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Sustainable Wisdom: Evaluating Traditional Mongolian Sustainability Practices in Addressing Environmental Degradation in Inner Mongolia

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Abstract. Traditional Mongolian communities have developed a variety of sustainability measures in their pastoral practices. This paper examines how traditional Mongolian ecological knowledge (TEK) can provide theoretical and practical guidance for contemporary environmental challenges in Inner Mongolia, including desertification, pollution, and biodiversity loss. By integrating TEK with modern environmental governance frameworks such as Political Ecology, Adaptive Management, and Common Pool Resource Governance, this research argues that environmental degradation is not merely a natural phenomenon but the result of extractive economic models and marginalized indigenous participation. The study evaluates current environmental policies through a stakeholder analysis, identifying critical gaps in cultural preservation and community involvement. It is found that traditional practices, such as seasonal pastoral mobility and community-based stewardship, are not outdated alternatives but essential complements to modern scientific approaches like satellite monitoring. Ultimately, the paper provides policy recommendations that advocate for the inclusion of indigenous voices, mandatory environmental impact assessments, and the protection of biocultural diversity. This research offers insights into how restoring indigenous wisdom innovatively can contribute to sustainable governance in arid plateau regions worldwide.

Keywords: Sustainability, Inner Mongolia, Traditional Practices, Environmental Protection

1. Introduction

Located in northern China, the Inner Mongolia Autonomous Region lies next to Mongolia's southern border, as shown in Figure 1. It extends over 2400 km from east to west and more than 1,700 km from north to south, covering 1.183 million square kilometers or one-eighth of China's total land area. Most of Inner Mongolia consists of a plateau with a temperate continental climate [1].

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Figure 1. Map of Mongolia country and Inner Mongolia province of China [2]

Historically, agriculture in Inner Mongolia was mainly focused on stockbreeding. Before the Mongol Empire, stockbreeding was the primary economic activity. Nonetheless, cultivation gradually replaced stockbreeding. As depicted in Figure 2, the value of output from crop cultivation and livestock has experienced rapid growth since around 1980, with crop cultivation consistently maintaining a higher output than livestock. The year 2003 marks a significant turning point; post-2003, both crop cultivation and livestock output have increased much faster than before. In 2003, the reform of Inner Mongolian agricultural policy promoted crop cultivation. The principal crops contributing to this development are corn, potatoes, and wheat [3]. Consequently, the share of crop cultivation in the overall agricultural economic output has risen.

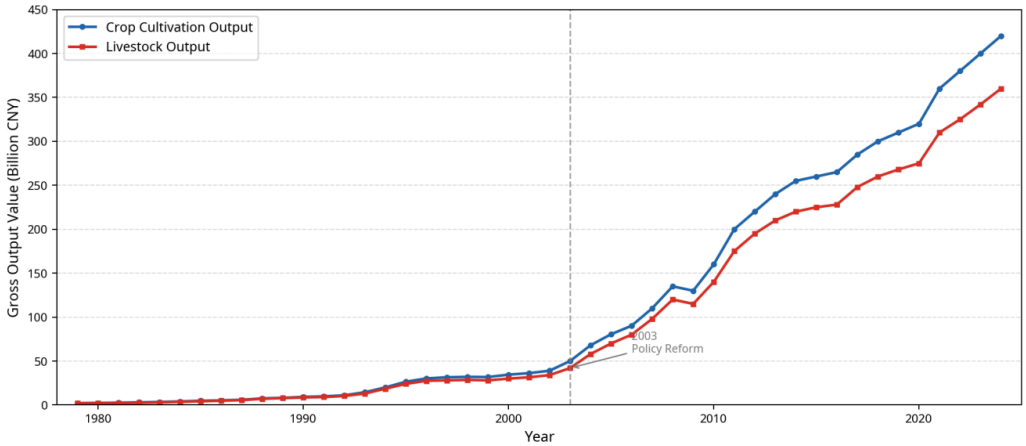

Figure 2. Gross output value of agriculture and livestock in Inner Mongolia, 1979–2024 (in Billion Chinese Yuan). Data acquired from: national bureau of statistics [4]

Inner Mongolia is one of the most remote and ecologically fragile regions in China. Through generations of nomadic living, Mongolian communities established a sustainable human–environment equilibrium in the region. However, in the nineteenth century, the Inner Mongolian grasslands faced critical degradation [5], which is discussed below. Since the founding of the People's Republic of China (PRC) in 1949, Inner Mongolia has been an Autonomous Region of the

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PRC. Several important policies were enacted by the government to protect the ecological environment in Inner Mongolia [6]. This research discusses how traditional Mongolian people's sustainability wisdom, such as seasonal pastoral mobility, can contribute to current environmental protection policies.

