Study on the Sustainable Development of Badain Jaran Desert from the Perspective of World Heritage

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Abstract. Badain Jaran Desert is the first natural resource related to desert listed in the Preparatory List of China's World Heritage in China. The desert is a complete desertification ecosystem. From the perspective of World Heritage, this paper first analyzes the resource status of Badain Jaran Desert, then introduces the world heritage related to the desert, compares the relevant protection laws and regulations of the World Heritage and the laws and regulations of Badain Jaran Desert, then puts forward the environmental status of Badain Jaran Desert facing desertification, introduces the concept of heritage tourism, and gives suggestions to the tourism industry of Badain Jaran Desert, Then it analyzes the characteristics of natural resources in the Badain Jaran Desert tourist area of Inner Mongolia, compares them, and gives feasible suggestions for Badain Jaran Desert to apply for World Heritage.

Keywords: Badain Jaran Desert, Heritage Protection, Desertification Prevention, Sustainable Development.

1 Introduction

World Heritage is a product of culture and nature, and a symbol of human history, culture and civilization, representing the most valuable humanistic and natural landscapes, which are the common valuable wealth of mankind [1]. UNESCO adopted the Convention Concerning the Protection of the World Cultural and Natural Heritage in 1972, which uses scientific and effective methods to protect the world's cultural and natural heritage of outstanding universal value. cultural and natural heritage of the world with outstanding universal value by scientific and effective methods.

There is no lack of desert heritage among the world heritage. Looking around the world, each desert world heritage has its unique characteristics, which make people deeply shocked. China has a large number of World Heritage Sites, but there are no desert-related World Heritage Sites in China at present. On December 20, 2019, the Badanjilin Desert-Sand Mountain Lakes Complex was inscribed on China's World Heritage Tentative List. At present, domestic research on this desert is mainly conducted in the areas of wind and sand control, desertification prevention and control, and soil and water conservation. From the perspective of world heritage, this paper focuses on

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Badanjilin Desert in Inner Mongolia Autonomous Region of China, and gives development suggestions in combination with the actual situation of Badanjilin Desert.

2 Overview

Approximately 22% of China's land surface is desert. This represents an area of 2.1 million km^2[2]. In Inner Mongolia, there are deserts from east to west, and there are ten major deserts (sandy areas) in the whole region, of which the eastern area is dominated by sandy areas, including the Hulunbeier Sandy Area, the Horqin Sandy Area, the Hunshandak Sandy Area, and the Uzhumuqin Sandy Area; and the western area is dominated by deserts, including the Badanjilin Desert, Tengger Desert, Ulan Buhu Desert, Kubuqi Desert, Bayin Wendur Desert, and the Maowusu Sandy Area [3].

2.1 Topography of the Badanjilin Desert

As shown in Figure 1. Badanjilin Desert is located in the north of Alashan Right Banner, Alashan League, Inner Mongolia Autonomous Region, China. Geographic location: 39° 04′15″ ~42° 12′23″N, 99° 23′18″~104°34′02″E. The terrain is high in the southeast and low in the northwest, with an elevation of 895 ~1572 m [4].

