of rural tourism in the region. (2) The contract development of rubber and rosin is large in scale and involves many stakeholders. It is the main income source of Bawangling Forest Development Co., LTD. (the former Bawangling Forestry Bureau, now the wholly-owned operation company of Bawangling Management Sub-Bureau of Hainan Tropical Rainforest National Park). However, in recent years, with the continuous downturn of rubber and rosin market, the aging of pine and rubber in the region is serious, and most of rubber and pine are located in the core protection area of national parks, so the scale of operation and output will be

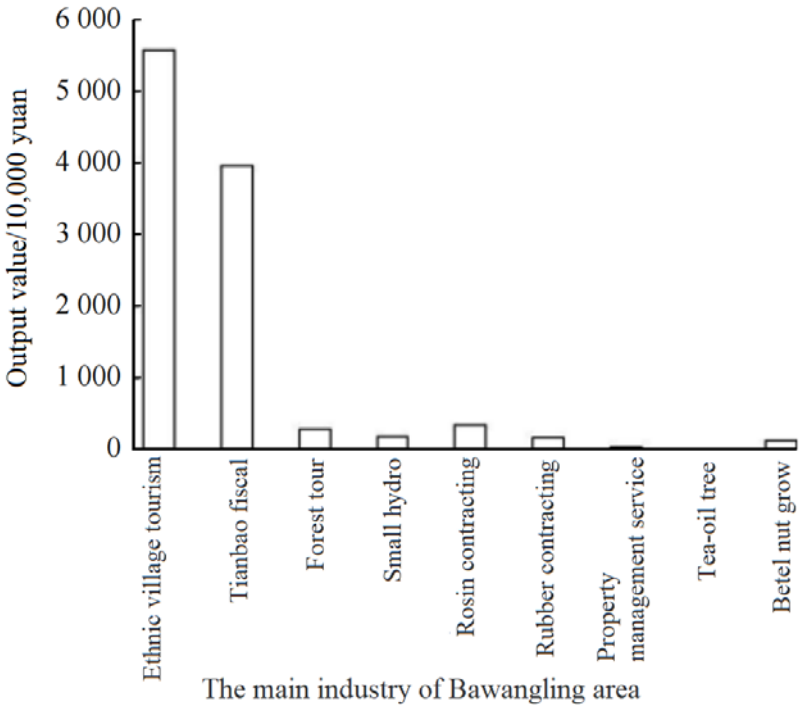

Figure 4. Output value of main industries in Bawangling Area in 2019.

greatly reduced in the future. Therefore, liquidated damages for early termination of the contract, resettlement of surplus employees after industrial reduction and ecological compensation for villagers are all arduous and important tasks for the transformation of national parks. (3) In terms of small hydropower and property management services, due to the withdrawal requirements of being located in the core reserves and the operating situation of losing money for years, they will face the risk of shutting down in the future. (4) Forest tourism in the region has begun to take shape, but the products are single, the facilities are obsolete, and the driving effect has not been brought into play. It is in urgent need of upgrading. Forest tourism, though not yet profitable, has the potential to become one of the main industries of Bawangling in the future.

4.2 Resource utilization score and comparative analysis in Bawangling Area

According to "2019 Bawangling Forest Development Co., Ltd. Production and Operation Management Plan", "2019 Bawangling Management Branch Financial Final Report", and the author's field investigation records from August 20 to 22 and October 22 to 31, 2020, Sixteen industries with statistical data in Bawangling area were extracted as data sources for analysis, among which bee, pheasant and mountain pig farming industries were not included in the analysis due to the unstable benefits of COVID-19 and other uncontrollable factors. The index data of 16 industries in Bawangling Area were substituted into the resource utilization evaluation system, normalized by R software and multiplied by corresponding weights to obtain the industry evaluation results (see **Table 2**).