The Mongols originated in the Mongolian plateau. They were once widespread and strong in Eurasia, as the Mongol empire was the single largest continental empire in human history. The Yuan dynasty (1271-1368 AD) refers to the period when the Mongols took governance of all of China [7]. The Mongols used to be the predominant ethnic group in Inner Mongolia. However, as the segregation of Inner Mongolia and Outer Mongolia occurred, the Mongols gradually became a minority ethnic group in the PRC, even in Inner Mongolia, following population migration. The Mongols constitute about 18% of the population in Inner Mongolia and 0.45% of the population in China [8]. Thus, their knowledge and culture, especially those related to the human-environment relationship, were not widely known, and their wisdom was underrepresented due to reasons such as language barriers and political factors [9]. According to Chinese law, the government promotes the use of Mandarin Chinese among all people, and advocating separatism among Mongolians is highly illegal.

An illustration of the underrepresentation of Mongolian culture is the 2020 new educational policy. In 2020, the Inner Mongolia Department of Education introduced new "bilingual" curriculum syllabi, which reduced Mongolian instructional hours and required subjects, including history, politics, and Chinese, to be taught exclusively in standard Mandarin Chinese. This effectively changed the status of Mongolian into a language lesson within an otherwise Mandarin-medium curriculum [10]. The policy is perceived by local Mongols as marginalizing Mongolian culture and assimilating ethnic minorities into Han Chinese culture [11]. Consequently, many Mongolian students chose not to attend school and protested. From this, it can be deduced that the government largely overlooked the significance of preserving Mongolian culture.

As the indigenous residents of Inner Mongolia, the Mongolian people's wisdom should be emphasized, especially in the environmental aspect. For instance, livestock practices in Inner Mongolia are increasingly industrialized, yet traditional Mongolian herders possess valuable experience in making them more eco-friendly. This research on Mongolian sustainability wisdom is necessary because it reveals the insights of the Mongolian people on comprehensively addressing ecological challenges, which helps spread the knowledge of the Mongolian people and contributes to environmental conservation.

To transition from a descriptive analysis of traditional practices to a theory-driven evaluation, this paper adopts a multi-theoretical framework rooted in environmental social science. The central analytical lens is Traditional Ecological Knowledge (TEK), supplemented by Political Ecology, Adaptive Management Theory, Common Pool Resource Governance, and Environmental Justice Theory.

TEK is defined as a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission [12]. It encompasses not only technical knowledge about species, ecosystems, and ecological processes, but also the cultural values, spiritual beliefs, and social institutions that govern human–environment relationships. Critically, TEK is not static; it is a dynamic and adaptive system that responds to environmental change over time [13]. Traditional Mongolian ecological wisdom — including seasonal rotational grazing, sacred site protection, and customary resource governance — constitutes precisely this kind of sophisticated TEK system.

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The relevance of TEK to contemporary environmental governance lies in its complementarity with modern scientific approaches. While Western environmental science tends to rely on quantitative data and controlled experiments, TEK offers long-term observational knowledge accumulated over centuries of direct interaction with local ecosystems. Integrating TEK into environmental policy can therefore enhance both the ecological effectiveness and social legitimacy of governance interventions.

This paper further draws on Political Ecology to analyze the structural causes of environmental degradation in Inner Mongolia, recognizing that ecological crises are not merely natural phenomena but are shaped by economic development models, power asymmetries, and resource governance regimes [14]. Adaptive Management Theory [15] is employed to evaluate the ecological rationality of traditional pastoral practices such as rotational grazing. Common Pool Resource Governance Theory [16] provides a theoretical basis for community-based environmental stewardship. Finally, Environmental Justice Theory [17] and Biocultural Diversity Theory [18] are used in the Discussion to argue for the inclusion of indigenous voices in policy-making.