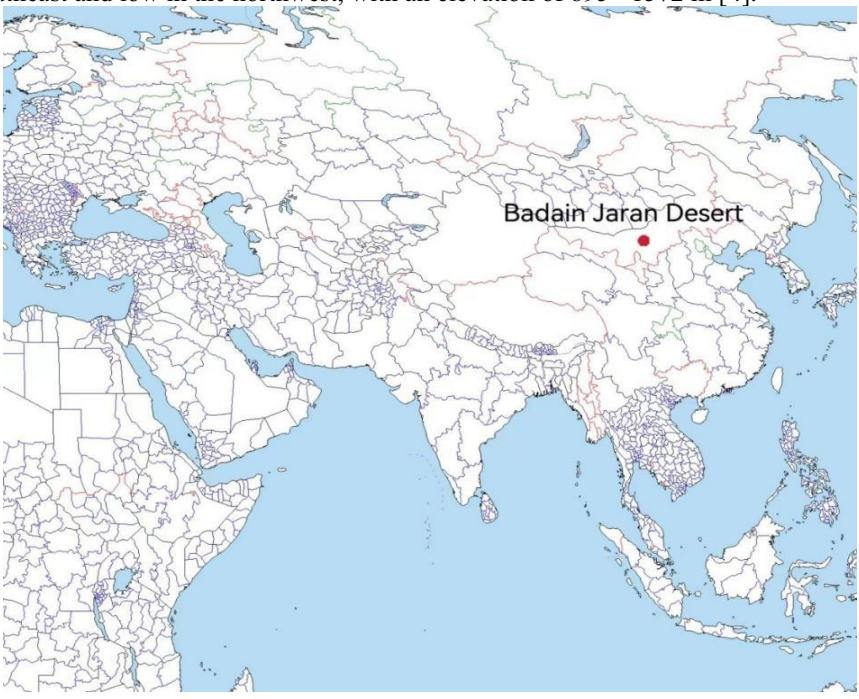

Fig. 1. Location of Badain Jaran Desert in Inner Mongolia

Note: The base map is referenced from the official website of the National Geographic of China, www.dili.com and organize.

The rolling high sand hills of the Badanjilin Desert are a unique resource not found in other deserts. In the Upper Alxa Massif, the geomorphologic pattern is gentle, and the fourth sediment covers the surface of the earth, forming the widely distributed Gobi and desert.

2.2 Natural resources of the Badenjilin Desert

Table 1. Resource characteristics of the Badain Jaran Desert

Category	Features
Geologic feature	Geologically, it belongs to the Alxa Massif, with a gentle geomorphologic pattern, mainly composed of stripped low-mountain residual hills and intermountainous depressions, forming widely distributed Gobi and desert.
Animal resources	Among the fauna, 90 species of vertebrates have been recorded, including 11 reptiles, 46 birds and 33 beasts. There are 12 species of state-level protected animals, including 4 species of state-level two key protected veterinary species, 2 species of state-level key protected birds and 6 species of state-level two key protected birds [5].
Botanical resources	In its flora, 116 species of seed plants have been recorded, belonging to 29 families and 80 genera, with two species of gymnosperms in one family and two species of gymnosperms in one genus; and 114 species of angiosperms in 28 families and 79 genera [5].
Climatic conditions	Temperate continental climate, precipitation is scarce, annual rainfall of 50-60mm, the average annual temperature of 7-8°C, the sand surface temperature reaches 70-80°C, annual evaporation is more than 3500mm. The summer is very hot, with the highest temperature reaching 38-43°C. The temperature of the sand surface reaches 70-80°C, and the annual evaporation is more than 3500mm.

Badain Jaran Desert , located in western Inner Mongolia, is the second largest desert in China and the fourth largest in the world, covering an area of about 50,000 km^2 [6], the Badain Jaran Desert is rich in ecological diversity, animal resources and plant resources, The geological and landform characteristics are relatively unique, and the climate conditions are also very unique. As shown in Table 1, The region has the characteristics of desert ecosystem and relatively complete and rich species resources, with many unique animals and plants and other natural resources.

Rich in plant resources, the Badain Jaran Desert is dominated by the white thorn community [5], and the more common plants include (Artemisia ordosica), (Haloxylon ammodendron),(Salix matsudana),(Salsolu laricifolia),(Salsola passerina),(Oxytropis aciphylla),(Ajania achillaeoides), etc. The plant resources of Badanjilin Desert are abundant. (Salsola passerina),(Oxytropis aciphylla),(Ajania achillaeoides), and so on. The dry plants distributed in the western half of Inner Mongolia are endemic to the Alashan Desert, including (Artemisia ordosica),(Potaninia mongolica),(Calligonum mongolicum),(Caragana brachypoda), etc [5].

There are also many national key protected animals in the reserve, including the golden eagle (Aquila chrysaetos) and the bobbed bustard (Chlamydotis undulata) at the national level, and the black kite (Milvus migrans), the eagle (Accipiter gentilis), and

the great buzzard (Buteohemilasius) at the national level. Buteohemilasius, Falcouespertinus, Falco tinnunculus, Athenenoctua, Felis bieti, Felis lynx, Gazella subgutturosa. subgutturosa), and pan sheep (Ouis ammon) [5].

