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Economic Impacts and Risk Issues of Climate Change

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Abstract: The purpose of this study is to systematically assess how climate change affects global and Mongolian economic growth, productivity, and risks. The study utilized international secondary data sources such as the World Bank, Germanwatch's Climate Risk Index (CRI), and Our World in Data, covering the period from 1990 to 2023, and conducted descriptive and comparative analyses. The results indicate that Mongolia is economically highly vulnerable to climate change, particularly affecting agriculture, food prices, inflation, and labor productivity. The main contribution of the study lies in linking climate indicators with macroeconomic outcomes, providing risk channels and directions that can be used for policymaking in Mongolia. Climate change poses physical, transferable, and resource risks to the economy. Policymakers around the world are placing significant emphasis on mitigating the impacts of climate change, promoting green technologies, and promoting finance. The article examines the economic impacts and risks of climate change in countries and in Mongolia.

Keywords: GDP, productivity, Climate Risk Index.

GUIDANCE

Climate change poses a major challenge not only to the environment but also to sustainable economic development. Rising temperatures, fluctuating precipitation, and increased frequency of natural disasters affect production, labor productivity, and price stability.

Climate is “average weather,” which is a statistical measure of the average variability of weather over a period of months to millions of years. The World Meteorological Organization defines climate as a set of parameters including temperature, precipitation, and wind over a 30-year period (MECC, 2018).

Climate change (CC) refers to long-term changes in temperature and weather patterns. Since the 1800s, human activities have been the main drivers of climate change, particularly the burning of fossil fuels such as coal, oil, and gas. Global climate change is accelerating due to industrialization and human activities, causing irreparable damage to the environment, society, and economy.

Survey scope and methodology: This study is a non-experimental, secondary data-based explanatory and comparative analysis. The data used include:

- Climate Risk Index (Germanwatch)
- World Bank, UNDP, Our World in Data
- Reports from the Ministry of Environment and Tourism of Mongolia, Ministry of Food, Agriculture and Light Industry.

The analysis assessed the relationship between climate indicators (temperature, precipitation, disaster) and economic indicators (GDP, inflation, agricultural output) using qualitative and statistical explanatory methods.

Global warming is accelerating due to human activities, causing damage to the environment, society, and economy. For example, the frequency of disasters such as earthquakes and floods is increasing, and the material costs arising from them are increasing year by year. If no action is taken to combat climate change, the global average annual loss of about 5 percent of gross domestic product (GDP) could be avoided by spending 1 percent of the global economy on reducing greenhouse gas emissions (Stern Review, 2006).

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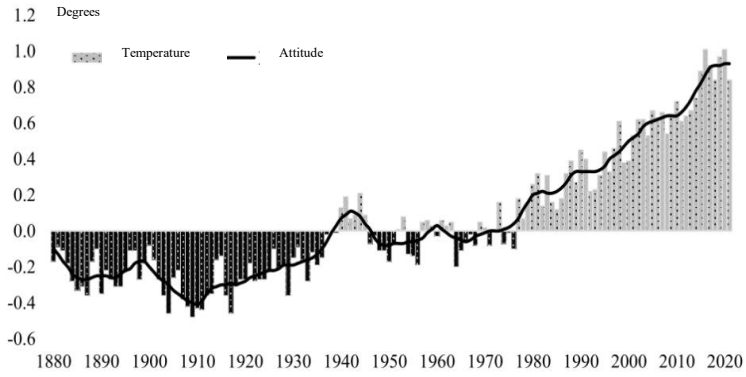


Figure 1. Average global temperature

Source: www.ourworldindata.org

Global average temperatures have increased significantly since the beginning of the 20th century, and the rate of increase over the past 30-40 years has been faster than in the past 20,000 years. (Acevedo, Mrkaic, Novta, Pugacheva, & Topalova, 2018)

Climate change is not just about increasing temperatures, but also about the disruption of natural balance.

In Mongolia, increasing average air temperatures and decreasing precipitation are shortening the time between catastrophic events such as dzud, drought, and earthquakes, creating problems such as pasture degradation and desertification. This could further impact other sectors of the economy by negatively impacting the agricultural (Agricultural) sector, such as declining livestock quality and reduced crop yields.