Taken together, these theoretical frameworks form an integrated analytical model, as illustrated below:

Simultaneously, Political Ecology explains the structural origins of environmental degradation, while Environmental Justice and Biocultural Diversity theories justify the normative imperative for indigenous participation in governance. By anchoring the analysis in this multi-layered theoretical framework, this paper moves beyond descriptive documentation of traditional practices to offer a theoretically grounded evaluation of their relevance to contemporary sustainability challenges in Inner Mongolia.

The remainder of this paper is organized as follows. Section 2 examines the sustainability principles and strategies of the Mongolian people, focusing on the ideological foundations embedded in Shamanism and Tibetan Buddhism, and their alignment with Land Ethics Theory. Section 3 analyzes the major environmental threats facing Inner Mongolia, including desertification and the ecological consequences of mining and industrialization, interpreted through the lens of Political Ecology. Section 4 explores how traditional Mongolian practices — particularly seasonal pastoral mobility and community-based stewardship — can be adapted to modern environmental management, drawing on Adaptive Management Theory. Section 5 conducts a stakeholder analysis, identifying the key actors in Inner Mongolia's environmental governance and grounding community participation in Common Pool Resource Governance Theory. Section 6 presents a Discussion that synthesizes the theoretical and empirical findings, arguing that TEK is complementary to modern science, that cultural preservation and environmental protection are inseparable, and that indigenous participation enhances policy legitimacy. Section 7 offers targeted policy recommendations for the Inner Mongolian government. Sections 8 and 9 provide a summary and conclusion, respectively.

2. Sustainability principles and strategies of the Mongolian people

Historical and cultural records indicate that the Mongolian people have developed a comprehensive set of principles and strategies over centuries, aimed at safeguarding and adapting to the fragile environment of their region. During this adaptive process, several factors contributed significantly to the formation and fixation of these customs. This section analyzes these approaches and explores the progression of Mongolian sustainability ideology through multiple lenses.

The ideology of Mongolian communities greatly influences their sustainability efforts. To analyze the ideology of Mongolian communities, it is essential to recognize that shared beliefs are often

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rooted in a common religion. Over time, religious practices within Mongolian communities have undergone significant evolution, but environmental protection has remained a persistent topic.

To illustrate the religious transition in Mongolia, the Dayan Deerkh Monastery (Figure 3) serves as a typical example. Dayan Deerkh is the spiritual guardian of a prominent limestone mountain and its renowned cave complex, situated near the village of Tsagaannuur. Currently, Dayan Deerh is widely recognized among both shamans who perform Buddhist rituals and Buddhist monks in Mongolia [19].



Figure 3. Dayan Deerkh Monastery, a symbol of Mongolia's religious tradition [20]. Retrieved from https://mongolia-guide.com/place/dayan-deerkh-monastery

2.1. Shamanism

According to Hesse, Mongolian Shamanism is characterized as "a belief system, a worldview, anthropology, folk medicine, a religio-magic cult of nature" [21]. Mongolian Shamanism has 99 tngri (meaning "God of Heaven"), of which 55 are white or benevolent and 44 are black or terrifying. Additionally, there exists the concept of 77 earth mothers (natigai). Among all the figures, the highest is köke mönke tngri, the Eternal Blue Sky. These deities are shared across all clans. In conclusion, Mongolian Shamanism is an early religion in which the Mongols deify nature. Mountains, rivers, and forests are considered to be inhabited by sacred guardian spirits. Harming such ecosystems is considered an offense to the spirits and brings misfortune to the community.

2.2. Tibetan Buddhism

Tibetan Buddhism is also referred to as Lamaism. Currently, Tibetan Buddhism is the predominant faith within Mongol communities. Tibetan Buddhism also held that mountains, rivers, and lakes are habitats for spirits and deities. Furthermore, this religion asserts that all living beings are interconnected and possess intrinsic equality. The doctrine of karma encourages environmental stewardship, as polluting the environment is regarded as negative karma, which may result in a less fortunate existence and rebirth into less desirable realms, and vice versa.