The results can be seen as follows: (1) nature conservation has the highest score, which is consistent with the main function of national parks to protect the authenticity and integrity of important natural ecosystems. Therefore, nature conservation can be regarded as the core industry of resource utilization in the area, and the development of forestry based on forest cultivation should be accelerated during the transition period from Bawangling area to national park. (2) The tertiary industry, mainly forest tourism and ethnic village tourism, scored second. This is the main way to realize the comprehensive functions of national parks such as scientific research, education and recreation, so it can be identified as a key industry in the transformation of the area to absorb the surplus labor force caused by the shutdown of the core protection areas. (3) The planting industries mainly featured flowers, rubber, mountain orchid rice, areca nut and puzzle

were ranked from 4 to 8 in order. All the above industries were featured industries in Bawangling area, with mature planting and picking technology and relatively stable employment income. With the implementation of national park control measures such as restricting development and production projects and forbidding destructive human activities, the above characteristic industries can be used as auxiliary industries to restrict development in the general control areas. (4) Rosin, camellia, rubber, betel nut contracting and small hydropower are affected by market and policy, and the advantages are not obvious. With the contraction of production control in national parks, industries related to the core control areas can be phased out. (5) Housing rental and property management services are still at a disadvantage. After the responsibilities of Bawangling Management sub-bureau are gradually clear, the transfer of its relevant social function industries should be accelerated.

4.3 Reconstruction of the resource utilization system in Bawangling Area

To reconstruct the resource utilization system means to reconstruct the industrial structure based on the resource utilization status and evaluation results of Bawangling area, and form the future resource utilization system of Bawangling area under the national park system (see **Figure 5**). Specific analysis is as follows: (1) Bawangling Hainan tropical rain forest national park area resource utilization system should be in the forestry ecosystem services (conservation) as the core resources development direction, formulated to protect the gibbon and habitats for core resource management scheme, in order to ensure the safety Bawangling area to the survival and development of resources, the economic development of other tasks through franchising system transfer out, complete the separation of government (Bawangling Management Branch) enterprise (Bawangling Forest Development Co., LTD.) and the separation of resource management rights and management rights; (2) tourism and leisure services as the key resource utilization mode, as an important resettlement outlet for surplus workers to transfer jobs and community villagers to supplement livelihood under the restricted development of national parks; (3) in other places in a green economy for auxiliary industry, as the core national park reserve ban on the implementation of the productive activities, the core should be early to reserve resource utilization type industrial repel or migration work, for the rest of the general control area, based on regional environmental bearing capacity of resources, the development of upstream and downstream side and related industry, absorption of surplus labor force, maximize industrial benefits per unit area; (4) the brand of "national park" can also be used to integrate idle natural, cultural and industrial resources into assets for marketing or investment, so as to form good brand benefits and add value to these traditional characteristic products.

However, it should also be noted that in the initial stage of the transformation of Bawangling area into a national park, core industries should not be developed singly and all existing industries in the core protection area should be "cut into one size", resulting in capital chain fracture, unemployment of forest workers and antipathy of community villagers. Some resource utilization methods with the highest comprehensive score will be included in the ecological industry group of the area, and the disadvantaged industries will be restricted and gradually withdrawn, so as to set aside adjustment time for the affected enterprises, employees and community residents, and provide targeted and diversified compensation and resettlement measures. To promote the tourism service industry as the leader, realize the simultaneous development and integration and upgrading of multiple industries, avoid the risk of unbalanced industrial development, and help to adjust the industrial structure of the area, leaving room for the settlement of workers suspended and community residents.

In addition, because the resource utilization evaluation is limited to the current utilization status, Bawangling area should always pay attention to green frontier technology and forestry hot spots, take the national park as the support focus of the central and local financial system, the new development concept of the "14th Five-Year Plan" and the important practice base of the "Two Mountains theory". The pilot work of green industry develop-

ment mechanism, such as smart culture and tourism promotion, green high-tech research and development, and green financial instrument innovation, is regarded as an important resource utilization content of its exemplary guiding role.