Mongolia has joined many agreements that provide guidance to the global climate change process, including the UN Framework Convention on Climate Change and the Paris Agreement. There are three broad categories of measures that need to be implemented:

- Reducing greenhouse gas emissions,
- Adaptation to climate change,
- Includes issues such as financing the necessary arrangements.

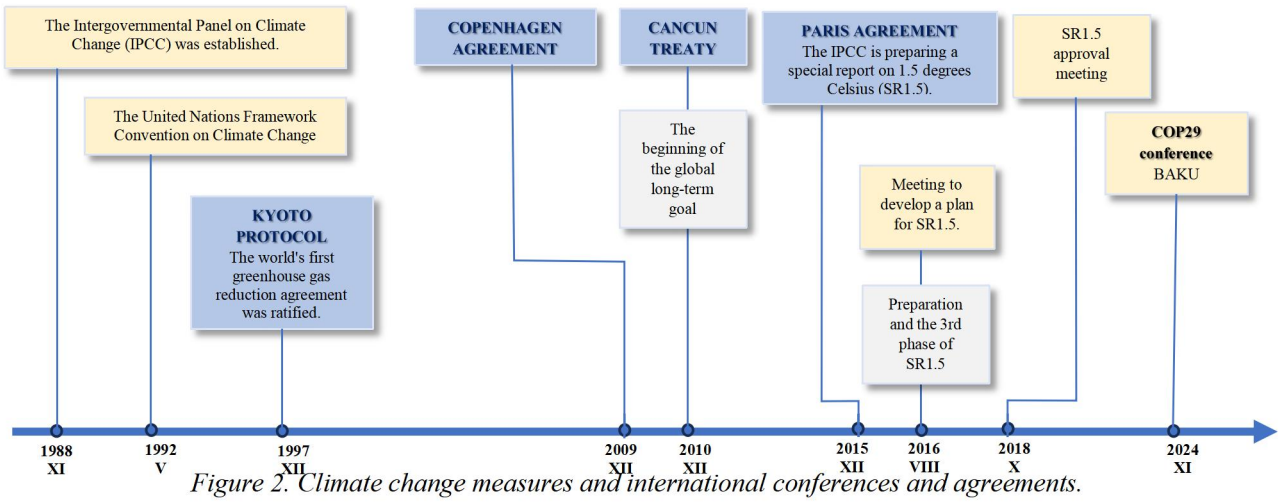
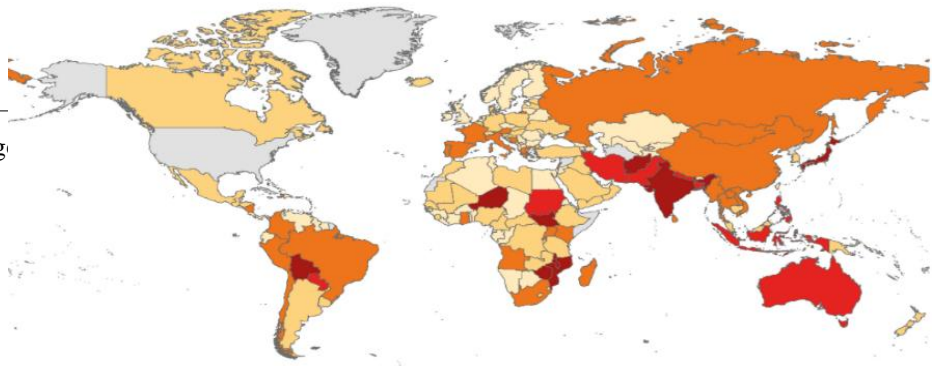


Figure 2. Climate change measures and international conferences and agreements.

Risk assessment and management.

The Climate Risk Index (CRI) from Germanwatch measures the level of exposure and vulnerability to extreme events and is an index that can be used to warn countries to prepare for more frequent and/or more severe events in the future.[3].



[3] https://www.g

Figure 3. Global Climate Risk Index.

In the above study, Mongolia was ranked 48th from 2000 to 2019 and 22nd in 2019. This indicator reflects Mongolia's geographical location, fragile ecosystems, lifestyle, society, and economy, which make it highly vulnerable to climate change (Table 1).

Mongolia Climate Risk Index[4]

Table 1.