The Dayan Deerkh Monastery demonstrates the Mongolian people's reverence and protection for nature. In the monastery, Invocation Nr. 3 to Dayan Deerh (a piece of text to the deity) outlines several prohibitions designed to safeguard nature and also references the protection of swans. Also,

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consider Peter B. Johnsen's interview with the monk Tserenochir at the Dayan Deerkh Monastery (see Figure 3). Tserenochir said, "Conserving nature from the perspective of religion is to not bring harm to nature because, in the end, this will bring back harm to you. The salmon fish lays many eggs, but only one has the chance to become a salmon fish. [Therefore,] the sin of killing a single salmon is equal to ending the lives of a thousand living things. There are instances where killing a salmon can deteriorate the killer's health and eyesight and bring about diseases" [22].

This deep reverence for nature aligns with the Land Ethics Theory, which expands the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land [23]. The Mongolian ecological perspective exemplifies this non-anthropocentric environmental ethics, emphasizing a symbiotic relationship between humans and the broader ecological community. Such an ideological foundation provides a strong moral imperative for conservation efforts.

3. Threats to the sustainability of Inner Mongolia

The environment in Inner Mongolia is fragile. With modernization and climate change, several new issues, including pollution, radioactivity, and land subsidence (the gradual sinking or lowering of the ground surface), have accelerated environmental degradation. This section discusses in what ways the Inner Mongolian environment is facing challenges and what factors have caused such challenges.

3.1. Desertification deterioration is still concerning, albeit strong forestation policies

The precipitation in Inner Mongolia decreases from east to west, and the vegetation changes from forest to grassland, then to desert. This low-precipitation continental climate leads to high aridity, as shown in Figure 4.

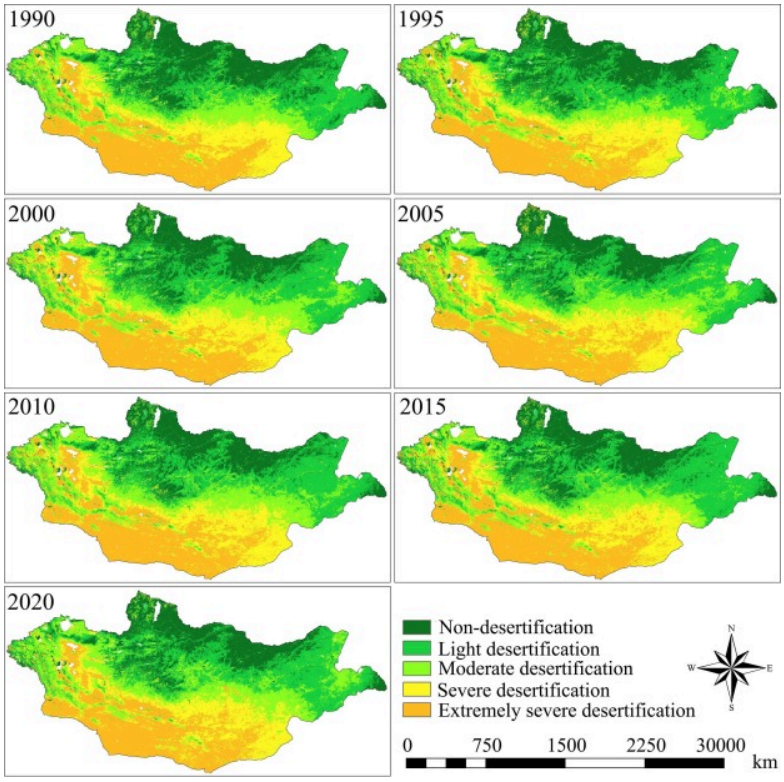

Figure 4. Climatic aridity map of Inner Mongolia and spatial distribution of the weather stations [24]

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3.2. Overmining and industrialization result in comprehensive ecological harm

The environmental degradation in Inner Mongolia cannot be fully understood merely as a natural phenomenon; it must be analyzed through the lens of Political Ecology. Political Ecology posits that environmental problems are inextricably linked to economic development models, power structures, and resource governance systems [14]. The ecological conflicts in the region stem largely from an extractive development paradigm that prioritizes short-term economic gains over long-term sustainability.

The Mongolian region is a resource-rich region with a relatively small population. The vast development of the mining industry in Inner Mongolia caused multiple deleterious effects on the environment, including but not limited to the following.

