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Review Article

Progress, problems, and key directions for establishing the first national park demonstration province in Qinghai, China

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ABSTRACT

Establishing a national park system is an important component of the ecological identity of China and an essential measure to achieving natural and ecological protection through governance systems. The goal was to create a model province that integrated environmental protection, ecological integrity, management and support systems, coordinated development, comprehensive evaluation, and livelihood protection, with national parks serving as the main body. A further goal was to obtain a reference and basis for the official establishment of a number of national parks and the initial establishment of a national park system in 2021. Based on the progress of the pilot national park system in Qinghai, in this study, we have summarized some common and individual problems encountered in the construction of a model national park province. Further, five key foci were revealed during the 14th Five-Year Plan period: resource management and functional areas, ecosystem protection, support system construction, coordinated community development, and nature education and ecological experience.

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1. Introduction

Qinghai Province is an integral ecological functional area in China, and plays an important role in China's national ecological security barrier. Therefore, the establishment of protected areas within the province is of particular importance, to which end a pilot program has aimed to protect the local ecosystem, improve ecosystem services, restore biodiversity, achieve breakthroughs in the management system, form a green development mode, and improve people's livelihood. As the main body representing the nature reserve system in the country, the Fifth Plenary Session of the 13th Qinghai Provincial Party Committee proposed taking the lead in forming a national park, and commenced with the establishment of a national park demonstration province. In December 2015, the central leading group on comprehensive reform adopted a pilot scheme for China's Sanjiangyuan National Park (SNP) System, marking the launch of China's first national park system pilot area (Ma, 2018). In June 2017, the National Development and Reform Commission approved a secondary pilot scheme of the Qilian Mountain National Park System (Huang et al., 2018); and presently, Qinghai Lake, Kunlun Mountain, Mengda, and Beishan National Parks are under planning. To ensure the effective formation and comprehensive promotion of the Qinghai Nature Reserve System, the three river sources, Qilian Mountain, and Qinghai Lake will be the main components of the first modeled national parks in China.

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The report of the 19th National Congress of the Communist Party of China explicitly proposed to “establish a nature reserve system with national parks as the main body” (Tang, Wang, Li, & Zhang, 2018; Zhao, Sang, & Min, 2020). Qinghai, as a large and ecologically diverse province, must make every effort to promote the pilot work of the two approved Sanjiangyuan and Qilian Mountains National Park systems and accordingly establish a nature reserve system with national parks serving as the main body. Summarizing and promoting the results of the pilot national park systems, the Qinghai provincial government and the National Forestry and Grasses Bureau jointly conducted the construction of a model province of national parks, compiled a “General Plan for the Construction of a Model Province of a Nature Reserve System with National Parks as the Mainstay in Qinghai,” coordinated the layout, and explored the establishment of a cluster of national parks with plateau characteristics. To further integrate the types of parks and nature reserves, the implementation of nature reserve management systems was proposed, with national parks forming the main body, nature reserves at the next level up, and various types of parks as supplements, to ensure systematic and complete protection of important natural ecosystems, relics, landscapes, and biodiversity, in addition to playing a demonstrative and driving role in China’s environmental protection efforts.

Scholars in China and abroad have carried out numerous comprehensive studies on the progress, challenges, and key directions of national parks. Some scholars mainly summarized and explored the principles, objectives, trajectories, progress, and problems of China’s national parks and put forward specific suggestions (Li et al., 2021; Yang, 2021; Zang et al., 2020). For example, Zhang (2019) evaluated the ecosystem service value of the Qilian Mountain National Park in Qinghai Province, whereas Peng et al. (2020) and Gao et al. (2019) explored the temporal and spatial trends of vegetation and bird species diversity in Sanjiangyuan National Park. Furthermore, other scholars have systematically summarized research status and achievements of national parks at home and abroad, with a focus on functional zoning, business development, facility construction, evaluation, main body, environmental impact, and management of national parks (Li, Wu, & Tian, 2020).

With the goal of taking the lead in establishing a national park demonstration province in China, according to the concept that mountains, rivers, forests, fields, lakes, grass, and soil constituting a community of life, innovate natural reserve management systems and approaches, and establish a natural reserve management system with national parks as the main body, nature reserves as the basis, and various natural parks as the supplement, the ecosystem service function within the national parks has been improved continuously. Specifically, grassland and forest shrub ecosystems have been conserved, and vegetation cover and water conservation have been improved, and the wetland ecological function has been enhanced. Furthermore, land desertification trends have been curbed, wildlife populations have increased significantly, and biodiversity has been restored significantly. Similarly, to establish a new system and model of ecological protection, enhance the modernization of ecological and environmental governance system, and governance capacity, and facilitate national ecological security, the national park system is expected to be established by 2025. Based on models of Sanjiangyuan and Qilian Mountain National Parks, national ecological restoration demonstration areas, nature reserve system demonstration areas, pilot areas for symbiosis between man and nature, Gaoyuanda Nature Reserve exhibition areas, and excellent cultural inheritance areas will be established with the national park as the main body. Finally, the “network model” of national parks will be established in Qinghai Province, which will be a national park demonstration province established as a reference and template for the establishment of national parks in other regions.

2. Studymethods

2.1. Study area

Sanjiangyuan National Park(SNP) is located in the hinterland of the Qinghai Tibet Plateau, in the southern region of Qinghai Province, with a total area of 12.8×10^5 km², accounting for 18.79% and 31.16% of the total area of Qinghai Province and the source area of three rivers respectively. Sanjiangyuan National Park is the origin of the Yangtze River, the Yellow River, and the Lancang River. It is an important freshwater source for China and Southeast Asia. It is also one of the regions most sensitive to global climate change. Its ecosystem service function, natural landscape, and biodiversity have national and even global protection value. In addition, due to its unique geographical location, rich natural resources, and important ecological functions, the park is an important ecological security barrier on the Qinghai Tibet Plateau in China.

The total area of Qilian Mountain National Park is 5.02×10^4 km². Among them, the Qinghai area is 1.58×10^4 km², accounting for 31.5% of the total area. The main protection objects are wetlands, glaciers, rare and endangered wild animals and plants, and the forest ecosystems. The Qinghai area of Qilian Mountain National Park is located in an alpine zone with a plateau continental climate, strong solar radiation, large daily temperature differences, long cold seasons and short hot seasons, distinct dry and wet seasons, and obvious vertical shifts in temperature and precipitation. The altitude is 2263–5791 m, the annual average temperature is -1.4 – 9.6 °C, and the annual average precipitation is 84.6–515.8 mm. There are numerous rivers in the area: the Datong River belongs to the Yellow River Basin, whereas the inland rivers include the Heihe River, Tole River, and Shule River.

2.2. Data collection methods

This paper uses literature collection and field research to obtain relevant data. The research progress is summarized by consulting a large number of literature and datasets. Data and information of the challenges and key directions are obtained through field investigations at Sanjiangyuan National Park Administration, Qilian Mountain National Park Administration, Qinghai Lake Nature Reserve Administration, and other relevant units. Research methods include discussion, exchange, and field investigation.