CRI/Year	CRI Rank	CRI score	Fatalities in 2019 (Rank)	Fatalities per 100 000 inhabitants (Rank)	Losses in million US$ (PPP) (Rank)	Losses per unit GDP in % (Rank)
Climate Risk Index for 2019	22	31.67	50	9	62	30
Climate Risk Index for 2000–2019	48	59.17	88	46	83	46

CRI - Climate Risk Index

Due to its geographical location and unique climatic conditions, Mongolia is considered to be extremely vulnerable to global warming, with impacts on its environmental status and socio-economic development. (D. Dagvadorj, 2020)
Over the past 70 years, the air temperature in Mongolia has increased by 2.1°C, making Mongolia one of the countries most affected by climate change.Rising temperatures and decreasing precipitation are increasing desertification, reducing pastures and water resources, and leading to a shift in natural zones [5]. (UNDP)
Avoiding the risks of climate change has become one of the most pressing issues today, and research sources show that there is a lack of risk assessments based on calculations and research into the economic, social, and environmental impacts of adaptation measures.
The World Bank estimates that climate change could push an additional 100 million people into extreme poverty by 2030, and that global warming could lead to millions more people being simultaneously exposed to natural disasters such as hunger, water scarcity, and coastal flooding. (World bank, 2020)

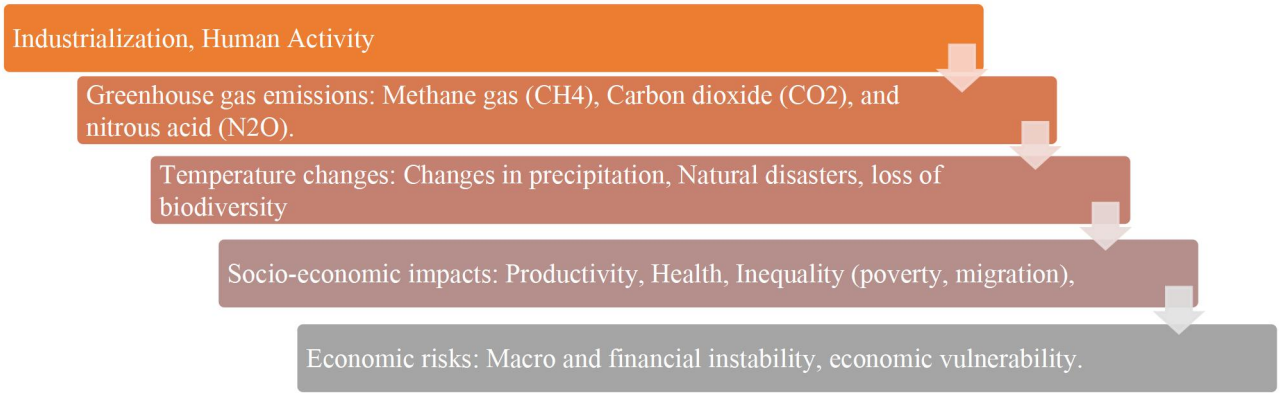


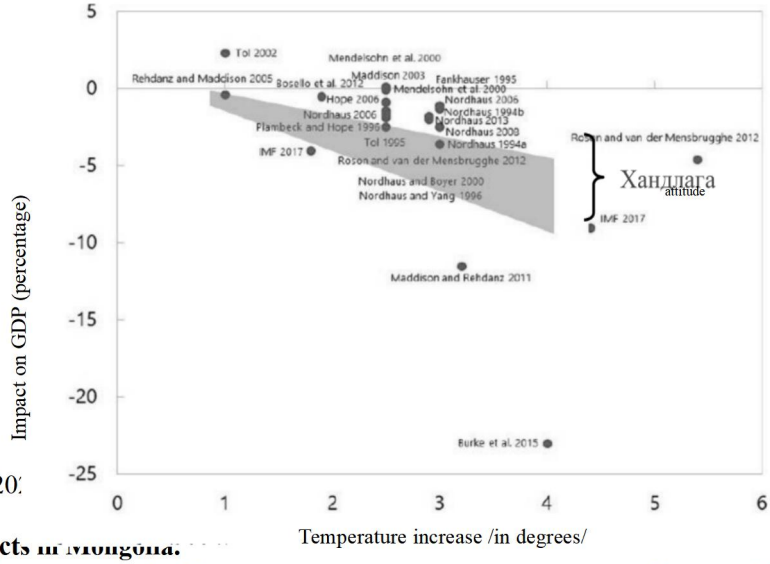
Figure 4. Causes and consequences of climate change

Climate change-related risks not only increase macro-financial risks and vulnerability, but also limit the ability to effectively implement climate change mitigation and adaptation measures. (Feyen, Utz, Huertas, Bogdan, & Moon,

[4] https://www.germanwatch.org/sites/germanwatch.org/files
[5] https://www.undp.org/mn/mongolia/stories/uur-amsgalyn-oorchloltiyn-malchdyn-amdrald-uzuulzh-buy-noloolol

2020) In order to mitigate these risks, it is first necessary to identify and measure them, and it can be said that the issue of measuring the economic costs of climate change is in its infancy.

