



Current Situation Analysis and Potential Solutions of Desertification in Inner Mongolia---Based on Big Data Analysis Methods

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Abstract. Desertification has long been a destructive environmental issue in Inner Mongolia. It turns fertile soil into arid sand, aggravates sandstorms, destroys habitats of wildlife, and threatens the normal living of Inner Mongolian residents. To overcome this natural crisis, the public is actively searching for possible ways to weaken the bad impacts desertification leaves on the soil and protect the rest of the grassland. This paper aims to closely analyse the environment of Inner Mongolia experiencing land degradation and propose practical solutions to fight desertification. The author uses big data analysis to read and compare information on the environmental conditions of Inner Mongolia in the past 20 years. Combining the collection of studies with relevant knowledge in chemistry, biology, economics, and environmental science, the author comes up with resolutions potentially effective in solving desertification. Finally, the paper reaches the conclusion that desertification still exists and harms both nature and human life in Inner Mongolia. However, the region continues to recover from the severe environmental destruction as society starts to take action against the crisis. With more settlements emerging based on careful research, it is reasonable to believe that one day Inner Mongolia can rebuild the broad prairie and no longer suffer from desertification.

Keywords: desertification · Inner Mongolia · environmental protection

1 Introduction

Desertification, by definition, is a change in soil properties, vegetation or climate, which results in a persistent loss of ecosystem services that are fundamental to sustaining life.[1] China is experiencing serious desertification in recent years: According to the official data, up until 2020, China has had 2.622 million square kilometers of soil degrading to barren desert, which takes up 27.4% of the country's whole land area. This environmental crisis often strikes the northwestern part like Inner Mongolia, where large patches of green grass have gradually turned into yellow sand, limiting the development of agriculture and intensifying the activity of sandstorms. Therefore, how to effectively combat desertification has become a widely concerned issue eagerly requiring resolutions.

The author aims to examine the current situation of Inner Mongolia under desertification, analyze the main causes and impacts of this natural disaster, and offer potential solutions to eliminate, or at least alleviate, the destruction of the crisis. This passage analyses data, experiments, and conclusions in various authoritative papers. Discussion about typical causes and impacts of desertification in Inner Mongolia is made based on the collected information. The last part summarizes existing solutions and proposes new ways to fight against this crisis. This article will point out the root cause of the desertification process in Inner Mongolia. Through the analysis and discussion of these reasons, the public may be inspired to carry out more effective soil management.

2 Situation Analysis

Inner Mongolia is seriously losing large areas of grasslands with the expansion of desertification. According to the official data, in the recent 30 years, the total desert area in Inner Mongolia has reached 105761.7 km² and is still slowly expanding [11]. In the past, there were ample grasses covering the prairie like a green blanket. Nevertheless, vast districts are currently under the threat of desertification, which thoroughly changes their landscape and breaks their normal ecological cycle. For example, a desert has formed in Kubuqi, an area in the south of Erdos of Inner Mongolia. The desert, where drought is the common state, covers 16756 km² in total. The ecology and environment of Kubuqi are in a fragile state due to its geological landform, soil type, weather condition and hydrological condition, which can easily cause desertification. [2] Fig. 1 [3] clearly demonstrates the distribution of degraded land in Inner Mongolia: from east to west, the soil condition continues to deteriorate, and large parts of the desert have already formed and keep expanding to the undegraded grassland.

The current desertification leads to serious destruction in the environment of Inner Mongolia. Several phenomena will be briefly discussed to illustrate the current situation in the affected lands.

2.1 Atrophied Grass

Nowadays, due to desertification, the blades on the prairie are yellowing and barely reach people's ankles. According to the data, the area of degraded grassland in Inner Mongolia accounts for 39.4% of the entire available grassland in the region. [4] This not only makes the scenery of grassland less appealing but also negatively affects the normal diet of animals, because the nutrients contained are diminished as the grass withers.

2.2 Infertile Soil

Much of the land in Inner Mongolia has lost its fertility and cannot support ordinary vegetation growth. The amounts of essential elements in the soil, such as nitrogen, phosphorous, and potassium, are decreasing rapidly. As a result, it becomes harder for new plants to germinate on the already degraded grassland, which further intensifies the condition of desertification.