2.3. Research roadmap

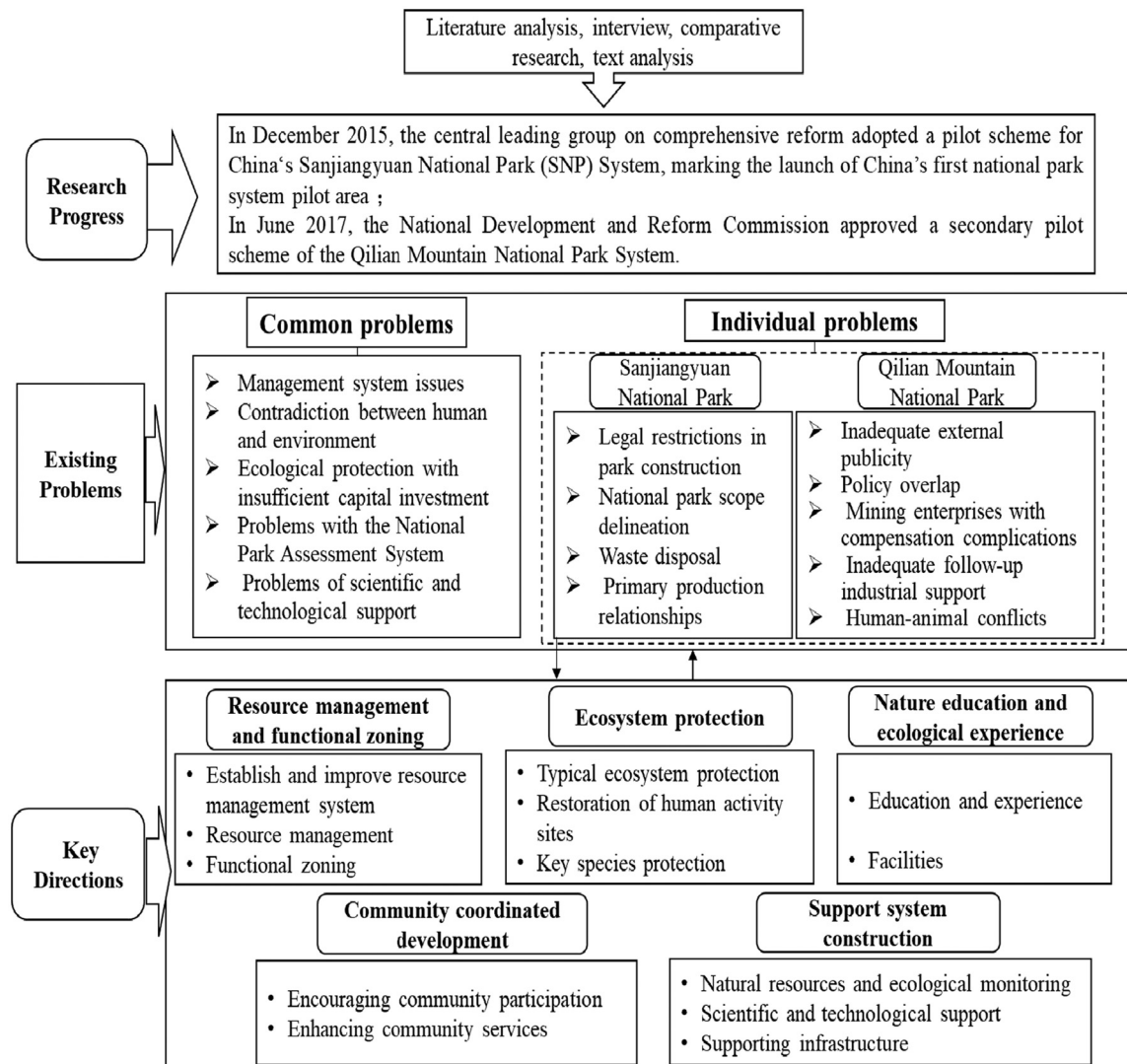


Fig. 1. Overall framework of the study.

3. Progress of the pilot national park system in Qinghai

In general, the pilot work of the national park system has been highly valued by the government and all sectors of society since its promotion (Ma, 2017). The research conducted in the pilot program area has led to the publication of a series of academic literature with global implications (Liu, Ma, Cheyne, & Turvey, 2020; Chen et al., 2019). Ecosystem services in these pilot areas have been stabilized or improved, illegal environmental destruction has been effectively curbed, the observed biodiversity has increased, habitat has been restored, and new species of animals and plants have been identified. By integrating and optimizing the management of nature reserves, and their corresponding lake, grass, sandy ecosystem of the mountains, rivers, forests, and fields, the systematic, authenticity, connectivity, and integrity of ecological protection in Qinghai Province have been quantifiable, and a national ecological security barrier has been firmly established. Further phases of the ecological protection project at Sanjiangyuan involve the restoration of pastures to grasslands, black soil management, sandy land control, protection of important water sources, and other key projects to ensure that "a river of clear water flows eastward". With the implementation of a policy of "One job per household" for ecological custodians, the initiative and enthusiasm of the general public to participate in the construction of national parks has steadily increased. In addition, the county and township administrative units, together with the National Park Administration, are managed by the same leadership team, greatly improving the efficiency of national park construction.

Ecological protection in the pilot areas of Sanjiangyuan and Qilian Mountain National Parks of Qinghai Province has generally been strengthened, and the monitoring and enforcement capabilities have been effectively improved. Each pilot area conducted

ecological monitoring, background resource and data investigations, publicity and promotion, community co-construction and co-management, and the implementation of various ecological protection projects (Table 1). Additionally, joint law enforcement should be performed against the main illegal activities threatening the pilot areas, the principles of natural recovery should be adhered to, and the necessary auxiliary measures to repair varying types and degrees of ecosystem degradation and damage should be undertaken in the pilot areas. Thus far, the pilot project of the national park system has achieved good results. The efficiency of natural resource asset management has been significantly improved, the intensity of ecological protection and restoration has been enhanced, people's livelihood within the community has improved, and social benefits have been highlighted (Zang et al., 2020). (See Fig. 1) (See Table 2).

4. Results and discussion

4.1. Common problems in the establishment of the national park province

4.1.1. Management system issues

Currently, the national park system was yet to establish a unified management and coordination mechanism, and the present system is imperfect. First, after the establishment of the park management office, its working relationship between the county party committee, and the government has not been thoroughly defined due to a lack of clear hierarchy, in addition to the problem of poor communication and convergence. Second, after the cancelation of county- and ecosystem-level environmental protection, water conservancy, and other functional government agencies, in addition to the transfer of personnel, all the ecological and environmental protection work, both inside and outside the park, still requires coordination and action. Therefore, the problems of “one team, two brands,” dual leadership, and multiple management still exist. Third, historically, the regional natural resources management departments have both local government and management institution components, and the explicit rights and

Table 1
Basic information of the pilot Qinghai Province national park system.