Researchers have different opinions on whether the impact of climate change will affect a country's GDP level or growth. For example, Kahn et all (2021) and Newell, Prest & Sexton (2021), based on international quantitative data, found that temperature reduces growth, not GDP, while Hsiang (2010), Cachon et all (2012), Jisung & Heal (2013), and Deryugina, Tatyana & Hsiang (2014) concluded that it reduces GDP. However, Dell, Jones & Olken (2012) found that temperature affects both, but only in poorer countries, as temperature stimulates investment and innovation. Additionally, it has been found that when a warmer-than-average year occurs, per capita GDP growth and industrial output in poor countries simultaneously decline, while in contrast, indicators in countries with cooler climates improve.

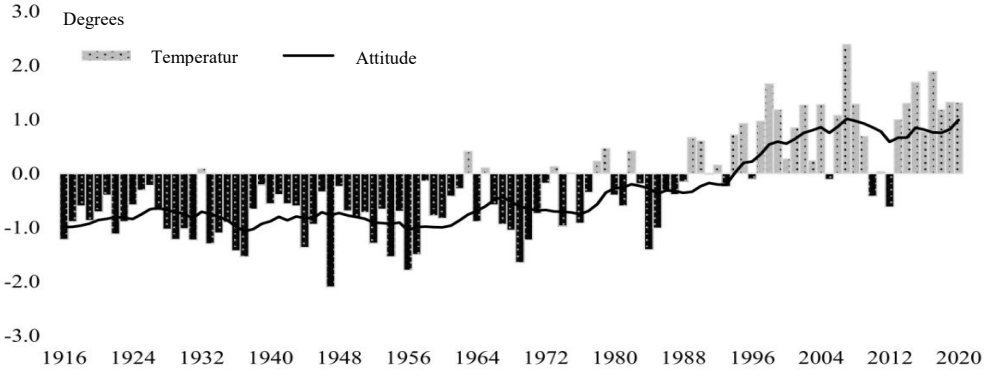


Source: Kahn, et al., (20

Climate change impacts in Mongolia.

The average annual air temperature in Mong sius over the past 80 years, which is almost twice the global average (MOE, 2020). Also, the number of natural disasters has increased 1.8-fold from an average of 2,400 per year between 1996 and 2010 to 4,300 since 2010 (Figure 5).

The Meteorological Department predicts that the average annual temperature in 2024 will be 1.9°C, or 2.5°C warmer than the average from 1961-1990, when climate change was relatively mild, making it the second warmest year since 1940[6]. Due to warming, the permanent snows of high mountains are melting, hundreds of rivers, streams, springs, lakes, and ponds are drying up, pasture yields are decreasing, and plant species composition is becoming scarce (MECC, 2017). For example, the ice sheet area of the Kharkhiraa, Turgen, Munkhkhairkhan, Tsambagarav, and Sair mountains decreased by about 30 percent between 1992 and 2002. Mongolia is one of the 25 countries most vulnerable to global warming and climate change due to its geographical location and extreme continental climate. Due to the impact of climate change, the amount of precipitation in the warm season has significantly decreased, leading to aridity, drought, and desertification. (Eckstein, Kunzel, & Schafer, 2021). For example, as of 2020, 76.9 percent of our country's total land area, or 120.3 hectares, was degraded, with 4.7 percent classified as severely degraded and 18.6 percent as severely degraded. (MECC, 2020)



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[6] https://weather.gov.mn/medee/795

Although there are no comprehensive statistics on the socio-economic costs of natural disasters in Mongolia, some studies have reported on the costs of the dzud disaster on the agricultural sector. According to a study by L. Davaajargal, B. Anand, and E. Khosbayar (2021), livestock declines can create short-term supply-side inflationary pressures in Mongolia, as the impact of food prices on the inflation basket is high.