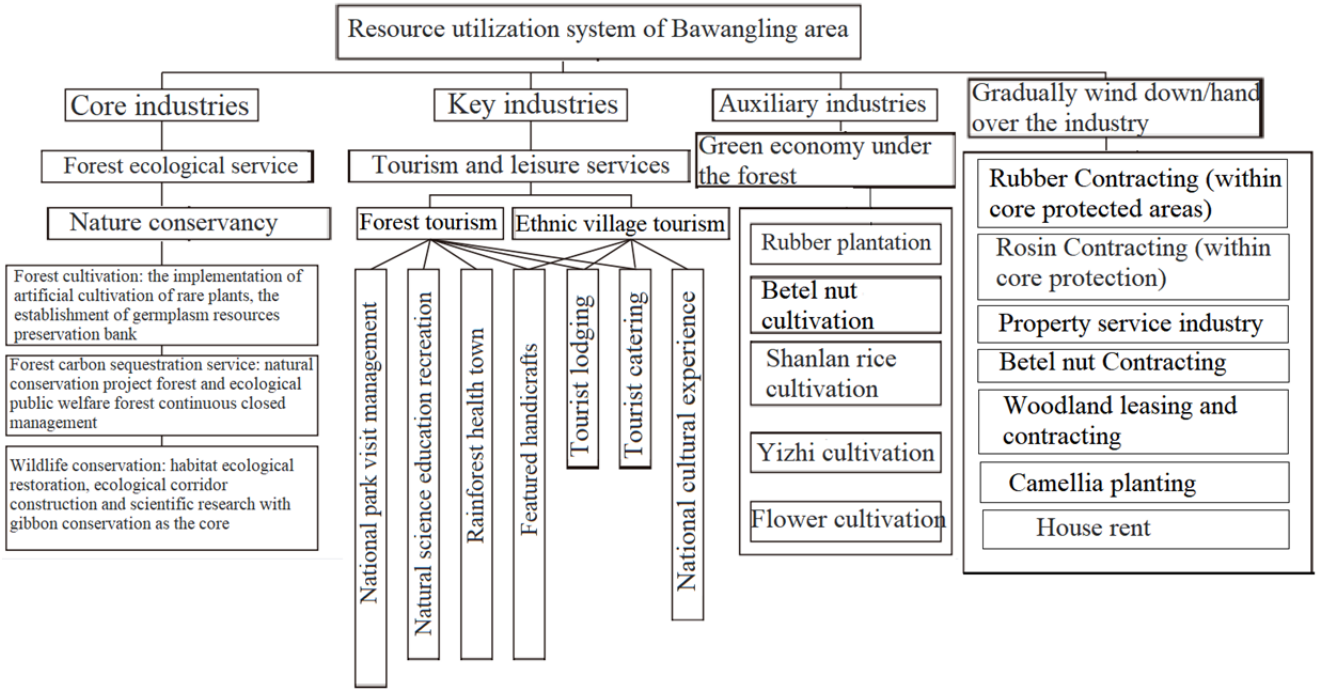

Figure 5. Future resource utilization system of Bawangling area under the national park system.

5. Optimization strategy of national park resource utilization system

5.1 Ecological adjustment of resource utilization system

As the reform of the management system and mechanism of the new nature reserve system is gradually advancing in the national parks, strengthening ecological protection has become the first priority for the transformation of each pilot area into a national park. However, from the practical experience of Bawangling area, the economic activities of national parks are also necessary to maintain the healthy development of the area, and the key is how to solve the conflict between the demands of natural resources, ecological environment protection and social and economic development.

First of all, it is necessary to ensure the core position of nature conservation, that is, to ensure resource supply and protect the ecological environment, and to strengthen the conservation activities of ecological assets such as management, conservation, cultivation and scientific research, which are the primary purpose of China's national park resource utilization system. Secondly, based on the interests of all parties, to ensure the realization of economic and social values, to find tourism, leisure or community green industries in line with the development goals of national parks. For reference, for example, is similar to the situation of our country, the national park also has complex stakeholders Japan home park's attitude toward the resource utilization. That is, while protecting beautiful landscapes and ecosystems, it contributes to citizens' health, entertainment and culture through resource utilization, divides protection levels through resource values, and uses control plans to regulate and control areas to achieve sustainable conservation of ecosystems and parks.