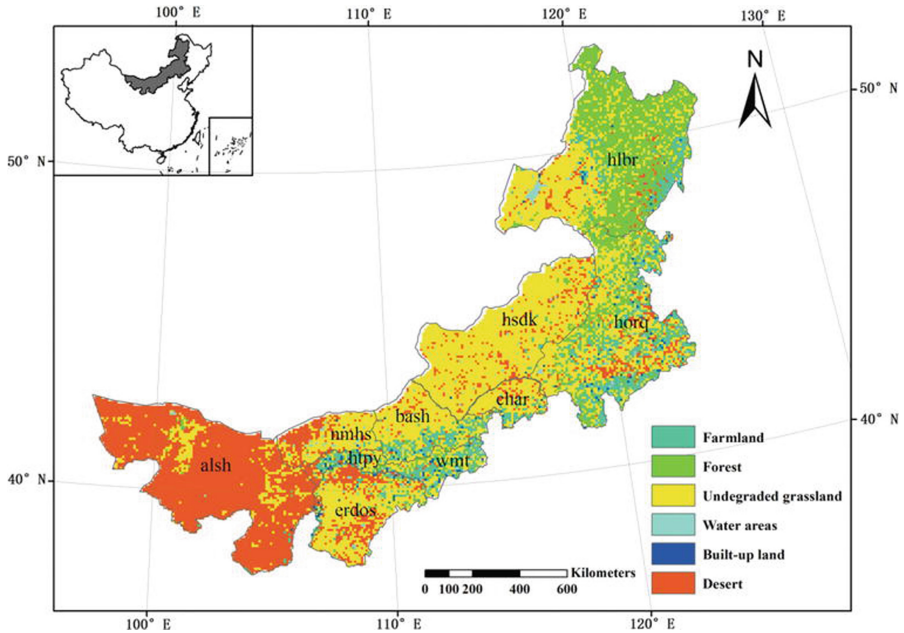


Fig. 1. Different landforms of Inner Mongolia

2.3 Drying Water Area

With more lands turning into barren desert, less moisture can be captured and stored in the soil, which causes the climate to become drier and contributes to the ultimate dry out of numerous water areas. Hundreds of lakes and rivers are shrinking and disappearing in Inner Mongolia, some taking just five to six years to dry completely. This phenomenon seriously affects the balance of ecosystem as well as the normal life pattern of residents.

3 Causes of Desertification

To reverse the deteriorating situation effectively, it is worthy to analyse what propels Inner Mongolia's desertification. This passage summarizes three main factors that cause the environmental crisis, including the influence of both natural climate and human activity.

3.1 Overgrazing

Researches have demonstrated that, as industrial production starts to flourish, the population of livestock receives a great increase in Inner Mongolia [5]. Livestock often eats plants completely, so vegetation can only grow short, unsustainable roots during the transient grazing break and, eventually, they will stop germinating from the ground. The over-consumption of plants that causes huge damage to the root is hard for the greenery to recover from. As people in Inner Mongolia raise more livestock than ever before, they

