

Article

A Study of Ecosystem Restoration to Prevent Desertification and Yellow Dust in Mongolia

Bat-Erdene Ganchimeg* and Jae Eun Lee

*Correspondence: smileganaa4372@yahoo.com; Tel.: +82-10-2464-8015

Department of Public Administration, Chungbuk National University, Chungbuk 28644, Korea

National Crisisonomy Institute, Chungbuk National University, Chungbuk 28644, Korea;

jeunlee@chungbuk.ac.kr

Abstract: The purpose of this study is to objectively examine issues related to climate change and desertification in Mongolian society, and to suggest measures suitable for Mongolian society and geography based on climate change and desertification data from countries around the world. Desert and arid regions are natural environment with unique ecosystems, but the expansion of rapidly desertifying regions due to artificial population, economic, industrial, and agricultural policies is a serious environmental crisis (Yun Yi-Suk, 2013: 85). Due to global climate change and indiscriminate development, desertification is progressing to a serious level. In particular, Mongolia has a world wide land area, but most of the area is a dry area and is very vulnerable to desertification (Sul-Erdene, et. al., 2011: 222).

Keywords: desertification, yellow dust, natural problems, desertification in Mongolia, prevention of desertification.

1. Introduction

In 1994, the United Nations (UN) launched the United Nations Convention to Combat Desertification (UNCCD) through agreements among countries around the world. It is the only legally binding international agreement linking environment and development for sustainable land management. UNCCD has presented the definition of desertification as follows. In other words, it refers to the phenomenon of land destruction in arid, semi-arid and dry-semi-humid regions as a result of various factors including climate change and human activities (Lee Seung-hyeok, 2020: 1). Mongolia joined the Desert Prevention Convention in 1996, and since 90% of Mongolia's vast territory is semi-arid and arid, and more than 45% of its territory is included as desert, it is very vulnerable to desertification. Desertification is increasing in Mongolia, and it is beginning to adversely affect the natural ecology and socio-economic development. About 400 rivers have dried up in the past decade, increasing droughts. Pasture resources are scarce and droughts occur annually. This is due to land, agriculture, and consequently rural-to-urban migration, overcrowding of the population, overloading of infrastructure, Negative consequences such as unemployment, air pollution and increased waste continue to occur. Therefore, the main purpose of this study was to introduce measures suitable for Mongolian society and conventional situation based on measures to prevent climate change and desertification of countries around the world.

2. Theoretical background

A desert usually refers to an area where vegetation is difficult to grow and there is very little precipitation, and it is the sandy desert that we commonly know. Not all deserts

are sandy deserts, but most countries without deserts only have access to data, so there is little interest and understanding about them. Desertification, which is a global problem, is not simply a concept of expanding deserts. UNCCD defines desertification as a land degradation phenomenon caused by various factors such as climate change and human activities in arid/semi-arid and subarid-humid regions. To put it simply, it can be summarized as the phenomenon of 'land degradation in drylands.' Land degradation is a phenomenon in which production decreases as soil power gradually weakens. Decreased soil production reduces food production and income for local residents, increases poverty and migration, and eventually creates desolate areas where no one can live.

Mongolian scientists and researchers have determined that Mongolia is one of the ten most vulnerable countries to global warming and climate change based on its geographical location and extreme continental climate. Over the past 80 years, Mongolia's average annual temperature has risen by 2.25 degrees Celsius, and precipitation has decreased by 7.3 percent. The frequency and number of weather-related natural disasters have increased significantly, and this situation is more observed in the Gobi, steppe and agricultural areas (<https://gogo.mn/r/vvjky>).

By country, Australia (Kingwell. et al., 2007), three South African countries (Stringer, et al., 2009), Mediterranean Europe (Briassoulis, 2011), drylands of Myanmar (Yamauchi & Inoue, 2012), and Northeast Asia (Yoon, 2013), and Inner Mongolia, China (Lee Seon-hwa, 2012; 2015; 2018). In general, inducing participation by increasing the income of local residents was pointed out as a key factor in countermeasures against desertification. The international community's efforts to prevent desertification and research related to cooperation are organized as shown in <Table 1>.