Rare earth production mainly occurs in Baotou Municipality. More than half of the global rare earth is produced in the Bayan Obo Mining District. Researcher Kilby has identified the Weikuangba tailing pond as the largest of its kind globally, containing over 230 cubic meters of hazardous waste [25]. The pond is merely 10 kilometers away from the second largest river, the Yellow River, thus the water safety is endangered in the entire region. Also, the bottom of the reservoir is not lined correctly, leaking into the groundwater [25]. Nearby, the village of Dalahai has observed increased levels of cancer, respiratory illnesses, and other diseases. The radiation levels of drinking water in Dalahai are significantly above the national standards.

The Figure 5 attached as below illustrates the severity of rare earth mining pollution. In 2019, I visited the Bayan Obo Mining District, where I observed extensive accumulations of solid waste generated by rare earth mining. The waste had formed large mounds, and fine greenish-grey dust permeated the surrounding air. This scene was truly concerning and prompted me to reflect critically on the trajectory of development in Inner Mongolia.



Figure 5. The pollution from the Bayan Obo Mining District [26]

Coal production mainly occurs in Ordos Municipality. Coal mining enterprises in Ordos dumped mining wastewaters into local lakes, making the water bodies and wetlands toxic to birds. The bird species Relict Gull experienced a significant population decrease in Ordos Municipality due to this

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pollution. Additionally, disturbed soil and ground cover can exacerbate the invasion of non-native species in Inner Mongolia [27].

Land subsidence is the gradual sinking or lowering of the ground surface due to natural processes or human activities, such as overmining and groundwater extraction. First, the government was planting numerous trees in arid areas, extracting large amounts of groundwater. The groundwater level decreased alarmingly. Second, although the majority of coal mines in Inner Mongolia are open-pit mines, there are still a significant number of underground mines. The extraction of groundwater and underground mining resulted in land subsidence, endangering many ecosystems and communities. In 2025, the construction of a new uranium factory was finished in Inner Mongolia. The pastoralists and other residents are subject to radioactivity and other dangers.

4. Adopting traditional Mongolian practices in modern situations

Traditionally, Mongolian herders rotated grazing areas according to the seasonal cycles, preventing overgrazing and allowing pasture to regenerate. Currently, the land-use rights in Inner Mongolia have been privatized, creating a barrier for rotational grazing. The amount of stockbreeding also decreased significantly. Therefore, the remaining stockbreeding should focus on promoting the quality by learning from traditional Mongolian pastoral practices.

This practice of seasonal pastoral mobility is a prime example of Adaptive Management Theory, which emphasizes the resilience and stability of ecological systems [15]. Rotational grazing is not a primitive or backward method; rather, it is a sophisticated approach to managing human-environment relations based on continuous ecological feedback, thereby enhancing ecological resilience.

Mongolian cosmology emphasizes harmony between humans and nature, treating rivers, mountains, and forests as sacred. These cultural norms historically protected ecosystems from exploitation. Incorporating this worldview into environmental education and protected-area governance can strengthen ecological stewardship today.

Traditionally, Mongolian communities held responsibilities and stewardship over their environment. Currently, the resource in Inner Mongolia is primarily managed by the government, which is a vertical administration. Promoting clan-based stewardship can add horizontal administration, co-managing the environment alongside the government. Legal recognition and formalization of community-based stewardship are beneficial for adopting this tradition in the modern context.

5. Evaluation of policy: integrating indigenous knowledge and stakeholder governance

The effective integration of traditional Mongolian sustainability practices into modern governance requires a comprehensive evaluation of current policies and the stakeholders involved. Environmental protection in Inner Mongolia is a complex process that involves the government, traditional Mongolian communities, academic institutions, environmental organizations, mining enterprises, urban consumers, and the tourism sector. Evaluating policy through the lens of Common Pool Resource Governance Theory [16] reveals that top-down administrative approaches often fall short when they exclude local communities. Ostrom demonstrated that local communities can effectively manage common resources through self-governance and community-based stewardship, avoiding the 'tragedy of the commons.' Therefore, a successful policy must transition from exclusive government control to a co-management framework that actively incorporates traditional Mongolian stewardship.