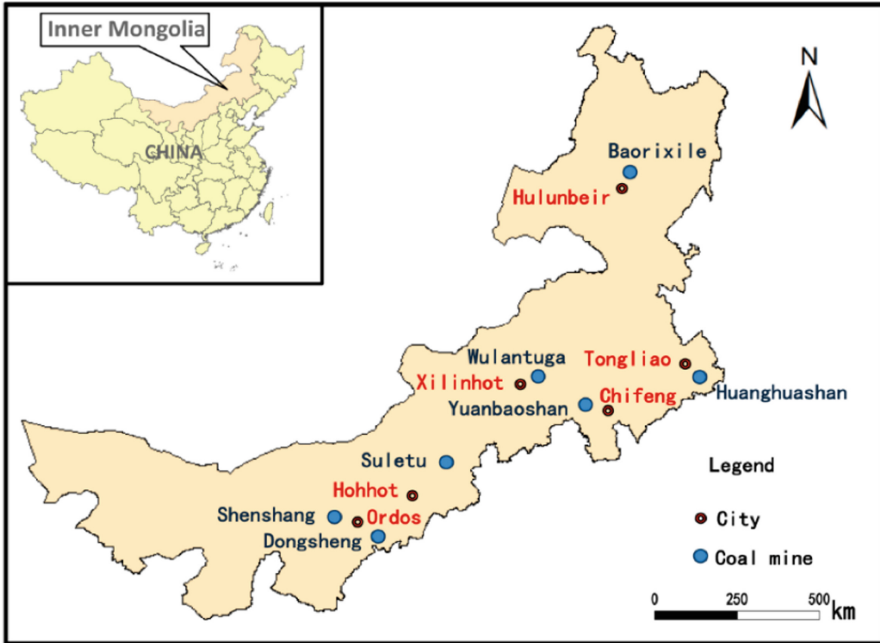


Fig. 2. Distribution of mining sites in Inner Mongolia

tend to graze their sheep, cows and horses intensively on one patch of grassland, which puts a heavy burden on the greenfield and strongly restrains normal vegetation growth. With livestock constantly consuming a large amount of grass every day, the prairie does not have any time to rest and grow new plants to fill the vacancy. Gradually, the over-grazing areas lose their capacity to maintain regular grass up-growth and ultimately turn into deserts.

3.2 Mining

It is well known that Inner Mongolia is one of the most active mining spots in China. Although critical for resources utility and economic development, mining has destructive impacts on the soil: It extracts important minerals from the ground, which greatly affects the productivity of lands. In addition, the mining sites are often randomly abandoned after the excavation work is over, without miners applying any reclamation measures on the destructed land. Figure 2 [6], identifying several main mining sites in Inner Mongolia, shows that most of them locate in the middle of the region where there are large areas of grassland. As the mining continues, more and more meadows are destroyed and gradually turn into sands. Therefore, mining not only changes the contents of different minerals in the soil but also damages the land surface due to the lack of proper soil protection after excavation, making the former grassland inhospitable for vegetation growth.

3.3 Persistent Draught

Under the trend of global warming, the temperature keeps rising in Inner Mongolia. Drier and warmer climate leads to constant draught on the grassland. Scientific studies have proved that, when lands are degrading, vegetation is very likely to die when suffering from extreme weather like consistent drought because of the insufficient nutrient supply and their weak supporting roots. As a result, when Inner Mongolia receives more and more severe drought recently, its desertification quickly expands since grass cannot survive from the strong heat and lack of water.

4 Impacts of Desertification

Desertification leads to severe negative consequences on nearly all aspects of Inner Mongolia, not only affecting the natural environment but also disturbing people's normal life. Three main fields, including ecology, economy, and health, will be discussed in order to demonstrate the destruction of desertification and contingency for suitable solutions.

4.1 Ecosystem

Due to expanding desertification, there is sparse vegetation and pasture-grass degradation on the prairie in Inner Mongolia [7]. The dominant grasses growing on the Inner Mongolian Plateau such as China *Leymus* and *Ruthenia medic* are the main food sources for animals living on the grassland, from common livestock like sheep and horses to endangered species like Asiatic Wild Ass. With gradual soil atrophy, existing grasses are unable to provide enough food, which creates a great threat to the normal living of the livestock and wildlife. The balance in the ecosphere might be interrupted as animals lose their food and habitats. As time goes on, desertification causes strong instability on the whole ecosystem in Inner Mongolia.

4.2 Economy

Many herders rely on the grassland for grazing and travel from one pasture to another as a routine to make a living. However, recent studies have showed that, because of the shrink of the greenfield, herders now often remain in one camp all year round [7]. The decrease in the prairie's area strictly confines the moving span of herders and their herds. Since a single patch of meadow withers annually, it cannot provide sufficient vegetation all year long. Without enough nutrition supply, the growth of livestock is negatively affected. As a result, herders have much less yield of products like wool and dairy to sell on the market, which leads to lower income. Figure 3 [12] articulates the development of agriculture in Inner Mongolia, which largely depends on stock raising, and indicates a trend of decreasing productivity since around 2014. It is not hard to tell that the overall economic growth of Inner Mongolia is hindered by the continual desertification.