Table1. Research on the international community's efforts to combat desertification and cooperation

Division	Autors	Content of research	Characteristics or implications
Convention of the international convention	UNCCD (2004)	Analysis of 10 years of achievements since UNCCD from the perspective of public land preservation	Poverty eradication, conflict resolution, forced displacement mitigation, public land and conservation, democratic governance and synergies with other environmental agreements.
	UNCCD (2016)	Suggestion of the setting direction for necessary elements in the process of establishing national-level LDN goals	Components: LDN Maximization Plan, Status Assessment, LDN Goal Establishment and Measurement, Financial Support
	Kuyper et al. (2018)	Analysis of the UNFCCC Evolution from the Kyoto Protocol to the Paris Agreement	·Voluntary contributions from each country ·Deriving results in various ways ·Changes in mitigation, adaptation and finance
	Safriel (2017)	Exploring the emergence and evolution of LDN from 2005 to 2015	·Adopt the concept of LDN to SDGs ·UNCCD expands as a mechanism to address global land degradation
By country	Kingwell	An analysis of the rationale, stren	·Improving awareness through participat

example	et al. (2008)	gths and weaknesses of community-based policies to combat salinization in the Australian drylands.	ion of residents and providing education contributes to responding to salinization ·Commitment to technology development and research
	Stringer et al. (2009)	Analyzing the cases of Malawi, Swaziland, and Botswana from a regional perspective on land use and management practices, education, culture, economy, law, technology, etc.	Policy supplementation and adaptability increase direction: Mutual cooperation between the government and local communities, approached in the context of integrated development
	Briassoulis (2011)	Integrating environmental policies for the management of desertification in Mediterranean Europe in a multi-layered governance context	Integrate development policies and present coordination between policies, institutions and programs, and effective community multi-level cooperation.
	Yamauchi & Inoue (2012)	An analysis of 59 cases of community-based forest management in central dry regions of Myanmar.	· Lack of ability and discord among members of the community are obstacles to policy ·Reflect local people's perceptions and strategies, consider regional characteristics, etc., and present the need
	Yoon (2013)	Finding ways to overcome desertification and yellow dust in Northeast Asia through a practical and comprehensive approach	Consideration of ecological, economic and social conditions under policy solidarity among multi-layered governance
	이선화 (2012, 2015, 2018)	A study on the ecosystem composition process of scientists, pastoralists, chickens, and grassland etc. in the grassland herding pilot project of a pastoral village in Inner Mongolia, China	Possibility of preventing desertification by solving the economic crisis of the local community through a new actor, the chicken.

3. Problem solving

1. Desertification in Mongolia

Decreased food production due to malnutrition of the soil, loss of natural recovery ability, increase in salinity and pollution of lakes, rivers, and streams due to increased flooding, lack of water resources and contamination of drinking water quality, cause of respiratory and eye diseases, and lack of soil nutrition As a result of the decline in living standards, population concentration in cities occurs (Lim Hee-mo, 2010: 297). After Mongolia joined the Convention to Combat Desertification in 1996, the third program approved by the government in 2010, the National Program to Combat Desertification, includes desertification assessment and mapping and is reported to the information every five years. According to the research results, the area affected by desertification increased to 72.0% in 2006, 77.8% in 2010, 76.8% in 2015, and 76.9% in 2020.

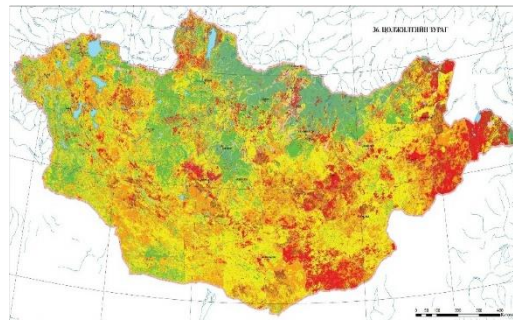
According to the desertification assessment in Mongolia as of 2020, 120.3 million hectares, or 76.9% of the country's total land area, was degraded, and about 30 million hectares, or 23%, were classified as severe and very severe. Of these, 4.7% are very strong and 18.6% are strong. 50-70% of the total area of the provinces of Dornogovi, Dundgovi,

Umnogovi, Gobi-Sumber, Gobi-Altai, Bayankhongor, Uverkhangai and Tuv aimag have been affected by desertification and land degradation. <https://eic.mn/dldbase/>.