Pilot cope	Latitude and longitude	Area (km ²)	Types of ecosystems	Advantageous plants	Advantageous animals	Areas	
Sanjiangyuan National Park	Yangtze River Source Park	89°50'57" ~ 95°18'51"E 33°9'5" ~ 36°47'53"N	90,300	Alpine grassland, Alpine meadow	<i>Kobresia humilis</i> , <i>Kobresia capillifolia</i> , <i>Kobresia pygmaea</i> , <i>Kobresia tabetic</i> , <i>Polygonum viviparum</i> , <i>Rhodiola rosea</i> , <i>Cordyceps sinensis</i> , <i>Saussurea involucrate</i> , <i>Notopterygium incisum</i>	<i>Panthera uncia</i> , <i>Cervus albirostris</i> , <i>Equus kiang</i> , <i>Poephagus mutus</i> , <i>Grus nigricollis</i> , <i>Aquila chrysaetos</i> , <i>Gypaetus barbatus</i> , <i>Procapra picticaudata</i> , <i>Ursus arctos pruinosus</i> , <i>Lynx lynx</i> , <i>Felis bieti</i> , <i>Cygnus cygnus</i> , <i>Tetraogallus tibetanus</i>	ZhiDuo county, QuMaLai county
	Huangheyuan Park	97°1'20" ~ 95°14'57"E 33°55'5" ~ 35°28'15"N	19,100	Alpine grassland, Alpine meadow	<i>Kobresia pygmaea</i> , <i>Kobresia humilis</i> , <i>Kobresia tabetic</i> , <i>Stipa purpurea</i> , <i>Thermopsis lupinoides</i> , <i>Roegneria thordiana</i> , <i>Carex spp.</i> , <i>Leontopodium leontopodioides</i> , <i>Potentilla chinensis</i> , <i>Saussurea japonica</i>	<i>P. uncia</i> , <i>Cervusal birostris</i> , <i>E. kiang</i> , <i>Poephagus mutus</i> , <i>Ciconia nigra</i> , <i>Grusnigri collis</i> , <i>Procaprapic ticaudata</i> , <i>Ursusarctos pruinosus</i> , <i>T. tibetanus</i>	MaDuo county
	Lancang River Park	93°38'24" ~ 95°55'40"E 32°22'36" ~ 33°56'6"N	13,700	Alpine grassland, Alpine meadow	<i>Salix cupularis</i> , <i>Potentilla fruticose</i> , <i>Hippophae rhamnoides</i> , <i>Spiraea alpine</i> , <i>Caragana jubata</i> , <i>Fritillaria delavayi</i> , <i>Anemarrhena asphodeloides</i> , <i>Saussurea involucrate</i> , <i>R. rosea</i> , <i>Gentiana macrophylla</i> , <i>Cordyceps sinensis</i>	<i>P. uncia</i> , <i>Pantholops hodgsonii</i> , <i>C. albirostris</i> , <i>E. kiang</i> , <i>Poephagus mutus</i> , <i>G. nigricollis</i> , <i>A. chrysaetos</i> , <i>P. picticaudata</i> , <i>U. arctos pruinosus</i> , <i>Felis lynx</i>	ZhaDuo county
Qinghai area of Qilian Mountain National Park	96°66' ~ 102°64'E 37°08' ~ 39°21"N	15,839	Temperate desert grassland, Cold temperate mountain coniferous forest, Alpine meadow	<i>Picea crassifolia</i> , <i>Sabina przewalskii</i> , <i>Populus davidiana</i> , <i>Betula spp.</i> , <i>Populus spp.</i> , <i>Potentilla fruticosa</i> , <i>P. glabra</i> , <i>Salix cupularis</i> , <i>Caragana jubata</i> , <i>Rhododendron</i> , <i>H. rhamnoides</i> , <i>Ephedra przewalskii</i> , <i>Simsii</i> , <i>Tamarix chinensis</i> , <i>Nitraria tangutorum</i> ,	<i>P. uncia</i> , <i>Przewalskium albirostris</i> , <i>Moschus chrysogaster</i> , <i>G. nigricollis</i> , <i>E. kiang</i> , <i>A. chrysaetos</i> , <i>Cordyceps sinensis</i> , <i>Saussurea involucrate</i>	De Lingha city, Qi Lian county, Tian Jun county, Men Yuan county	

Table 2
Main progress of pilot Qinghai Province national park system.

Pilot scope		Implementation of the institutional pilot	Key contents
Sanjiangyuan National Park	Yangtze River Source Park	Dynamic monitoring and investigation of ecological status.	Conduct a dynamic monitoring survey of grassland ecology within the park, including the average annual grass production, average elevation and growth, and development cycle of the region. Collect monitoring and imaging data on grassland degradation status and wildlife habitat.
		Implementation the ecological public welfare post policy.	Complete the task of setting up “one post per household”, establish efficient ecological caretaker assessments, management methods, and patrol systems.
		Snow resistance, disaster relief, and wildlife rescue.	The park management office has established an anti-disaster working group. Arrange and deploy disaster prevention and mitigation, and wildlife rescue, and conduct household investigation on the disaster situation. Organize some ecological management and protection personnel in the park to track and master the disaster situation in the park, and actively enhance the capacity of ecological management and protection personnel to give early warning for disasters.
		Ecological protection infrastructure construction and Sanjiangyuan phase II construction project were effectively implemented.	Based on the first phase of the project, the second phase of the Sanjiangyuan project in the park established the value assessment of the ecosystem service functions of Sanjiangyuan, the ecological and environmental cost accounting system, and the ecological compensation measurement method.
		Strengthening of the patrol work of river leaders at all levels.	Fully implement the work of the river director system in the park, adequately adjust the river (lake) director, announcements, and update information related to the river (lake) director public sign.
		Law enforcement of resources and environment.	The Park Management Office actively develops inspection programs to cooperate with the Leading Group of the Special Struggle against Blackness and Evil, and the Working Group of the Centralized Combating and Rectification of Pollution and Environmental Crimes in the Yangtze River Basin, to crack down on illegal unlicensed activities, transboundary mining, and theft of sand and gravel resources by law.
Huangheyan Park		Innovation system and mechanism.	Integrate the institutional responsibilities of departments related to natural resources and ecological protection; the formation of the Yellow River Source Park National Park Management Committee responsible for the management of natural resources inside and outside the park, ecological protection, concessions, social participation, and other responsibilities.
		Promoting natural resource management through overall planning and diversification.	To conduct unified registration of natural resources such as water flow, forests, wetlands, mountains, grasslands, wastelands, beaches, wild animals, mineral resources, and other natural resources in the park; to identify the basic situation of the type, ownership, location, boundary site, quantity, quality, and protection status of natural resources in the park.
		Strengthening comprehensive law enforcement.	Integrate county forest public security, land law enforcement, environmental law enforcement, grassland supervision, fisheries, and other law enforcement agencies to establish the Bureau of Resource and Environmental Law Enforcement; realize unified law enforcement of ecological, environmental, territorial control, and natural resources in the jurisdiction, and actively explore the mechanisms of natural resource criminal justice and administrative law enforcement.
		Conducting overall publicity and promotion.	Make full use of the network WeChat, microblogging, Maduo micro propaganda, Maduo today, and other media to increase publicity and promotion, vigorously publicize new highlights, achievements, and experiences of the pilot national park system in the Yellow River Source Park.
Lancang River Park		Preliminary establishment of “point, line, and surface” comprehensive “network management and protection system”.	Combined with the work of poverty alleviation, the ecological public welfare management post was set up from the poor households in the park, realizing “one post for one household”.
		Establishment of compensation mechanisms for human animal conflict avoidance.	Funded the establishment of a pilot “human-animal conflict insurance fund” as a mechanism for wildlife injury compensation proceedings.
		Community co-construction and management to improve the ecology of the park.	Conduct environmental education “into the school, family, community, village, monastery, and organs”; form village and community sanitation teams, and gradually realize the new pastoral waste reduction and recycling treatment mechanisms of “household picking, village collection, township operation, and county treatment”.

Table 2 (continued)

Pilot scope	Implementation of the institutional pilot	Key contents
Qinghai area of Qilian Mountain National Park	Exploring the new mode of franchise in demonstration villages.	Through activities such as ecological experience, nature observation, tracing the Mother River, and extreme hiking, actively explore new models of ecological experience and nature education in national parks.
	Field investigation, demonstration, and resource census.	All basic data on lands, minerals, forests, wetlands, glaciers, and grassland resources, industrial and mining enterprises, water, electricity, and road infrastructure, resident farmers and herders in the park were verified in detail, and a basic data ledger was established.
	Investigation of background resources and data information on national parks.	County-level financial implementation of the park system pilot inspection, patrol, and other work; the organization of "Qilian Mountain Nature Reserve spring patrol and law enforcement special inspection", "Green Shield 2018", and other special operations; improve the "one enterprise, one book" file.
	Establishment of community participation mechanism of "two village committees +".	Conduct a national park background resources and data information survey, complete the pilot area boundary drop, functional zoning, and in situ verification work.
	Establishment of community participation mechanism of "two village committees +".	Explore the establishment of "two village committees +" based on community participation in the common construction and management sharing mechanism, selected pilot villages, sign "two village committees +" common construction and management agreements.
	Conducting cooperation in scientific investigation in various fields.	Establish national long-term scientific research bases, accelerate the construction of ecological environment monitoring and assessment systems, actively build a scientific research cooperation platform, and build a "heaven, earth, and air" integrated ecological environment monitoring and control network.

responsibilities of owners, managers, and regulators remain unclear. Thus, issues with fragmentation of natural resources protection and management, multiple management, unpolished systems, and inefficient collaborative protection are prominent, leading to a low efficiency of the protection and management system.