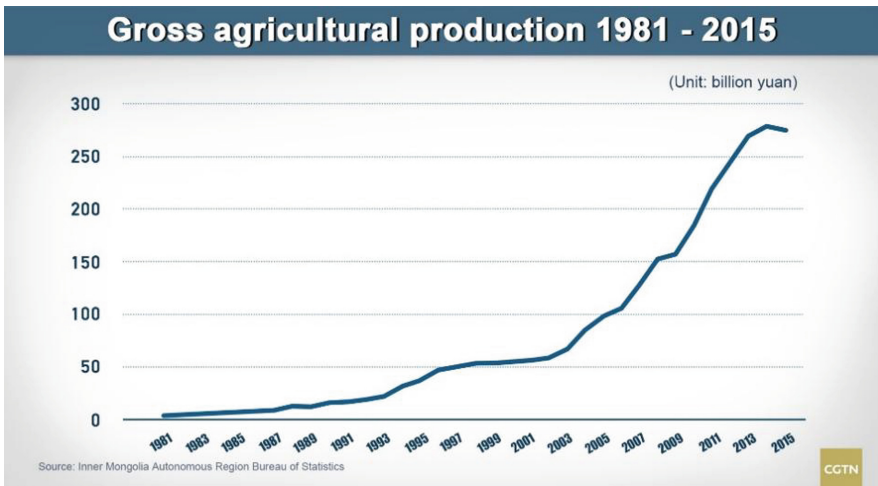


Fig. 3. Gross agricultural production of Inner Mongolia

4.3 Health

Desertification damages people's health by causing the "yellow sand phenomenon," which occurs most frequently in the spring season in some arid areas of deserts. The powerful wind can spread the accumulated sands and dust in the desert throughout Inner Mongolia. If people accidentally breathe in these fine particles, whose diameters range from 0.0625 mm to 2 mm, their respiratory system will be greatly harmed by the sand accumulation in their lungs. Inner Mongolia government's official report on citizen health indicates that respiratory disease ranks in the top five illnesses that leads to high mortality and causes approximately 20% of all death cases in this region [13]. The health of people in Inner Mongolia is under great threat caused by the yellow sand phenomenon.

5 Potential Solutions

Properly dealing with desertification needs the support of effective solutions. The author lists some of the major existing responses in society and proposes original solutions that have the probability to be adopted and applied to real governance.

5.1 Government

During the combat against the environmental crisis, government plays the central role of giving proper orders and supporting the implementation of beneficial proposals.

1) **Releasing legal policies**

Recently, people are calling on the government to formulate policies that are in accordance with legal provisions to provide formal political support for the grassland preservation. One existing example is The Chinese National Action Plan to Combat Desertification, which has implemented and organized large-scale development of cross-region, cross-basin, and cross-industry ecological projects and accelerated desertification prevention work. Local governments in desertified regions have also enacted corresponding local regulations and rules to further help the environmental combat [8]. Clear policies can provide correct guidance for people who are striving to alleviate desertification and decrease time-wasting, complicated trails.

2) **Building natural reserves**

Prairies and deserts take up more than three quarters of Inner Mongolia's total area, occupying 73.26% and 12.67% of the land respectively. Although there is still a notable contrast between the areas of the two landforms, deserts are expanding annually, eroding the meadow and turning grasses to barren sand. To retrieve the lost grassland, it is applicable for government to build protection zones in Inner Mongolia, because these areas offer a relatively safe environment for wildlife to reproduce and grow. In this case, grasses will not be disturbed by tourists or livestock from their regular growth, and wild creatures can have sufficient food sources and broad habitats to maintain their living. As a result, the ecosystem is likely to recover quicker from the current damage of desertification. Figure 4 [9] displays the main nature reserves in Inner Mongolia, which spread throughout the region and effectively cover areas of desert and degraded grassland.