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Stakeholders in Inner Mongolia can be assessed based on their vulnerability, influence, and responsibility regarding environmental issues. For instance, mining companies and the tourism sector exert high influence and bear high responsibility due to their direct ecological impact, yet they often face low vulnerability. Conversely, traditional Mongolian communities are highly vulnerable to environmental degradation—such as the pollution from the Bayan Obo Mining District and coal mining subsidence in Ordos—but historically possess low influence in policy-making. The government, holding high influence and responsibility, must bridge this gap. A critical evaluation of recent policies, such as the 2003 'farm recover to prairie' initiative and the 2011 grazing prohibitions, shows that while these top-down policies aimed to restore grasslands, they often forced indigenous people to abandon their sustainable lifestyles. This resulted in clandestine stockbreeding and increased conflicts between herders and the government, highlighting the inefficiency of policies that lack indigenous participation.

To address these policy shortcomings, traditional ecological knowledge should be viewed as a complementary system rather than an alternative to modern science. Integrating indigenous wisdom with modern technological tools can create a robust environmental governance framework. For example, while satellite remote sensing and Normalized Difference Vegetation Index (NDVI) tracking provide macro-level data on desertification, community-based observations offer micro-level, qualitative insights into ecological changes that satellites might miss. Policies should explicitly award rotational herding practices rather than imposing blanket bans, thereby enhancing ecological resilience in alignment with Adaptive Management Theory [15].

Furthermore, policy evaluation must consider the intrinsic link between cultural preservation and environmental protection. According to the Biocultural Diversity Theory [18], linguistic, cultural, and biological diversity are deeply interrelated and mutually reinforcing. The 2020 educational policy changes that marginalized the Mongolian language not only threatened cultural identity but also risked eroding the traditional ecological knowledge embedded within that language. Therefore, the government must respect and preserve Mongolian cultural education as a fundamental component of its environmental strategy.

Finally, incorporating indigenous voices into environmental decision-making processes is essential for policy legitimacy. Environmental Justice Theory [17] posits that the equitable distribution of environmental risks must be accompanied by the recognition of marginalized communities in governance. The government should require stringent Environmental Impact Assessments (EIAs) for all economic and population policies, ensuring that mining companies cannot expand production without installing environment-preserving technologies. By institutionalizing independent environmental evaluation agencies and making the decision-making process more participatory, Inner Mongolia can develop policies that are not only scientifically sound but also socially just and culturally sustainable.

6. Conclusion

In the face of climate change and rapid modernization, traditional Mongolian sustainability practices offer profound insights for addressing modern ecological crises in Inner Mongolia and similar arid plateau regions globally. This study demonstrates that the environmental challenges facing the region—such as desertification, mining-induced pollution, and land subsidence—are deeply intertwined with extractive economic models and the marginalization of indigenous knowledge. By applying a multi-theoretical framework encompassing Traditional Ecological Knowledge, Political Ecology, and Common Pool Resource Governance, this research highlights the necessity of shifting from top-down, technology-centric environmental policies to inclusive, co-management strategies.

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The evaluation of current policies reveals that while the government has made significant efforts to protect the environment through forestation and grazing bans, these measures often overlook the biocultural diversity and adaptive resilience inherent in traditional Mongolian pastoralism. Integrating indigenous wisdom with modern scientific monitoring not only enhances ecological effectiveness but also ensures environmental justice and policy legitimacy. Moving forward, sustainable governance in Inner Mongolia must prioritize the preservation of Mongolian cultural heritage, mandate rigorous environmental impact assessments, and actively involve local communities in decision-making processes. Ultimately, recognizing and restoring indigenous ecological wisdom is not merely a cultural imperative, but a vital component of global environmental sustainability. The current analysis involved at length in this paper is limited for the following reasons. Firstly, the Mongolian people's voice is underrepresented. In the research, the sources are mainly academic journals and government institutions. Secondly, this research mainly focused on the societal aspect of the Inner Mongolia environment through literature analysis. The following measures can improve this research: First, gather more first-hand information from indigenous people. Second, incorporate a more scientific viewpoint and include data analysis in the research. Additionally, some questions remain unanswered in the research. For instance, the increasing military activities in Inner Mongolia are difficult to monitor because minimal information is available. Such activities, including exercises and parades, potentially impact the environment negatively. However, the broader ecological implications are difficult to measure.

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