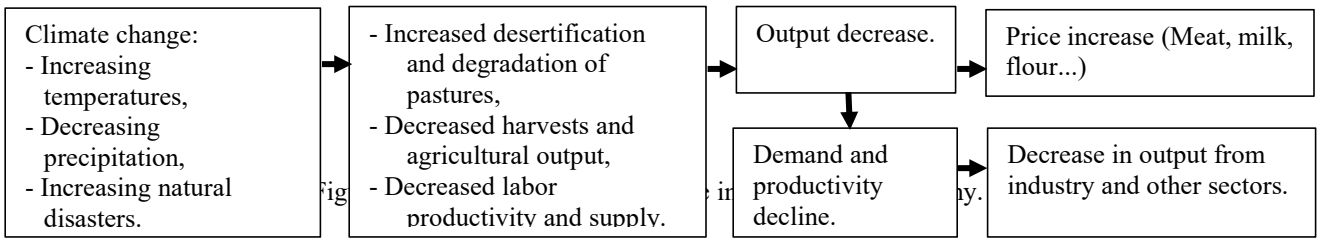
The increasing frequency and severity of droughts, coupled with climate warming and drought, pose a major challenge to agriculture, especially in rural areas, where more than 30 percent of the population is poor.(Gimenez, Batkhishig, Batbuyan, & Ulambayar, 2015) As pastures deteriorate and the number of extremely hot days increases, livestock are unable to fully recover from summer and fall heat waves, reducing their ability to withstand the "dzud" disaster.

Costs and droughts caused by climate change in Mongolia.

Table 2.

Research work	"Dzud" disaster	Losses (number of animals)	Total cost (trillion ₮)
S. Sainbayar et al. (2021) The extent of damage caused by the frequency of dzuds in the livestock sector of Mongolia.	1944-1945	9.2 million	
	2000-2001	4.2 million	162.5
Ministry of Agriculture, Policy Research Center (2017) Recommendations for improving the criteria for early warning and announcement of combined drought-flood disaster risks, taking into account the well-being and preparedness of herders.	1999-2000	11.2 million	333
	2009-2010	9.7 million	527
	2016	1.1 million	
M. Erdenetuya (2004)	Annual average	0.3 million	18.5 million $

The table above shows that the risk of drought and the associated costs caused by climate change continue to increase with each passing year. Increasing natural disasters and rising average temperatures are leading to a high risk of reduced crop yields, increased pasture degradation and desertification, and reduced yields.



The economic impact of climate change is illustrated by the decline in the supply of meat, dairy products, and vegetables, which are the main food commodities, and their prices are rising, increasing inflation and increasing vulnerability. Reduced agricultural output may affect other sectors by reducing livestock farmers' income, demand, and productivity.

Results and Analysis: The analysis results indicate that in Mongolia, rising temperatures are creating a pathway for decreased agricultural yields, which in turn leads to higher food prices. According to the CRI index, Mongolia was ranked 22nd in 2019, reflecting economic vulnerability.

Discussion: These results are consistent with previous studies, but they particularly highlight that in Mongolia's specific conditions, climate change indirectly affects inflation and poverty.

CONCLUSION

Human activities and industrialization have led to a dramatic increase in greenhouse gas emissions, raising the average global temperature. If the current trend continues, countries are expected to lose an average of 5 percent of global GDP each year until 2100. The countries of the world have agreed to adopt and implement a plan to contribute to keeping the global average temperature below +2 degrees Celsius above pre-industrial levels by the end of this century, and to pursue efforts to limit it to +1.5 degrees Celsius.

Mongolia has set a target of reducing greenhouse gas emissions by 14 percent by 2030. Mongolia is one of the top 25 countries most vulnerable to climate change, with an average temperature increase of 2.25 degrees Celsius over the past 80 years, almost twice the global average. Also, according to the CRI index, Mongolia ranked 48th from 2000 to 2019 and 22nd in 2019.

According to the research findings, Mongolia is economically highly vulnerable to climate change. Therefore:

- Assess the impact by sector, and quantify the effects, risks, and risk evaluations for vulnerable sectors,
- Create a unified platform to publicly provide an "Integrated Climate-Economic Data Repository" for researchers and to inform the public,

- Study from multiple perspectives how it affects GDP and economic indicators,
- It is necessary to align adaptation policies at the macro level, according to the researcher.

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