3 Desert landscapes in World Heritage sites

As of the 44th World Heritage General Assembly held in Fuzhou, China from July 16 to 31, 2021, there are 1,154 World Heritage properties inscribed on the World Heritage List by the UNESCO World Heritage Committee. These include 897 cultural, 218 natural and 39 mixed properties [6]. A number of these properties are located in desert regions and these World Heritage properties are characterized by their own development.

The desert related World Heritage Sites are Lut Desert, Bam and its Cultural Landscape, ǂKhomani Cultural Landscape, Namib Sand Sea Namib Sand Sea, Wadi Rum Protected Area and dozens of other desert-related World Heritage Sites. In this paper, seven World Heritage Sites are selected. The comparison of World Heritage sites is shown in Table 2.

Table 2. Comparison with World Heritage Sites Related to Deserts

Name	Country	Area	Criteria	Time	Features
Lut Desert	Iran	Property: 2,278,015 ha Buffer zone: 1,794,134 ha	(vii) (viii)	1991	The arid continental subtropical region is known for its rich diversity of spectacular desert landscapes. The region regularly experiences some of the highest surface temperatures on earth. Has what is considered to be the best windswept sand landscape in the world. It is one of the most actively developing dune fields in the world.
Bam and its Cultural Landscape	Iran	/	(ii) (iii) (iv) (v)	2004	Bam had its heyday between the 7th and 11th centuries, was at the crossroads of important trade routes, and was known for its production of silk and cotton clothing. The existence of life in the oasis was based on underground irrigation canals qanats, and Bam preserves some of the earliest evidence of this in Iran.
Wadi Rum Protected Area	Jordan	Property: 74,179.7 ha Buffer zone: 59,176.9 ha	(iii) (v) (vii)	2011	The reserve has narrow canyons, natural arches, towering cliffs, ramps, giant landslides and caves. Petroglyphs, inscriptions and archaeological remains in the area show evidence that humans have lived here for the past 12,000 years. The sites show the development of agriculture, ranching and urban activities in the area.
Cultural Sites of Al Ain (Hafit, Hili, Bidaa Bint	United Arab Emirates	Property: 4,945.45 ha Buffer	(iii) (iv) (v)	2011	The property is very diverse in nature, with tangible elements including the remains of circular stone tombs and settlements of the Hafet and Hili periods, wells and partially underground irrigation systems, oases and

Saud and Oases Areas)		zone: 7,605.46 ha			mud-brick buildings. It provides exceptional testimony to the development of successive prehistoric cultures in the desert region from the Neolithic to the Iron Age.
Namib Sand Sea	Namibia	Property: 3,077,700 ha Buffer zone: 899,500 ha	(vii) (viii) (ix) (x)	2013	The Namib Sand Sea is the only coastal desert in the world. It has gravel plains, coastal plains, rocky hills, the Inselberg in the Sand Sea, coastal lagoons and ephemeral rivers, creating an exceptionally beautiful landscape.
Air and Ténéré Natural Reserves	Niger	Property: 7,736,000 ha	(vii) (ix) (x)	1991	The largest protected area in Africa, the reserve boasts a great variety of landscapes, plant species and wildlife. Has an extraordinary portfolio of relict ecosystems combining mountain and plains landscapes of outstanding aesthetic value and interest.
Tsodilo	Botswana	Property: 4,800 ha Buffer zone: 70,400 ha	(i) (iii) (vi)	2001	The Tsodilo Hills, one of the world's greatest concentrations of rock art, is known as the "Louvre of the Desert". Its waterholes and hills are revered as sacred cultural landscapes by the Han Pau and San communities.

Note: Information from the UNESCO World Heritage Center https://whc.unesco.org.

The Lut Desert, a World Natural Heritage Site in Iran, protects the globally recognized iconic hot desert landscape, one of the hottest places on earth, with surface temperatures reaching up to 70.7°C. The Lut Desert is famous for its spectacular landscapes. The heritage represents a special case of ongoing geological processes associated with erosion and sedimentary features in a hot desert. Much of the Lutte Desert is inaccessible due to its remoteness from major population centers and extreme environmental conditions, including extreme heat and water scarcity, and is therefore protected by nature.