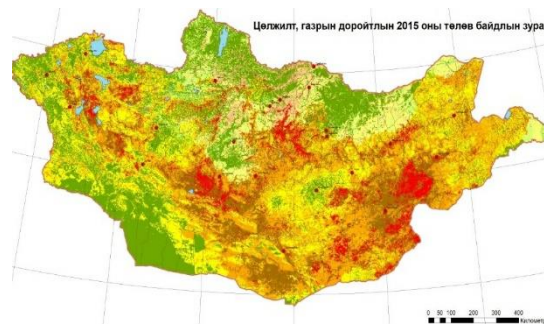
Table 2. Assessment of desertification

Desertification assessment year	Vulnerable area	Moderately exposed area	Strongly detected area	Very strong area	Of the total area %
2006년	23.0	26.0	18.0	5.0	72.0
2010년	35.3	25.9	6.7	9.9	77.8
2015년	24.1	29.8	16.8	6.1	76.8
2020년	31.5	22.1	18.6	4.7	76.9

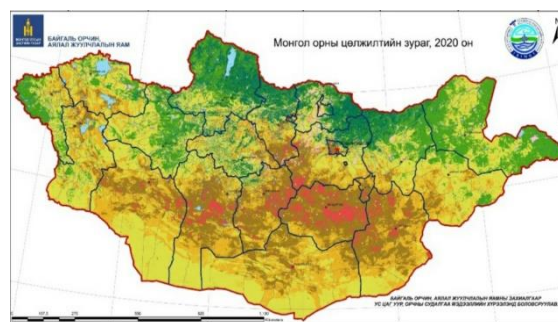
Source: <https://eic.mn/dldbase/> Desertification Database (2020)



<Figure 1> Status of desertification and land degradation (2010)



<Figure 2> Status of desertification and land degradation (2015)



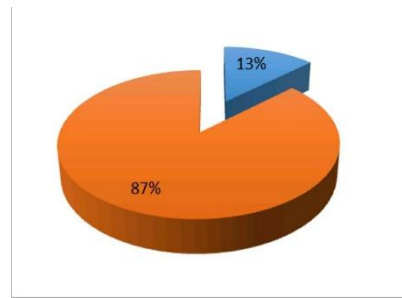
<Figure 3> Status of desertification and land degradation (2020)

Comparing the desertification map in 2010 with the previous map in 2006, the distribution areas with very strong and severe desertification have changed greatly, and in particular, areas with very mild desertification have been newly formed. Alternatively, when comparing the 2015 results of desertification and land degradation in 2015 with the results of 2010, which evaluated the status of desertification and land degradation using the same method, the area of very degraded area decreased by 1% and 3.8% respectively, but the area of weak area increased by 10.2%, and the area of moderate and strong desolation decreased by 3.8%. The number of areas that became available increased to 3.9% and 10.2%, respectively. For example, in the last 5 years, 6.4% of areas classified as underdog or medium moved to the strong category, indicating an increase in insider threats (<Figures 1> and 2). According to <Figure 3>, 4.7% of Mongolia's total area is very, 10.6% strong, 22.1% moderate, 31.5% weak, and 15.3% undetectable.

2. Desertification Factor

The causes of desertification are divided into two main categories: natural factors and anthropogenic factors. According to the <Cream 4> diagram, 87% of desertification is caused by anthropogenic factors and 13% by natural factors, and overgrazing is the biggest factor in human activities. In Mongolia, most of the artificial activities are due to mining development, land neglect, land loss and erosion, tourism and pollution, forest resource deforestation, and forest fires. In addition, population growth, urbanization, and people's low awareness problems are also artificial causes.

veral limitations. First, of the many variables in public crisis management, this study focused only on the risk perception of the public in regard to anxiety and efficacy. There is a need to explore other variables (e.g., social capital, culture, beliefs, values, etc.) that influence public crisis management in the future. Second, the participants in this study were limited to Koreans during the COVID-19 pandemic. Since research on overcoming a pandemic has a worldwide impact, there is a need to examine various countries, types of damage, victims, and private organizations, and to compare the results in the future.



<Figure> Causes of desertification in Mongolia

Mongolia is a dry, windy region far from the sea due to several geographical features such as high mountains, wide grasslands, and the Gobi Desert. Over the past 80 years, Mongolia's average annual temperature has risen by 2.25 degrees Celsius and precipitation has decreased by 7.3 percent. The frequency and number of weather-related natural disasters increased significantly, and the number of strong storm days per year increased from 20 to 37 in 1960-1999 to 20-43 days in 2000-2016. This situation seems to have been observed more in the Gobi region, grassland and Nonghyup region (<https://gogo.mn/r/vvjky>).