In conclusion, rather than a "one-size-fits-all" approach to conservation, an ecologically-oriented resource utilization system is an important tool to ensure the health, vitality and sustainable management of national parks. The modernization of "ecologicalization of economy" requires judging the total value provided by various resource utilization modes under the national park system from the perspective of ecosystem service value[43], which

can be calculated by calculating the direct use value representing economic and social benefits and the existence value and future value of resources representing public welfare of the whole people. The resource utilization evaluation index system that is most suitable for national park protection priority, ecosystem service value maximization and sustainable concept is selected.

5.2 Constructing an appropriate resource utilization system

Suitability analysis is the process and procedure of determining the suitable use of a particular piece of land[44]. The difference in application depends on the actual or expected relationship between benefits and observed factors such as demand, preference, and environmental consequences[45]. In order to form a high-efficiency resource utilization system in national parks, constructing an appropriate resource utilization system is the fundamental way to accurately improve the value of ecosystem services in each pilot area under the dual constraints of land and functions of national parks. How to comprehensively consider the influence and constraint conditions of various resources utilization is the key to construct the appropriate resource utilization system according to the development goal and resource status of national parks.

5.2.1 Industrial suitability analysis

The analytic hierarchy process (AHP) used in this study to construct the evaluation index system of resource utilization is a commonly used item ranking method for suitability analysis[46], and the resource utilization evaluation system constructed based on this method can reflect the effect of all natural, social and economic functions of national parks. According to the industrial evaluation experience of Bawangling area, the industrial suitability analysis of national park should be based on the comprehensive analysis results of industrial resources, industrial scale, industrial structure and industrial subjects. For example, the evaluation index system of resource utilization used in this study can accurately optimize the industrial structure of Bawangling through quantitative comparison among industries. According to the results of the Bawangling area resource utilization system reconstruction can be found in similar Bawangling legacy industry and general control area is building the core reserves many national park, in the community should be in order to solve the problem, optimization of core area industrial repel and general control area industrial structure and resource utilization of the sustainable development path as its limited financial background of the development of new ideas; In addition, adaptive management methods can be combined, that is, dynamic management of strategies can be adjusted in time according to industrial development ideas and resource utilization system index changes, so as to achieve timely loss stop and minimize the destructive interference of human social system and economic system to the national park ecosystem[5].

5.2.2 Suitability analysis for development stage

Based on the application research of Bawangling area, the utilization mode of resources in the pilot area is closely related to the construction stage of national parks, which is also consistent with the conclusion analyzed by relevant scholars[2] that “the protection and utilization of national parks should be considered in the overall environment of social and economic development stage to determine the utilization intensity and sequence of national parks”. In the pilot stage of transforming into a national park, it is necessary to carry out resource utilization evaluation, actively guide the industry and population of the core protected areas to withdraw, and establish the green development concept of the area and surrounding communities. In the construction period of national parks, it is necessary to actively seek for projects close to nature, with nature conservation as the core industry, tourism and leisure services as the key industry, and green economy under forests as the auxiliary industry, and always pay attention to green frontier technology and forestry hot spots. In the completion period of the national park, local residents with good education background and stable income base can use the national park brand to build a benefit sharing system and further deepen the value co-creation concept and consciousness of stakeholders in pursuit of

"maximizing the value of national park ecosystem services"[4]. Through the tourism association and driving effect generated by high-quality services such as recreation development, natural science and education, accommodation, catering and cultural experience of national parks, the linkage with green economy of other forests is realized, and the resource utilization pattern of "cross-regional linkage, productive integration and multi-participation" is basically formed.

5.2.3 Normative restriction suitability analysis

The utilization of resources in Bawangling area involves a huge ecosystem, especially the incoordination of stakeholders. In order to achieve the goals of effective protection of natural resources in national parks, maximizing the value of ecosystem services and sustainable utilization of resources, in addition to meeting the development needs of national parks and the interests of stakeholders, Managers, community residents, concessionaires and visitors should also be guided to conduct responsible and eco-friendly behaviors to regulate and restrict industrial activities and micro-subject behaviors in the utilization of national park resources[19].Good regulations on the utilization of national park resources need to be formulated in terms of laws, regulations and standards. Including management rules and regulations to protect the safety of ecological resources, monitoring of franchise regulation of the industry development, guarantee the attraction of tourists tourism and leisure resources negative behavior regulation, ensuring the sustainable livelihood of employees and residents welfare regulation, establish protection priority values of popular science education, etc., to ensure that industry development after the smallest negative impact ecosystem, the largest supply of social welfare.