5.2 **Charity Organization**

Charities are working with the government as well as local residents to build ecological restoration projects that help recover the greenery in Inner Mongolia. The Million Tree Project (MTP) led by Shanghai Roots & Shoots is a good illustration. By planting, maintaining, and monitoring the oxygen-producing trees, both volunteers make a contribution to lessening the negative impact of desertification. When the trees are young, local farmers involved can interplant crops such as beans to earn extra income. Up until now, the Million Tree Project has planted 2,514,637 trees in Inner Mongolia. This program is a win-win action since it balances the environmental protection and the well-being of humans, and there are many similar restoration programs conducted in Inner Mongolia.

5.3 **Local Herder**

Herders are very important in grassland protection, because their decisions can affect the grazing activity, which can lead to serious desertification if overly carried out. It is a good idea for them to provide nutritious forages to their livestock so that the sheep, cows and horses do not have to rely on grasses on the greenfield as their only food source. Usually, the artificial forages contain compositions like crude protein, neutral detergent fibre, acid detergent fibre, and lignin [10]. The livestock can eat natural grass and nutritious

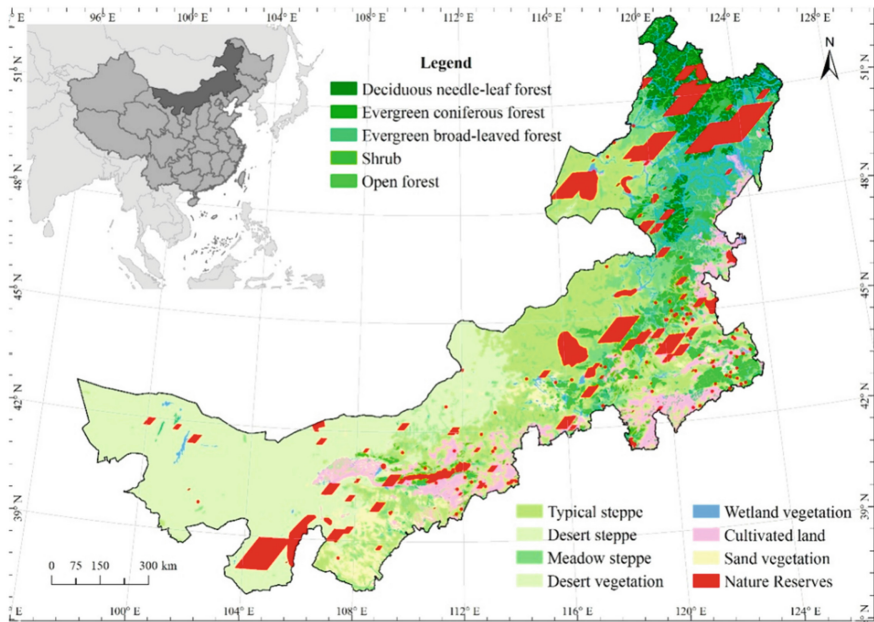


Fig. 4. Distribution of nature reserves in Inner Mongolia

forages alternately—mainly consuming vegetation when there is sufficient supply on the prairie and having fodder when the plants start to wither or just germinate from the soil—which offers grasses enough time to grow and largely avoids land degradation. Briefly speaking, less grass depletion provides lower probability for desertification. To make sure all herders can afford the forages, the local government can set up an assistance program: people are allowed to register at specific program spots to report the number of their livestock and the corresponding fodder required every year. After verification, they can get a reasonable amount of subsidy.

6 Conclusion

To summarize, the author discusses the desertification in Inner Mongolia, including the current state of Inner Mongolia under desertification, three causes and three impacts of this long-existing environmental crisis, as well as traditional and original solutions in response to desertification. Recently, Inner Mongolia is experiencing serious environmental damage: grasses atrophy on the barren soil, lakes and rivers keep shrinking, and the wildlife cannot find adequate sustenance. Humans, whose irrational actions partly cause the desertification, are also affected by this natural disaster. Thanks to the timely reactions of government, organizations, and local people, the desertification trend is largely restrained by solutions ranging from politics to economics to ecology. Given all these points stated above, it is clear to understand that the desertification in Inner Mongolia has exerted great negative influences on the environment as well as human life, so it is pressing for people to actively combat this crisis and recover disappearing grasslands.