Satisfying the endless human needs with nature's finite resources is a cause of endangering the ecosystem. The balance between grazing enemies and tentacles has been disrupted, and soil erosion and desertification are progressing in some areas. Due to desertification, not only 64.7 million hectares, or 41.3% of Mongolia, belonged to the Gobi Desert, but also the survival range of animals and plants was narrowed, and the crisis of extinction is gradually spreading. Recently, due to the lack of soil management, the quality of farmland has deteriorated and the fertility has also decreased (Bachurichatsral, 2014: 4). As a result of particle size analysis of soil samples, currently mine developments in Mongolia all have the potential for desertification. There is a high possibility of desertification in the area around mines due to waste rocks and waste soil generated from mine development and soil contamination due to scattering dust, so systematic management is urgently needed (Park Jong-hoon, 2019: 10).

4. Anti-desertification big data between countries in the world

Of the world's 41% land area is dry and this region is considered vulnerable to desertification and land degradation (<https://montsame.mn/mn/read/228574>). Globally, afforestation, greening, forest and barrier construction, cultivation, water accumulation, mechanical protection, pasture fencing and protection are being used to combat desertification. If we study the experience of other countries affected by desertification, each country responds according to its conventional characteristics. For example, China benefits by planting trees and creating artificial oases, and Israel benefits by growing desert-tolerant plants and producing products there to serve the world market. North African countries such as Algeria, Tunisia and Morocco are developing camel breeding, while Australia and the United States are using technological and economic power to fight desertification. Niger and Niger are reducing desertification with sensible land policies by transferring land damaged by desertification and mining to local communities. Turkey, Uzbekistan, Kazakhstan and Pakistan are implementing grassland management measures to combat desertification.

1. Morocco

Morocco completed its National Action Plan in June 2001. In order to minimize the impact of drought, the meteorological observation system was improved and related information was improved. On World Day in June 2004, fundraising programs were run for a wide range of NGOs and institutions, and 53 projects were planned and 34 were decided to be pursued. In addition, in September 2004, a roundtable meeting was held in Rabat, the capital of Morocco, for financial expansion, and 17 NGOs were allocated state subsidies for anti-desertification projects. In addition, projects for the eradication of poverty and development of agriculture were carried out at the same time.

2. Niger

In Niger, the National Environment Council for Sustainable Development (NECSD) is embedded within the government body and oversees a number of environmental issues. It works closely with Italian, French and German regional environmental committees that make up the region. In October 2000, the Niger government signed a memorandum of understanding with Italy for the promotion of UNCCD (Choi Choi, 2010: 51). Unlike Nigeria, Niger is affected by desertification in the Sahara Desert located in the north, and is a landlocked country with a dry climate like Mongolia. It is also heavily affected by desertification due to mining activities. However, the government, in cooperation with mining companies, has issued a policy that gives local citizens the right to use the areas affected by mining activities free of charge. Local citizens fertilize the land brought from the mine for free, plant vegetables and use it for living. If the area is cultivated and vegetables can be grown, the government is working to create a business environment that says tax exemption has resulted in a reduction in desertification in Niger.

3. China

Desertification issues and desertification prevention work are carried out by the Central Committee and the National Committee (CCICCD-China National Committee for Implementation of International Convention to Combat Desertification), which prepares the China National Report. At the request of UNCCD, CCICCD prepared and developed the China National Action Program (NAP) to Combat Desertification in late 1994. The Governments of China and Japan, in collaboration with the UNCCD Secretariat and the United Nations Office of Special Coordinators of Africa and Less Developed Counties (OSCAL), organize an Asia-African Forum on the Implementation of UNCCD's Work on Desertification. They exchanged experiences on prevention and discussed the possibility of regional cooperation. In addition, the National Desertification Monitoring Center, the National Desertification Prevention Training Center, and the National Desertification Prevention Research and Development Center have been established to develop desertification prevention capabilities and are conducting monitoring. The main projects of the Chinese government are strengthening leadership and establishing accountability systems for local governments, promoting reform and establishing appropriate business institutions, expanding the scope of support and ensuring stable policies, applying and developing advanced science and technology and methodologies, enacting anti-desertification laws, and appropriate and strengthening management bodies and project implementation. In order to maximize the efficiency of the anti-desertification project, the Chinese government manages it by dividing it into four zones: metropolitan area (urban area), agriculture-grazing area, grassland area, and desert-oasis area, and preparing countermeasures considering the characteristics of each area. (Lee Jeong-ok, 2012: 37-38).