4.1.2. Contradiction between human and environment

Most of the protected areas in national parks are important, ecologically functional, sensitive, and vulnerable areas, whose development and utilization are heavily restricted under relevant protection policies. Residents inside the park live on traditional animal husbandry, with low levels of public service, opportunities for increasing income or social status, and efficiency. Herdsmen's income primarily derives from traditional animal husbandry, policy income, and sporadic side jobs. Thus, herdsmen tend to fall into a wide range of poverty. In addition, incidents of wildlife injuring people and livestock occur from time to time in the parks, which poses a risk to the life, property, and safety of park residents, without any reasonable compensation standards or safeguard measures in place.

4.1.3. Ecological protection with insufficient capital investment

National parks typically cover a large area, and many of the protected land types are distributed across high-altitudes or uncommon locations, with low levels of social development, restricted or prohibited development, limited development space, and a significant lack of financial resources. Additionally, access is inconvenient, infrastructure is weak, and the corresponding costs of management, care and operations are high. Although national and provincial finances provide a certain level of support for national parks, there is a lack of continuity and effective financial guarantees to meet the sustained needs of national park ecological protection. Simultaneously, the levels of ecological protection subsidies and incentive funds are relatively low, although they are the primary mechanism for addressing the subsistence of herders. Additionally, the finances for support facilities necessary for migrants is insufficient (He, 2016).

4.1.4. Problems with the National Park Assessment System

Currently, the evaluation system of national parks was characterized by the following limitations: first, because national parks are still new in China, there are few studies pertaining to the evaluation system of national parks. Second, there is limited available data for evaluating the conservation objectives, resource quality, utilization, and current situation of the protected areas. Third, the selected evaluation indices have failed to reflect the results achieved since conservation implementation; this has perhaps prematurely prompted protected area managers to adjust their strategies. Fourth, management efficiency evaluation indicators have primarily focused on the evaluation of management foundations and daily behavior, and rarely involve the influence of stakeholders on management efficiency (Li, Guo, & Liu, 2015). To adequately address these problems in an effort to build a functional national park system in Qinghai Province, an evaluation system should be constructed according to the location, functions, and management objectives of the national parks, including an evaluation of the conservation value of national parks, particularly that of ecosystem and species diversity.

5.1.5. Problems of scientific and technological support

The novelty of the national park system in China demonstrates an insufficient accumulation of preliminary research and theoretical knowledge, and the system pilot is thus constrained by scientific and technological support (Huang et al., 2018). In particular, the management and technical standard system needs to align with international standards, and the unified natural resource rights registration, background survey, boundary delineation for all natural resource assets, monitoring of index systems, and technical systems are important prerequisites for the construction of national parks; however, all these are presently missing.

4.2. Individual problems with national park establishment

As the actual situation at each national park in Qinghai Province is unique, there are a number of specific problems. The following sections will address Sanjiangyuan National Park and Qinghai Province area of Qilian Mountain National Park as illustrative examples.

4.2.1. Sanjiangyuan National Park

4.2.1.1. Legal restrictions in park construction

During the implementation of the pilot SNP, the national park and nature reserve systems were parallel, and the park construction was applied to both the Regulations of the People's Republic of China on Nature Reserves, and the Regulations of SNP (for trial implementation), although the types of regulated nature reserves, division criteria, and management regulations for the two protected areas were different (Ma et al., 2019). Article 30 of the Regulations of SNP includes provisions for strengthening the construction of infrastructure and public service facilities of the park, whereas the Regulations of the People's Republic of China on Nature Reserves prohibits the protection of core and buffer zones, and the interface between the two is unclear.

There is a further contradiction between the strict implementation of environmental protection policies, park construction, poverty relief, and the improvement of livelihood through specific management practices. First, it is difficult to approve construction projects for park patrol roads and other infrastructure due to conflicting regulations, and they are left in limbo without approval, and unable to break ground. Second, the park is restricted to the construction and production of living infrastructure. Research has found that the Yangtze and Lancang River source townships within park jurisdiction suffer from poor traffic, communications, housing, and other infrastructural limitations, with a road access rate < 50%, mobile communication coverage rate < 60%, and substandard herdsman production and living conditions; however, because of the restriction of the prohibition clause placed on the nature reserve, infrastructure projects such as water, electricity, roads, and communications cannot be implemented.

4.2.1.2. National park scope delineation

Although a substantial progress has been made towards delineating the institutional mechanisms of vertical management and local governments at all levels (namely those that are mutually beneficial, assistive, and directed towards common development), they have yet to be comprehensively strengthened. The areal extent of the national park does not coincide with the administrative boundaries of the four counties, nor has the park been adjusted since administrative division. The park management entity was not newly established when the agency was formed, and the original agencies of the four counties themselves have long lacked professional and technical personnel. They were now tasked with “highlighting and effectively protecting and restoring the ecology” of the national park, but also must consider their county when addressing the ecological protection tasks within and outside the park. Thus, management capacity is not fully adapted to the needs of national park construction.

Although the “Sanjiangyuan National Park Regulations” have been introduced, the area of SNP and Sanjiangyuan National Nature Reserve overlaps by ~95%, and the pilot period to meet the ecological protection, aboriginal production, and livelihood infrastructure construction is still subject to the laws and regulations of the nature reserve, limiting the full and effective implementation of any “regulations”. In addition, there are eight townships in ZaDuo County, three of which are outside the range of the national park. Although the geographical environment of each township is similar, as is the importance of park protection, due to the differing policies inside and outside the park, external residents cannot partake in the beneficial park policies and the development inside and outside of the park is not well coordinated.

4.2.1.3. Waste disposal

Due to both natural and historical limitations, the economic development of the park is lagging, and the construction of waste disposal sites, supporting facilities, and operating expenses have thus far been borne by the government. Presently, there are no unified dumping sites or supporting facilities in the townships, other than those at the county-level. Therefore, villagers have casually begun landfilling and incinerating their waste, resulting in serious environmental pollution. Coupled with limited local government funding, these townships can rely only upon the state to invest funds for establishing unified waste disposal sites. Concurrently, the construction of waste disposal sites at the county-level only covers a small service radius of the country, and some of these sites are already near capacity and unable to meet the demand. Currently, waste inside the park comprises of easily decomposable waste, such as fruit peels and paper; however, non-degradable waste, such as electrical appliances and plastic bags, is increasing exponentially (Zhang, 2013). In townships with waste disposal sites, the waste is collected without sorting, and cannot be readily recycled. As a result, the only method of disposal available is a landfill, which can cause a host of secondary pollution issues.

4.2.1.4. Primary production relationships

Herdsmen, livestock, and wild animals have been living together for a long time within the now SNP. This has always been a traditional vocation with abundant water and grass, forming a unique grassland ecosystem. Farming culture in this region has not fully adapted to the development of animal husbandry, as resistance to frequent natural disasters, as and connections with the larger market are limited. Moreover, the current practices do not fulfill the standards of environmental protection and development; and although grazing prohibition is a commonly employed method of ecological protection, there are several other issues requiring further consideration. For example, Yushu prefecture reflected that the effect of grazing prohibition in Qiangtang was obvious in the early stages; however, grassland degradation occurred as time progressed, (e.g., black soil beach). Alternatively, Batang grasslands have long been grazed by herdsmen, and its ecological integrity has always been maintained due to the coevolution of the grasslands of Sanjiangyuan with grazers. These issues must be further addressed to appropriately manage for primary production, and achieve a cycle of sustainable ecological production.

4.2.2. Qilian Mountain National Park

4.2.2.1. Inadequate external publicity

In terms of external publicity, Qilian Shan National Park is severely lacking compared with SNP. Research has indicated that Qilian Shan National Park has no special publicity funding, and the annual budget for publicity <200,000yuan, ~1% of the annual publicity funding for SNP. The corresponding lack of external publicity, have resulted in a lower external influence, and a reliance on conservation associations and other small media for publicity.