The Wadi Rum Protected Area (WRPA) is a mixed natural and cultural heritage with a diverse desert landscape. The petroglyphs, inscriptions in the reserve can be considered as exceptional witnesses to the cultural traditions of its early inhabitants, and they provide evidence of the long-term pattern of human activity in the reserve. The Bedouin (Arab nomads) who have inhabited the area for generations have long coexisted peacefully with the natural wonders of the region, thus providing a home for the Arabian Oryx, which is why the Ram Reserve has been inscribed on the list of World Mixed Natural and Cultural Heritage.

The Adel and Ténéré Nature Reserve constitutes a Sahelian enclave surrounded by the Sahara Desert, thus creating an extraordinary combination of relic ecosystems with mountain and plains landscapes of outstanding aesthetic value and interest. The Adel and Ténéré Reserves are the last bastion of Saharan wildlife in Niger. A total of 40 species of mammals, 165 species of birds, and 18 species of reptiles have been identified in the reserve, which contains important natural habitats for the survival of the

three antelopes of the Sahara Desert. The property was inscribed on the List of World Heritage in Danger in 1992 due to political instability and dissent among the population.

4 Comparison of domestic and international regulations on the protection of desert resources

World heritage is the common wealth of all mankind, aiming at the joint protection of natural areas and cultural heritage of outstanding value around the world. World natural heritage is the result of hundreds of millions of years of nature's miraculous creations, carries the spiritual and cultural values of humankind, and has a bearing on the ecological security of the Earth. Deserts, as an important part of World Heritage, play an important role in history, culture and biodiversity. Deserts belong to a kind of ecosystem, and in addition to being the home of a few plants and animals, the existence of deserts is also beneficial to the natural ecology. Studies have shown that 56% of the annual minerals in the Amazon come from the Sahara Desert, and that this dust travels on air currents from North Africa to South America, where it nourishes the local vegetation. Marine plankton also benefit from minerals from the desert. In order to protect the natural environment and biodiversity of the desert, a series of laws have been introduced to protect its natural resources.

4.1 Laws and regulations for the protection of the Badenjilin Desert

Nominating a World Heritage site is a difficult and long-lasting process that requires great attention from the government and local people. The status of legislation is one of the decisive factors in the evaluation of world natural heritage. In recent years, China has been continuously formulating and improving the laws and regulations for the protection of the Badanji Lin Desert, so that the protection of the Badanji Lin Desert has been elevated to the level of law and system, and a high-standard management system for the protection of the desert has been established that is on a par with the international standards.

The Inner Mongolia Autonomous Region formulated the "Inner Mongolia Autonomous Region Environmental Protection Regulations" in 2018 and the "Inner Mongolia Autonomous Region Geological Environment Protection Regulations" in 2021. These laws have a protective effect on the environment of the Badain Jaran Desert.

In order to further protect the ecological environment of Badanjilin Desert, the People's Government of Alashan Right Banner drafted and prepared the Regulations on the Protection of Sand Mountain and Lake Groups in Badanjilin Desert of Inner Mongolia Autonomous Region in April 2021. The formulation of the law practiced the concept of green development in the Inner Mongolia Autonomous Region, promoted high-quality development in the region, and paved the way for the road to bidding for the Badanjilin Desert.

4.2 Laws and regulations for the protection of world heritage

The relevant conservation legislation for World Heritage properties is shown in Table 3

Table 3. Regulations for the Protection of World Desert Heritage Sites

Desert name	Country	Relevant protection legislation	Implementation time
Bam and its Cultural Landscape	Iran	Law of Conservation of National Monuments	1930
Old Walled City of Shibam	Yemen	Historical Cities Preservation Law	1962
Wadi Rum Protected Area	Jordan	Law of the Department of Antiquities	1988
Aflaj Irrigation Systems of Oman	Oman	Law on protection of sources of potable water	2001
		Law of Agriculture System	2006
		Law of organizing & protection of Aflaj	2017
Tsodilo	Botswana	Law of Heritage Protection	
		Monuments & Relics Act	2001
		Anthropological Research Act	1967
		National Parks Act	1967
		Tribal Act	1968
ǂKhomani Cultural Landscape	South Africa	Relevant environmental protection laws	1998
		National Heritage Resource Act	1999

Note: Information obtained from the UNESCO World Heritage Center https://whc.unesco.org.