The article still has some parts that can be improved. For example, it lacks appropriate experiments to test the practicality of the proposed solutions. In the future, the author will put the research focus on ameliorating current grassland restoration methods and evaluating the effectiveness of new trials in order to determine whether these attempts can be applied in a real situation to fight desertification.

Acknowledgement. Firstly, I would like to show my deepest gratitude to my teachers in my school, who have provided me with valuable guidance in every stage of the writing of this thesis. Further, I would like to thank all my friends and my parents for their encouragement and support. Without all their enlightening instruction and impressive kindness, I could not have completed my thesis.

References

1. D'Odorico, P., Bhattachan, A., Davis, K. F., Ravi, S., & Runyan, C. W. (2013). Global desertification: Drivers and feedbacks. *Advances in Water Resources*, 51, 326–344. doi:<https://doi.org/10.1016/j.advwatres.2012.01.013>
2. Cui, Y. (2013). Interpretation and Dynamic Analysis in Desertification – A Case Study of Kubuqi Desert. *Applied Mechanics and Materials*, 295-298, 2102–2106. doi:<https://doi.org/10.4028/www.scientific.net/amm.295-298.2102>
3. Xu, Duanyang., (2018) The Impact of Desertification Dynamics on Regional Ecosystem Services: A Case Study of Inner Mongolia (China). “Community and Global Ecology of Deserts. IntechOpen.
4. CHANG, I. S., ZHAO, J., MA, W., WANG, L., WU, J., & YANG, Y. (2018). Prospects of Grassland Carbon Sink in Inner Mongolia, China.
5. Cao, J., Yeh, E. T., Holden, N. M., Qin, Y., & Ren, Z. (2013). The Roles of Overgrazing, Climate Change and Policy As Drivers of Degradation of China's Grasslands. *Nomadic Peoples*, 17(2), 82–101. doi:<https://doi.org/10.3167/np.2013.170207>
6. Liu, L.; Liu, J.; Zhang, Z. Environmental Justice and Sustainability Impact Assessment (2014): In Search of Solutions to Ethnic Conflicts Caused by Coal Mining in Inner Mongolia, China. *Sustainability* ,6, 8756-8774. <https://doi.org/10.3390/su6128756>
7. Torgonshar, N. (2013). Changes in Mobile Pastoralism and Grassland Degradation in Eastern Inner Mongolia. *Inner Asia*, 15(1), 33–56. doi:<https://doi.org/10.1163/22105018-90000054>
8. Li, Z.-B., Li, P., Huang, P.-P., & Liu, X.-J. (2013). Comprehensive Chinese Government Policies to Combat Desertification. *Restoration and Development of the Degraded Loess Plateau, China*, 123–135. doi: https://doi.org/10.1007/978-4-431-54481-4_9
9. Ma, W.; Feng, G.; Zhang, Q. (2016) Status of Nature Reserves in Inner Mongolia, China. *Sustainability*, 8, 889. <https://doi.org/10.3390/su8090889>
10. Sha Du, Ming Xu & Junhu Yao (2016) Relationship between fibre degradation kinetics and chemical composition of forages and by-products in ruminants, *Journal of Applied Animal Research*, 44:1, 189-193, DOI: <https://doi.org/10.1080/09712119.2015.1031767>
11. Minjie, Wang, 2019, Research on Desert Area, Boundary and Desert Lake Changes in Western Inner Mongolia in the Past 30 Years[D]. Inner Mongolia University.
12. Hong Zhao, 2017, Infographic: Inner Mongolia's economic achievements in 70 years Retrieved, August 26, 2021, https://news.cgtn.com/news/3d55544f3345544e/share_p.html
13. Inner Mongolia News, 2018, Report on health and population health in Inner Mongolia Autonomous Region, Retrieved, August 26, 2021, <http://gov.nmgnews.com.cn/system/2018/11/29/012609830.shtml>

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