4.2.2.2. Policy overlap

In the process of allocating parts of the Menyuan and Qilian counties into the Qilian Mountains National Park, there were many problems with overlapping policies. For example, 35% of the area of Menyuan County was assigned to the national park, 60% was assigned to the ecological red line area, 100% of which was a demonstration area for tourism, with unclear management objectives in the cross-over areas (Zhang et al., 2019). In addition, there is a widespread issue of multi-management of “one land, two certificates” in the Qilian Mountains National Park, where the same piece of land can be under the joint jurisdiction of forestry, agriculture, animal husbandry, and land departments, with multiple attributes and policies. Due to these variable management responsibilities and resource protection objectives for each department, the problem of unclear management ownership, cross-functionality, and variable standards are severely prohibitive.

4.2.2.3. Mining enterprises with compensation complications

After investigating the Qilian Mountain National Park planned range of mining sites, based on the preliminary delineation of the pilot range involving >100 mining rights, it became apparent that the pilot will affect the pre-processing of these projects, and their subsequent construction. To address this problem, the situation should be mapped based on a thorough understanding of policies, and strengthened communication between relevant state departments. Increased national support for the Qilian Mountain National Park system pilot area is necessary, and more policies must be implemented on the ground to ensure that all mining enterprises affected are removed in a phased, orderly manner.

4.2.2.4. Inadequate follow-up industrial support

Approximately 41,000 people live in the Qinghai Province area of Qilian Mountain National Park. They are primarily farmers and herdsmen, with minimal education or labor skills (Xue et al., 2019). Moreover, the total regional economy is small, and the follow-up industries that are supporting development are inherently insufficient. The successful construction of the Qilian Mountains National Park system pilot area should accelerate support for the development of successive alternative industries, and encourage the residents of the Qilian Mountains region to support the national park “brand” by supplementing traditional agriculture and herding industries with the provision of recreational services and other correlated business activities. In addition to ecological compensation and poverty alleviation, ecological care, concession, and other positions to achieve local resettlement should focus on eco-friendly projects to support the development of successive alternative industries.

4.2.2.5. Human-animal conflicts

The main types of human-animal conflicts in the Qinghai Province area of Qilianshan National Park involve interactions between brown bears, wolves, snow leopards, and livestock. These animals can interfere with grazing, and brown bears even pose a threat to herder's physical safety; however, the current situation in the area differs to some extent from that of Sanjiangyuan. In the Qilian Mountains, herders believe that wolves are more serious than brown bears in terms of personal safety and livestock damage, likely due to the number of brown bears in the Qilian Mountains being relatively low, and local herders keeping sheep livestock, which are much more easily preyed on by wolves than yaks. Moreover, sheep are the primary source of income for the herders of the Qilian Mountains, and if they are injured, their finances are seriously affected. This is in addition to the fact that brown bears are known to enter homes, destroy property, and steal food, although these interactions are not yet common in the Qilian Mountains, and herders are primarily concerned with livestock (Cheng et al., 2019).

4.3. Key directions for Qinghai Province National Park

4.3.1. Resource management and functional zoning

4.3.1.1. Establish and improve resource management system

With the aim of mastering the background and ownership of natural resources, to facilitate the maintenance of the integrity of the ecosystem in accordance with the requirements of relevant provisions on the unified right confirmation registration of natural resources, harmonize the relationship between the ownership of natural resources and the administrative power, confirm and register the right of state-owned natural resources assets in the model province of Qinghai national park, and completely resolve the overlap of natural protection areas, division, fragmentation, and isolation of protected and management areas, address the status of “Jiulong water control” system and the problem of “fragmentation” of supervision and law enforcement, realize “one brand, one set of people and one map of a nature reserve,” and establish a unified management system for natural resource assets with clear ownership, clear responsibilities, and effective supervision.

4.3.1.2. Resource management

Based on land survey data, a background survey was completed for the distribution, quantity, grade, and status of the five major natural resources—grasslands, forests, wetlands, water resources, and wildlife—as well as desert and sandy regions. Efforts will be made to map the distribution of natural resource assets and their changes over time, which can then be overlaid on a unified and standardized high-precision geospatial database to establish a national park spatial information platform, and a natural resource information platform, in addition to the provision of relevant data services to the public. Based on the construction of this perfectly “integrated” ecological and environmental monitoring network, a sound and standardized natural resources statistical survey and evaluation system can be established, as can an inventory of natural resource assets and liabilities. Taking the pilot scope of the SNP system as the registration unit, a pilot registration of natural resource rights can be conducted to clarify the rights and interests of natural resource assets owned by the state at the regulatory level, and jointly release the results of natural resource background and status assessments to the administration and any relevant departments.

4.3.1.3. Functional zoning

“3S” is an indispensable technology and tool in the functional zoning of national parks. GPSs are mainly used to provide real-time spatial location information of protected object distributions and most required area information in national parks (Wang, 2017). RS is mainly used to provide larger-scale environmental information of national parks, such as topography, hydrology, vegetation, roads, residential distributions, and can identify changes in landuse-land type over a defined time period. GIS is the basic platform for amassing data, integrating a database of functional zoning, comprehensive processing and analyses of spatiotemporal data from various sources, and providing the most intuitive mapping and attribute data (Fu et al., 2019). In recent years, some progress has been made in the research of species habitat assessment and protection on a large scale; for example, the maximum entropy (MaxEnt) habitat suitability model maintains a high level of accuracy based on the niche principle, using locations of species occurrence points and environmental variables to evaluate habitat suitability for a species (Miao, Zhao, & Meng, 2018).

Functional zoning is an essential part of national park planning and management. Therefore, the data needed for functional zoning should be collected and classified in detail in early field investigations. The database of functional zoning of national parks is established according to the characteristics, values, and threats facing the region, used to determine the corresponding zoning principles and methods. Then, based on the calculations and analyses of various indicators, first the needs of ecological suitability must be met, followed by that of sustainable utilization, as well as those for multi-criteria decision-making. Under the target system guidance, and after numerous communications with all relevant interest groups, the functional zoning of the national park can finally be determined (Wang, Tang, & Zhang, 2017). Concurrently, it can support an adjustment plan through the regular evaluation of the functional zoning in the later stages of national park construction, to continuously optimize follow-up planning (Fig. 2).

4.3.2. Ecosystem protection

4.3.2.1. Typical ecosystem protection

Typical ecosystem protectionism includes alpine grasslands, wetlands, forest shrublands, and desert ecosystems. The primary protection measures are presented in Table 3.

4.3.2.2. Restoration of human activity sites

The main responsibilities of restoration are to protect areas from development, and restore those which have been destroyed. The restoration of human activities includes abandoned mines, sand mining plants, and cottage livestock pens; and the majority of the abandoned mines in the park belong to open-pit mining areas. Though the mining rights licenses issued by the government prevail (Zhang & Xi, 2020), the restoration and management of these geological environments should be connected to the original geological environment to achieve “one mine, one scheme”. Ecological restoration of mines within the park should be combined with the destruction characteristics, regional ecological background, and