The Komani Cultural Landscape is located entirely within the Kalahari-Gemsbok National Park (KGNP), which forms the most important cultural component of the park, and is also included in the Kgalagadi Transfrontier Park (KTP). Both parks offer formal statutory protection as protected areas.

Tshodilo Hills was declared a National Monument in 1927 and a revised Integrated Management Plan was developed in 1997 and approved by stakeholders by the Department of National Museums and Monuments in collaboration with the Tshodilo Authority, in order to ensure the protection of all site attributes An Integrated Management Plan detailing community initiatives was developed in 2007 and is being implemented in the buffer zone of the site. With the assistance of the African World Heritage Fund, a core area management plan was developed for the site in 2009.

5 Study on the sustainable development of the Badanjirin Desert

5.1 Problems faced - desertification

5.1.1 Status of desertification in China.

China is one of the countries in the world most seriously jeopardized by desertification, with desertification in the Inner Mongolia Autonomous Region topping the list, and after more than 70 years of ecological construction since the early days of the founding of the People's Republic of China, the prevention and control of desertification have achieved world-renowned successes.

Nearly 80% of Alashan area in Inner Mongolia Autonomous Region has been desertified, for which many scholars in China have made research for desertification prevention and control in Inner Mongolia Autonomous Region. Li Ang et al [7] studied the scientific principles, engineering practices, and restoration effects of ecological restoration in the northern sandy and windy areas. Jia Jujie [8] studied the composite ecosystem management in desertified areas of Alxa League. Xiao Shengchun [9] conducted a study on the mechanism of climate change and environmental evolution in the desert of Alashan League in modern times. Li Wanyuan [10] studied the spatial and temporal variations of precipitation at the southwestern edge of Badanjilin Desert and its correlation with monsoon and dust storms. Pan Cunjun [11] studied and analyzed the soil salinity characteristics of shrub communities in the Alxa Desert area. Zhao Xinyue et al [12] studied and analyzed land salinization in Alashan area. Previous researchers have made important progress in studying desertification from various aspects.

5.1.2 Summary of shortcomings and recommendations.

Although China has made some progress in desertification control over the past few decades, there are still many problems that need to be solved urgently. There are some misconceptions about desertification control: large-scale afforestation may exceed the carrying capacity of the land and cause some damage to the original ecological land; the desert is a natural ecosystem, and it is unrealistic for human beings to completely transform it. In the new period of historical development, China should have a new understanding of desertification control.

This paper puts forward three suggestions for the sustainable development of Alashan area by combining the research results of the previous researchers:

(1) Adhere to the principle of scientific and systematic governance, focus on the protection of desert edge, degraded grassland, adhere to the water to green, natural restoration-based, scientific restoration of desert ecosystems.

(2) Adhere to the principles of local conditions and sustainable development, rationally utilize land resources and improve the carrying capacity of land.

(3) Coordinate the relationship between local industrial development and ecological protection, and promote the development of local desert tourism and environmentally friendly industries.

5.2 Development Strategies and Suggestions for Badanjilin Desert Tourism Area

5.2.1 Current Situation of Badanjilin Desert Tourism Area.

Badanjilin Desert was named the most beautiful desert in China by China National Geographic magazine in 2005, one of the "50 places most worth visiting for foreigners" by GlobeNewswire and won the gold medal, and was named the World Geopark in 2009. Badanjilin Desert is famous for "strange peaks, singing sands, sacred springs, lakes and temples". The towering sand mountains, mysterious and unpredictable singing sands, quiet lakes and wetlands in the area constitute the unique and fascinating landscapes of Badanjilin Desert. Badanjilin Desert has the world's largest sand area, the center of the area are the relative height of 200-500 m of the sounding sand mountain, the sound of sand like thunder, resounding thousands of miles, known as "the world's Kingdom of the sounding sand". There are 144 lakes in Badanjilin Desert, including 12 freshwater lakes. These lakes in a variety of ways, each with their own characteristics, the scenery is very different; lakeside green trees into the shade, sand and water, water and sky, forming a unique desert landscape, known as the "desert in the Jiangnan".