To sum up, an appropriate resource utilization system needs to be comprehensively analyzed based on the industrial foundation of national parks, the construction stage of national parks and the normative mechanism (see **Figure 6**) to ensure that the resource utilization system supports the sustainable operation of national parks and monitors the resource utilization to meet the management requirements.

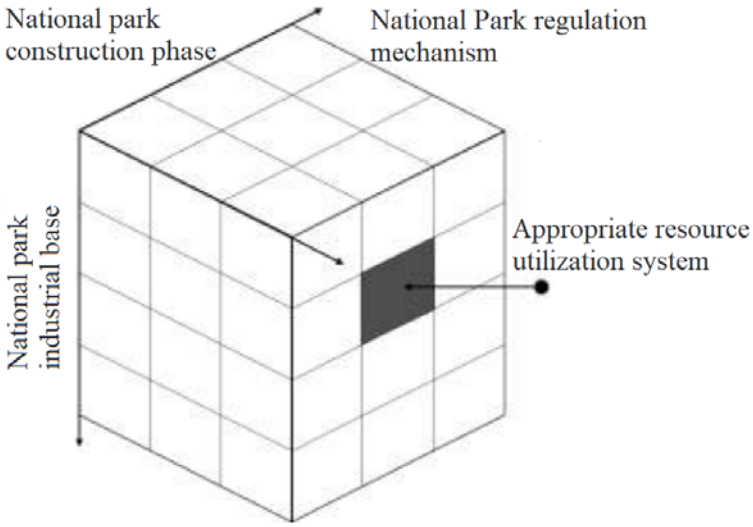

Figure 6. Appropriate observational factors for resource utilization.

6. Conclusion

The most typical problem in the pilot areas of national parks lies in the original contradiction between protection and utilization. The key to solve this problem is not only the priority of ecological protection, but also the new way of resource utilization. Rational resource utilization is not only an important channel to realize diversified investment and financing of national parks, but also an important guarantee to realize the goals including ecological protection, community co-management and public sharing. Resource utilization assessment is the basis for understanding the suitability of production activities in national parks. The ranking of

resource use assessment can reflect an industry's contribution to natural harmony and human well-being. This study based on national park, ecological protection, ecosystem services value maximization and the target of sustainable development of resource utilization, puts forward the value of ecosystem services under the perspective of resource utilization index system, and combining the Hainan tropical rain forest national park Bawangling partition application analysis, put forward the new type of Bawangling nature reserve system for resource utilization system. On this basis, resource utilization is bound to be a long process of control, and its impact is unknown. In order to make resource utilization assessment an effective resource management tool for national parks, the following points should be done in resource utilization for future national parks like Bawangling area, which should guarantee the basic productive activities of community residents.

(1) Adhere to the road of modern development of "ecological economy", retain the value appeals of ecological, social and economic parties to maximize the value of the ecosystem; in order to promote the national park management department to make full use of the national park resource utilization evaluation index system, to quantitatively and systematically analyze the feasibility of the development of each industry, and judge the annual environmental impact trend of the industry, timely control.

(2) Based on the scientific analysis of industry suitability, development stage suitability and normative restriction suitability, and on the premise of assuming the responsibility of protecting the integrity and authenticity of the ecosystem, the adaptive management method should be used to release the maximum ecological, social and economic benefits of the region.

(3) The core position of nature conservation in the resource utilization system of national parks should be firmly established, the social needs of tourism and leisure service development should be met, and the system of green economy and technology under forests should be actively innovated to create a resource utilization pattern with the participation of relevant stakeholders.

Acknowledgements

This work was supported by research project of Hainan National Park Research Institute "Bawangling Forest Area Protection Priority, Ecosystem Integrity and Sustainable Resource Utilization Transformation Research" (KY-2000403-KT).

Conflict of interest

The authors declared no conflict of interest.

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