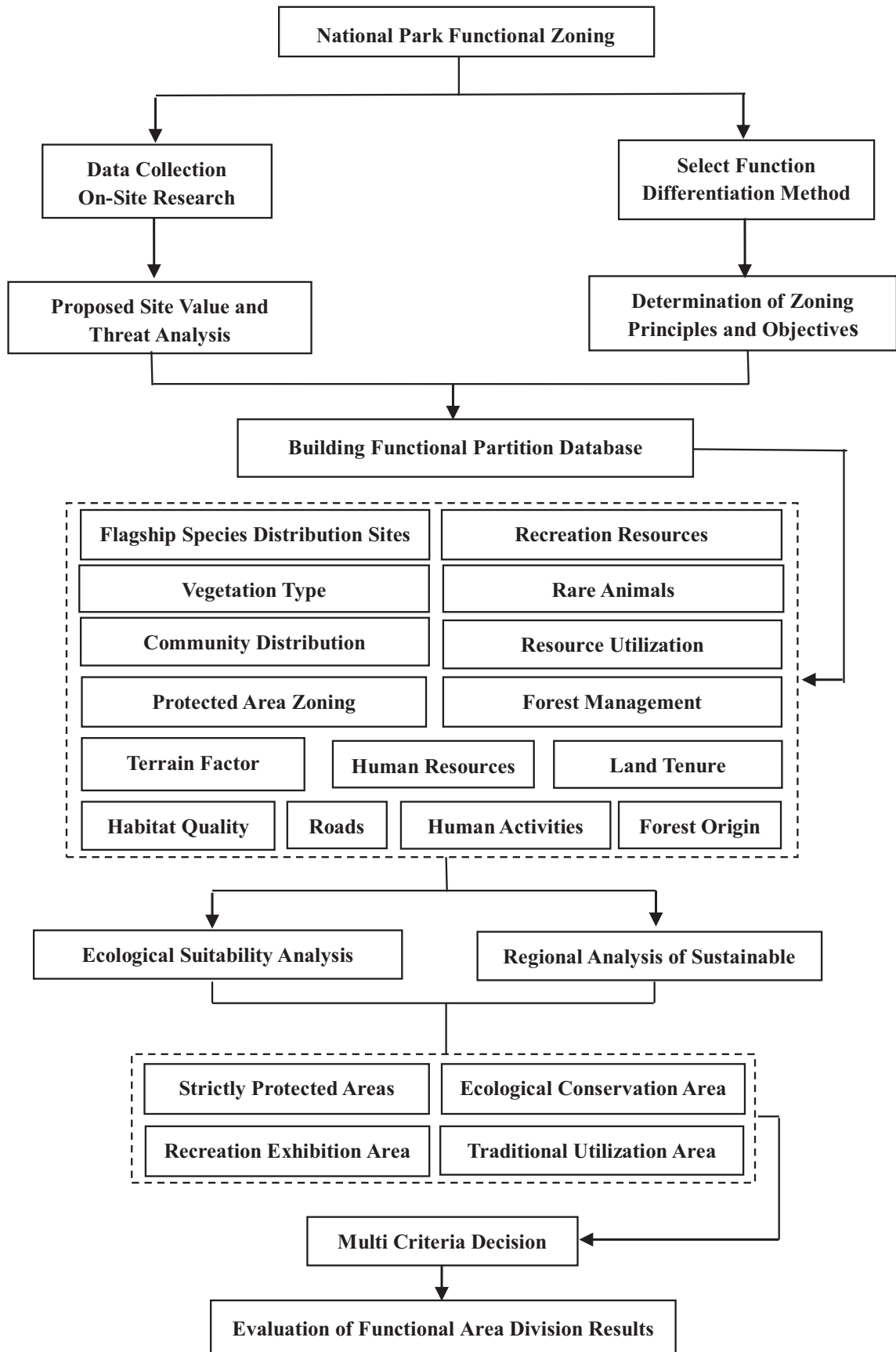


Fig. 2. Logical framework of national park functional zoning.

Table 3
Typical ecosystem protection measures.

Ecosystem types	Protected area	Protective measures	Core content
Alpine Grasslands	Core conservation	Strict confinement	It is necessary to maintain the natural ecological processes of alpine grasslands, take strict enclosure measures, gradually remove the fence, and limit and reduce human activities. For grasslands with high coverage, the policy of balance between grassland and livestock should be strictly implemented to coordinate the human and livestock carrying capacity with the natural environment; implement seasonal rest and rotational grazing. For the meadow grassland ecosystem, a strict grazing prohibition system should be implemented during the restoration period, the moderate use of rest and rotational grazing should be allowed post-restoration, and the strict protection should be strengthened. For degraded grasslands, grazing prohibition should be enacted, and artificial restoration and replanting measures should be taken through the restoration and reclamation of grasslands
	Traditional utilization	Balance between grass and livestock	
	Ecological conservation and restoration	Strengthen protection	
Wetlands	Core conservation	Grazing prohibition	The protection of wetland ecosystems is primarily to maintain their natural state. Strictly protect all wetlands, prohibit fishing and sand mining, and protect important species habitat from human interference.
	Traditional utilization	Balance between grass and livestock	
	Ecological conservation and restoration	Balance between grass and livestock	
Forest shrublands	–	Strict protection	In view of the singular structure and weak regeneration ability of forest and shrubland ecosystems, strict protection is needed. All natural forests, shrublands, and open forests within the park are designated as national ecological public welfare forests to implement enclosure protection, strengthen the prevention and control of forest pests, build a forest seedling base, cultivate forest endemic species in Qinghai Tibet Plateau, and protect forest endemic species within the park.
Deserts	–	Closure and protection	The structure of desert ecosystem is simple, vegetation coverage is low, and species composition is relatively small. The stability of desert ecosystem is low and fragile, so it is necessary to strengthen protection, and prohibit all human activities except for patrol and research.

accessibility of restoration materials. According to local conditions, the process can be divided into three steps: terrain, soil, and vegetation reconstruction. Landscape configuration technology should also be considered when macro-regional ecological restoration is involved. Most of the abandoned sand and stone quarries in the park belong to mechanized mining areas left over from railway construction. For the restoration of abandoned sand quarries, the main responsibility falls upon those who developed and destroyed the location. Through technical measures such as pit leveling, drinking water silting irrigation, backfilling and covering with soil, sowing seeds, the ecological integrity of the abandoned sand mining plant in the park can be gradually restored. The livestock pens of abandoned villages in the park are scattered, and for those not used by wild animals within the park, the natural ecological environment can be gradually restored by removing fences, enclosure, and natural restoration processes.

4.3.2.3. Key species protection

Wildlife is not only a primary protection goal of national parks, but are an integral part of ecosystem stability. There are many rare, endangered, and endemic species of the Qinghai Tibet Plateau, in addition to keystone species of disproportionate significance to the balance of the park's ecosystem, so protective measures are urgent. Accordingly, the key species protective measures are listed in Table 4.

4.3.3. Nature education and ecological experience

4.3.3.1. Education and experience

To adequately construct an experience system of national parks, natural education, and ecological experience must rely upon all levels of roads within the general control area, such as patrol roads, observation platforms, those leading to relocated villages, as the road station system must connect and provide access to the natural education nodes in the park. The roads include a scenic route that can directly access the more attractive sites, as well hiking trails for visitors to experience and connect more deeply with the natural ecology. The (generalized) post station should also include a viewing platform for visitors to rest and observe. Bicycle lanes ought to be set up on provincial, county, and township roads within the national park, avoiding expressways and other major national roads. A patrol trail should be set near the marketing and education points to help maximize visitors' in-depth experiences. A service station will mainly use the existing reception facilities of counties, townships, and villages along the scenic and hiking roads to enable local community residents to participate in the ecological experiences, and provide services for park visitors. The station with large-scale and perfect facilities is selected as the Qilian Mountain natural education base to educate visitors. Abandoned houses from relocated villages within the park area can also be used for building stop-post stations for visitors to rest.

Table 4
Key species protection measures.