Until the 1990s, the place where desertification was progressing at the fastest rate in the world was China. There were opinions that the cause of such rapid desertification was human activity and that it was a natural phenomenon. Representative measures to combat desertification that have been implemented since the 1990s include the installation of green barriers, support for the cost of reducing the number of livestock in Inner Mongolia, and the Green Silk Road Partnership (Kim Dae-hwan, et al. 2019: 207).

5. Conclusion

In Mongolia, the mining sector, especially gold, coal and copper mines and mining business, determines Mongolia's economic development and is very important, but it does not restore used areas.

Since the 1970s, the government, private organizations, and companies have been making various efforts, such as green space and afforestation projects, and various campaigns. If our efforts are added here, we can prevent desertification and environmental pollution. First, 'saving water for living' in order not to deplete limited natural water resources. Second, actively participate in planting events. Third, by actively separating discharge, it helps efficient circulation of resources.

Author Contributions:

Bat-Erdene Ganchiemeg: She received her bachelor's degree from Mongolia and her master's degree from Korea National University of Transportation. She completed his PhD in Public Administration at Chungbuk National University. She is currently a researcher at the National Crisis Management Institute while she is studying for her PhD in Public Administration at Chungbuk National University. Her interests include crisis management, health and safety management, and organizational management.

Jae Eun Lee : He received his B.A., M.A., Ph.D. from Yonsei University, Korea in 2000. He is a Professor of the Department of Public Administration and a Director of National Crisisonomy Institute at Chungbuk National University, in which he has taught since 2000. His interesting subject and area of research and education is crsisonomy, disastronomy, organizational studies, and policy implementation. He has published 205 articles in journals and 18 books, including 16 co-author books.

References

1. Munkhtsetseg. 2011. Establishment of disaster prevention forest and analysis of vegetation growth change to prevent desertification in Mongolia. Graduate School of Gyeongsang National University. Master's thesis.
2. Seunghyuk Lee. 2020. Ecosystem Restoration and C-S-R Strategy Analysis of Temperate Dryland Plants to Prevent Desertification in Inner Mongolia. Kongju National University Graduate School. Doctoral dissertation.
3. Jonghoon Park. 2019. Potential contamination of water and soil environment in coal and iron mines in Mongolia. Yonsei University Graduate School. Master's thesis.
4. Bachurichatsral. 2014. A Study on Environmental Protection Legislation in Mongolia: Focusing on Domestic Law Implementation of International Conventions. Chonbuk National University Graduate School. Master's thesis.
5. Jung-Ok Lee. 2012. A study on the formation of an environmental community between North and South Korea through efforts to prevent desertification in Northeast Asia. Hankuk University of Foreign Studies. Master's thesis.
6. Choi Dae-Sung. 2010. A Study on Environmental Issues and International Cooperation: Focusing on Desertification. Graduate School of Policy Studies, Korea University. Master's thesis.
7. Suldwerden, Ko Shin-young, Choi Yeon-woong, Cho Ki-seong. 2011. Analysis of desertification change in Mongolia using land cover classification method of satellite images. Korean Spatial Information Society. Korean Geospatial Information Society Conference. Vol.2011 No.10(222~223).
8. Lim Hee-mo. 2010. Ecological mission to prevent desertification in Mongolia. Korean Christian Association. Journal of Korean Christian Theology Vol.71 No.(295~319).
9. Yoon Yi-suk. 2013. Response to Desertification and Yellow Dust in Northeast Asia. Korea Environmental Policy Association. 環境政策 Vol.21 No.2(85~113).
10. Jeon Yong-ha, Lee Jung-ju, and Kim Seon-yeong. 2022. Desertification-Related News Big Data Analysis and Implications for Sustainable Development: Focusing on LDA Topic Modeling Analysis. International Development Institute, Chungbuk National University. Social Economy and Policy Research Vol.12 No.4(23-55).
11. Daehwan Kim, Min Jeon, Hanju Choi, and Taehun Kim. 2019. A study on the meaning and prospects of artificial rainfall as a countermeasure against desertification in China and Xi'an. Seoul National University National Territorial Research Institute. Geography theory Vol.65(205~215).
12. <https://eic.mn/dldbse/>. Desertification Database.
13. <https://gogo.mn/r/vvjky> Comprehensive news database.
14. https://www.ot.mn/media/ot/content/archive/documents/World_Day_to_Combat_Desertification_Essay_Competition_3_Bat-munkhB.pdf