Every year in August, September in Alxa right flag held Badanjilin Desert Cultural Tourism Festival in the Desert Cultural Tourism Festival, during this period in addition to the world's highest close-up appreciation of the sandbergs, the largest area of sand, desert springs and other natural landscapes, there are horse races, camel races, climbing dunes and other traditional Mongolian sports competitions and stone exhibition activities, to show the unique desert flavor. According to the analysis of the current situation, the opportunity for the development of Badanjilin Desert area lies in the development of tourism and the promotion of local tourism according to local conditions.

5.2.2 Heritage Strategy - Development of Heritage Tourism.

According to the World Tourism Organization, heritage tourism is "tourism that provides in-depth exposure to the natural landscapes, human heritage, arts, philosophies and customs of other countries or regions". Heritage tourism is developed through the integration of World Heritage and sustainable development, where tourism and heritage management planning are integrated, natural and cultural assets are valued and protected, and appropriate tourism is developed.

This paper puts forward three suggestions for the bidding of Badanjilin Desert in Alxa League:

(1) Improve the scientific management system: formulate and improve the relevant protection laws and regulations, and enhance people's legal awareness.

(2) Popularize world heritage education: popularize world heritage-related knowledge to local residents, so that local residents and the government can jointly protect the ecological resources in the region and contribute to the bidding of Badanjilin Desert.

(3) Establish a natural disaster prediction system: improve the digital monitoring system to predict the local natural disasters, climate disasters, ecological environment, to monitor and improve the mechanism of disaster prevention, mitigation and control [13].

5.3 Significance of the application

China ranks first in the world in terms of the number of World Natural Heritage sites, but there is no desert-type natural heritage. Promoting the Badanjilin Desert to be declared as a World Natural Heritage site will not only fill the gap of desert-based natural heritage in China's World Heritage list, but also better protect the ecological environment of the Badanjilin Desert, strengthen the management of wind and sand sources in the Beijing-Tianjin-Hebei region, build up a solid ecological security barrier in the northern part of China's territory, and enhance the capacity and level of protection and management of deserts.

The process of bidding for the Badanjilin Desert is also a process of displaying the image of the region, expanding external publicity and strengthening its own construction. For the local tourism and economic development has produced a very significant effect. The Inner Mongolia Autonomous Region will take the bid as an opportunity to introduce international advanced concepts to create an international tourism landscape with unique desert characteristics, to better benefit society and the people.

6 Conclusion

The balanced development of world heritage has become a focus of international attention, and the World Heritage Committee strongly advocates and encourages the richness and diversity of heritage types. The protection of heritage does not exclude its utilization, and the utilization of heritage resources should follow the principle of sustainable development to develop its scientific, cultural and tourism resources, so as to move heritage resources towards the track of a virtuous circle of protection and development [14]. There are many desert natural resources in China, such as the Taklamakan Desert in Xinjiang, the Tengger Desert and the Kubuzi Desert in the Inner Mongolia Autonomous Region, but only the Badanjirin Desert has been selected for the China World Heritage Tentative List. The research in this paper supports the bidding of Badanjilin Desert-Sand Mountain Lake Complex. According to the selection criteria of the Convention Concerning the Protection of the World Cultural and Natural Heritage, the Badanjilin Desert-Shashan Lakes Complex is analyzed as a World Heritage site. Through the analysis, it is concluded that the natural resources of the desert satisfy (vii)(viii)(x) of the criteria. The Badanjilin Desert should take the local situation into account, take the road of sustainable development, and accelerate the bidding for the Badanjilin Desert-Sand Mountain Lakes Complex, so as to make up for the gap of the World Heritage of deserts in China.

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