Animal and plant types	Key species	Protective measures	Core content
Carnivore	Snow leopard, jackal, desert cat, etc.	Strictly protect and strengthen monitoring	Strengthen monitoring of predator-prone infectious diseases, such as rabies. If carnivore species are scarce, their distribution areas should be immediately and strictly protected, and monitoring should be strengthened. Research on the behavior and food habits of species that are prone to human-animal conflicts, such as wolves and brown bears, should be targeted, and preventive measures should be actively taken. Snow leopards are the flagship species in the park; thus, emphasis should be placed on protecting their habitat <i>Panthera pardus</i> . For their breeding grounds and areas of long-term concentrated activity, engineering and construction are prohibited, and outsiders are forbidden to enter without authorized approval. Its population, distribution area, and feeding behavior are studied via infrared cameras and radio telemetry.
Ungulates	Tibetan antelope, white lipped deer, wild yak, Tibetan wild donkey, rock sheep, Tibetan gazelle	Strengthen investigation and monitoring, set safety distance	For migratory ungulates, strengthen investigation and monitoring, clarify migration routes, and build migration corridors across roads and railroads. Prohibit tourists from driving close to, or chasing hoofed animals, and set a safe interactive distance.
Rodents	Plateau pika, marmot	Strengthen plague surveillance and protection	The park prohibits the use of rodenticide that can cause harm to other species for rat extermination, and avoids the use of any poison as much as possible. Within the core conservation area, especially the habitat of important species, no rodent extermination will be performed. In other areas, rodent extermination will only be performed if their presence poses a great danger to production and life. In the ecological conservation, restoration, and no-grazing areas of the traditional utilization area, the rodent population is mainly controlled through the installation of eagle recruitment frames, physical control, and other measures. In the grass-livestock balance area of the traditional utilization area, biological toxins that do not cause harm to other species, as well as the aforementioned techniques, can be used to control rodent populations.
Birds	Waterfowl	Seasonal management and strengthening regional patrol	Focus on protecting the natural breeding areas of birds, particularly the wetlands where waterfowl concentrate on breeding for seasonal management. During the breeding period of spring and summer, it is strictly prohibited for extraneous people to enter and interfere, illegal actions such as collecting bird eggs, are thoroughly investigated and punished, and the use of drones other than for approved scientific research activities is prohibited. During the high season of avian influenza in winter and spring, patrol of waterfowl activity areas will be strengthened, and epidemic prevention work will be conducted in a timely manner if an epidemic occurs. In ecological conservation and restoration areas, the setting of eagle stands can be optimized in conjunction with rodent control work, but no additional eagle stands will be installed in core conservation areas or those where raptors already breed naturally.
Aquatic animals and plants	Otter	Management and control of fishery activities and regular monitoring	Projects that generate water pollution are prohibited near the habitats of key protected aquatic species. Protect aquatic vegetation and prohibit their collection without authorized approval. Control release and stocking activities; and in waters where key aquatic animals occur, all such activities except those approved and scientifically proven are strictly prohibited. No release of aquatic animals in the core conservation areas. In the distribution areas of key protected aquatic animals, the construction of dams and other water management facilities that will affect the survival of aquatic animals is prohibited. Conduct regular monitoring of aquatic animals, particularly focusing on areas where otters are active.
Flora	Rare and endangered plants	Mining ban, monitoring survey	Visitors entry, construction, and grazing activities are prohibited in areas where rare and endangered plant species are concentrated. Within the core conservation areas, removal of plants is prohibited except for approved scientific research. In the traditional use area, the removal of non-endangered medicinal plants is controlled, and the number people and plants are limited. Planting of exotic species for ornamental use is prohibited in the park. Conduct regular monitoring surveys of park flora, especially in the biodiverse southern part of the Lancang River source, so that conservation measures can be adjusted in a timely manner according to changes in species distribution, numbers, and stress factors.

4.3.3.2. Facilities

The unique natural and cultural landscape characteristics of the national park should be highlighted, in accordance with the requirements of viewing, setting, refining, enlightening, and sublimating the scenic locations. Combining natural landscapes, forests, and grasslands with local traditional culture will create more opportunities for people to integrate into nature. Nature education centers can aid with informational exchange across a variety of subjects, such as natural resources, ecosystems, biodiversity, traditional culture, traditional utilization, protection and management, scientific research monitoring, science and technology information services, and multimedia. The sand table of the national park can be configured, interesting popular science models can be placed alongside educational science books, publicity leaflets and explanatory manuals, and publicity videos can be played. Three-to-five nature interpretation trails were set outside each education center. Combined with the surrounding environment of the trail network, each node can adjust measures to local conditions, explore, innovate, and set up an outdoor interpretation system and experience facility. Thus, constructing a nature education with respect to the rare animals and ecosystems in the park, and according to the division of different age groups of visitors, can impart in-depth education for visitors. In addition, towns and villages with unique and historical ethnic characteristics can be selected for the ecological and cultural villages of the national parks. These villages inherently have beautiful scenery and profound ethnic cultural connotations. The appearance of these villages can be improved, ethnic cultural experience projects for visitors can be established and implemented, and the business behaviors of operators can be standardized, as the key foci of ecological park experiences.

4.3.4. Community coordinated development

4.3.4.1. Encouraging community participation

Encouraging and guiding community participation in the construction of national parks through various forms, can provide necessary support, and transform residents from a farmer or herdsman to a park builder, guard, or manager (Cheng, 2019). First, it can provide labor for the construction, operation, ecological protection and restoration, engineering facilities, scientific research and monitoring facilities, ecological guides, and education facilities. Second, residents within the national park can also be employed to serve as intermediaries between ecological management, social services, and public welfare, so they can participate directly in the ecological protection and operation management of the national park throughout the entire process. After the establishment of the national park, ecological management posts should be set up systematically according to the ecological management standards of the nature reserves, natural forest protection, ecological public welfare forests, and grasslands. In addition, existing grassland, wetland, and woodland management and protection posts can be unified into a singular ecological management and protection post, and priority can be given to the residents, especially the impoverished who have established and registered poor population, to perform daily patrols of inland lakes, woodlands, grasslands, wetlands, and wildlife within the park. Finally, in the processes of engineering construction, scientific research monitoring, and patrolling among others, the community can be used as a logistical support location. In the process of ecological experience and environmental education, priority should be given to guiding First-class community and Second-class community to provide necessary catering and accommodation services. Further encouragement and support for qualified herders to participate in the operations and management of ecological experiences and environmental education can be acquired through franchising.

4.3.4.2. Enhancing community services

Different communities can develop enterprises by category, and comprehensively improve the level of public services provided, such as building necessary service facilities, advocating assembly type and movable facilities, and minimizing the environmental impact of facility construction under the premise of ecological protection. A group of communities can gradually improve all kinds of facilities and equipment to create a well-equipped and functional central community. Another type of community center settlement is a comprehensive service center, to provide a place for publicity and marketing activities, various types of training, parties and gatherings, cultural and sports activities, a supporting medical structure, early childhood education, and other necessary public service facilities. A final type of community relies on the first two in the township where they are located to provide relevant public services, and provide farmers and herdsman with photovoltaic, water purification equipment, and other essentials, while the township government organizes touring services on a regular or semi-regular basis (Su & Li, 2019). Through the differentiated social services of the different types of communities, farmers and herders can be further encouraged to voluntarily concentrate and reduce their direct use of natural resources, thereby further promoting ecological protection. In addition, focusing on the living protection and transmission of intangible heritage, such as traditional performing arts, handicraft skills, and folk activities, encourages the cultivation of cultural inheritors, the spread of the distinctive cultural activities, and strengthens cultural marketing so that community culture becomes a beautiful scenery of the national park.

4.3.4.3. Establish concession mechanisms and social capital

In accordance with the requirements of relevant laws, regulations, and rules, it is necessary to “prepare the management measures for national park concessions, regulate national park concession activities, prepare industrial development plans, promote the healthy and orderly development of concessions, and maintain market order.” This mandates strictly implementing a concession access system with the National Park Administration establishing the access criteria, stipulating concession fees, the scope, and duration of the concession, the measures necessary for resource protection and environmental maintenance, the rights and obligations of operators, the ecological protection red line system, strengthening ecological and environmental controls, and

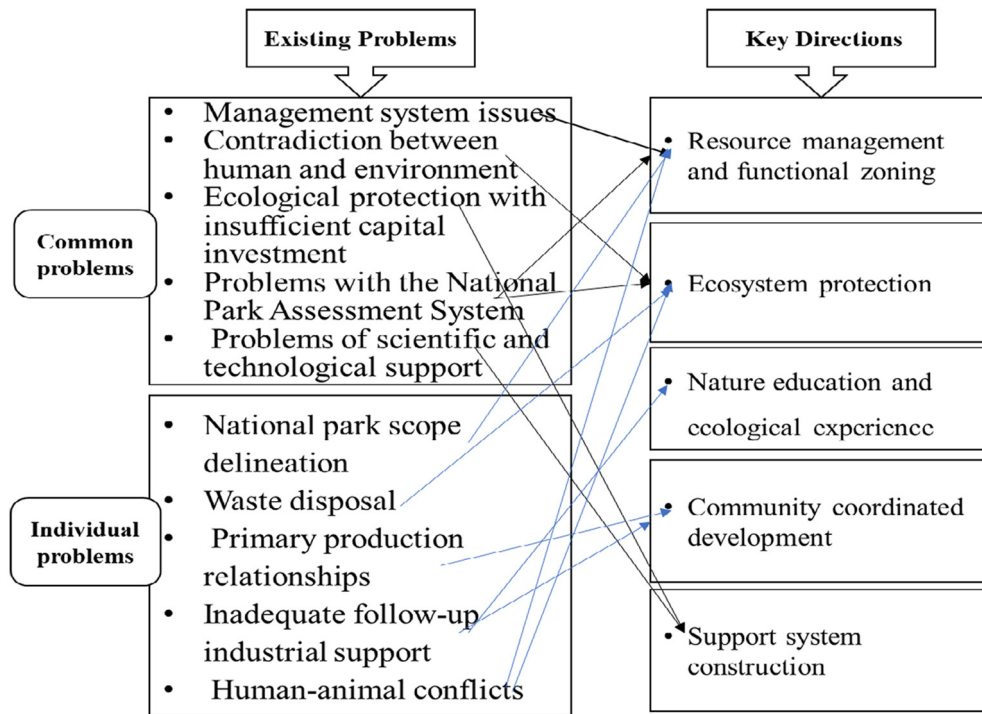


Fig. 3. Logical framework of the relationship between challenges and directions.

ensuring that all concessions are implemented in accordance with the laws and regulations. The recruitment of individuals and acquisition of social capital to engage in national park concessions projects should be performed so as to give priority to farmers and herdsmen who implement conversions, diverted employees of state-owned forestry, poor people with established cards, and relocated residents, and enterprises. The concession fees charged by the state-owned park authority should be diverted directly to concession projects to implement the management of two lines of income and expenditure: used exclusively for either ecological protection of the park, or the improvement of people's livelihood.

4.3.5. Support system construction

4.3.5.1. Natural resources and ecological monitoring

The objectives are to integrate modern communication, networks, artificial intelligence, and other high-tech technologies, wired and wireless fusion networks, video monitoring, automatic sensing, infrared cameras, vibrating optical fibers, drones, helicopters, and other technical means to make full use of existing data resources, and integrate with regional mapping and spatio-temporally large, big data and cloud platforms. Further goals should be the implementation of monitoring and real-time data transmission for land, forests, mountains, grasslands, wetlands, wildlife, aquatic organisms, minerals and other natural resources, water, soils, gasses, and other ecological factors, in addition to forest and grassland fire hazards, anthropogenic activities, and other aspects. Simultaneously, the existing monitoring stations should be fully utilized to form a ground station system with adequate density and function, in order to establish an all-weather, rapid response to the integrated monitoring system.

4.3.5.2. Scientific and technological support

National park management agencies rely on existing ecological monitoring and assessment agencies, and forestry or grassland surveys to build national park ecological monitoring and assessment platforms. Thus, it is necessary to organize and conduct ecological monitoring in national parks, monitoring and benefit assessment of major ecological projects, key areas, and typical ecosystems, and the development and training of relevant monitoring technical protocols. Further efforts should be made to cooperate with scientific research institutes, supplement and improve monitoring and experimental equipment, and establish a laboratory for ecological and environmental analysis in national parks. The National Park Administration, universities, and scientific research institutes inside and outside the province can jointly conduct analyses and assessments of ecosystem structure evolution, soil and water conservation, and the status of rare and endangered species populations. Scientific and technological research, inheritance, and demonstration of key technologies for ecosystem restoration and management, environmental monitoring technologies, watershed water circulation laws, biological resource development technologies, traditional agriculture and livestock industry optimization, and upgraded technologies to provide scientific and technological support for the construction of the

national park, should be pursued as well (Ma et al., 2019). Meanwhile, close cooperation with domestic and foreign experts and scholars can aide in the formation of a national park expert think tank.

4.3.5.3. Supporting infrastructure

The objectives should be to improve the national park patrol road network, management facilities, and other infrastructure to provide enhanced protection for patrol, scientific research, ecological experience, environmental education, and community development. Additional goals should be defined according to the development needs of the national park community, community infrastructure such as transportation, electricity, communication, sanitation, water conservancy, and disaster prevention and mitigation. Initially, a patrol road network system should be established using with national, provincial roads, county, township, and rural roads as the backbone to meet the needs of patrol and law enforcement of the national park, internal and external connectivity, and access of herdsmen into the park, while considering the needs of scientific research and ecological experience. Second, modern management platforms and technologies should be actively introduced to achieve intelligent, informative, and refined management policies. The construction of related facilities must maximize the use of pre-existing facilities, and prioritize construction outside of the park to better ensure appropriate park protection and function. Public transportation within the park should primarily rely on the patrol road network, to which end road management should be strengthened, road diseases eliminated, and the ecological integrity along roadsides maintained. Finally, an improved garbage collection and treatment system is necessary. For communities with insufficient collection and transportation capacity at this stage, additional garbage bins, trucks, and other facilities and equipment to improve the collection and transportation capacity should be acquired. Additionally, the introduction of advanced waste gasification treatment facilities should be considered, to achieve local disposal of domestic waste. Once the pilot project has achieved positive results, it will be gradually promoted in the park to form a comprehensive national park waste disposal system, together with the existing external waste collection and transportation system.

The logical framework diagram used to show the relationship between the problem and the direction is as follows. The diagram illustrates the logical relationship between existing problems and problem oriented categories (Fig. 3).

5. Conclusion and outlook

As a type of nature reserve, national parks are centered around the protection of large natural ecosystems and ecological processes, adequately representing national natural resources, characteristics, and values, while providing social services for the public good. National park protection and management is a complex system project that requires multidisciplinary and collaborative research. Based on the strategic layout of Qinghai's regional, economic, and social development, the distribution of core and unique resources, in addition to pre-existing nature reserves, parks, forests, historical sites, and ethnic cultures, all must be considered when appropriately engaging the prerequisites for establishing a national park system. The present research has reviewed the accomplishments, limitations, and future directions for national park demonstration provinces in the Qinghai Province. Qinghai Province contains diverse natural landscapes, intact ecosystems, rich biodiversity, primary forests, ample wetland water resources, and is the origin of many rivers. Therefore, it is necessary to consider natural resources, landscapes, and ecology as the main components of selection, pioneering regional planning and design to optimally implement a new national park.

In general, the construction of the national park demonstration provinces in Qinghai is a mandatory step towards the establishment of a new system of state-led, regional ecological protection and management, exploring new models for the coordinated development of sustainability and livelihood improvement, creating long-term mechanisms of ecological protection in the national park system with innovative concepts, and fundamental research on coping strategies in the context of global warming.

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Author contributions

J.G. conceived the research and made significant contributions to first drafting; H.K.Z. guided the research framework and modified the manuscript. Z.X.Q. supervised and laid out the format of the main text. W.Z. and Z.C. conducted the field surveys. All authors meaningfully contributed to manuscript development, and give their full approval for submission and publication. All authors have read and agreed to the published version of the manuscript.

Declaration of Competing Interest

The authors declare no conflict of interest.

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