

# Study on current climate change issues and response strategies

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**Abstract.** Today, human activities are generating massive emissions of greenhouse gases, intensifying the issue of global climate change. This paper provides a comprehensive analysis of the current situation, impacts, and response strategies related to climate change. It also discusses the influences of climate change on agricultural production, socio-economic systems, and human health. Global warming, primarily caused by human-induced greenhouse gas emissions, has intensified due to feedback effects. Frequent extreme weather events and significant changes in ecosystems have profoundly affected agricultural production, socio-economic systems, and human health. To tackle climate change, mitigation and adaptation approaches are suggested, including the development of clean energy, ecosystem conservation, technological innovation, and policy support. It emphasizes the importance of international cooperation and points out that enhancing public education and participation is key to addressing climate change. In the future, global attention to and research on climate change must be continuously strengthened, and response strategies need to be constantly improved. Nations should further increase their investments in clean energy development, ecosystem protection, and technological innovation, faithfully fulfil international cooperation agreements, and jointly work to slow down the pace of climate change.

## 1 Introduction

In the current global environmental context, climate change has emerged as one of the paramount challenges confronting humanity. With the acceleration of industrialization and urbanization and the increasing frequency of human activities, the concentration of greenhouse gases in the atmosphere continues to rise, leading to significant changes in the global climate. Frequent extreme weather events, such as heavy rains, floods, droughts, and hurricanes, pose serious threats to human life and property safety. Concurrently, climate change has also caused huge impacts on ecosystems, with matters like biodiversity loss, sea-level rise, and glacier melting becoming increasingly prominent. These changes not only affect the lives of the current generation but will also have profound effects on the survival and development of future generations.

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Currently, scholars have carried out research on climate change issues. In terms of the causes of climate change, human activity-induced greenhouse gas emissions are commonly regarded as the main driving factor. In terms of impact assessment, studies have covered the effects of climate change on a wide range of areas, including agriculture, water resources, ecosystems, and human health. In terms of response strategies, the international community has taken a series of measures, such as the signing of the Paris Agreement, with countries setting emission reduction targets and increasing the development and utilization of renewable energy. Simultaneously, technological innovation also plays an important role in addressing climate change, with technologies like carbon capture and storage and new energy technologies emerging continuously. However, despite certain research achievements and practical progress, the problem of climate change remains severe, and further in-depth research and exploration of effective response strategies are still needed, as analyzed by scholars like H Mohajan on the relationship between greenhouse gas emissions and temperature rise [1], and by Xiu Xin and Liu Jun on the economic effects of some emission reduction policies [2].

This paper will provide a comprehensive analysis of the current status of climate change, its impacts, and response strategies. The research content includes the scientific basis of global climate change, its extensive impacts at global and regional levels, and tactics for mitigating and adapting to climate change. This paper will also explore the roles of technological innovation and policy support in addressing climate change, and how to strengthen the global response to climate change through international cooperation and public participation. It aims to provide a comprehensive perspective on the issues of climate change and its response strategies, facilitating the implementation of global climate actions.

## **2 Status of climate change**

### **2.1 Global warming**

Global warming refers to the phenomenon of rising global temperatures resulting from the accumulation of the greenhouse effect due to the substantial emissions of greenhouse gases from human activities. Greenhouse gas emissions are the primary cause of global warming today. Because of their infrared activity, greenhouse gases are capable of absorbing and emitting infrared radiation within the same wavelength range emitted by the Earth's surface, clouds, and the atmosphere, thereby preventing heat from escaping into space [3]. This phenomenon leads to an increment in Earth's surface temperature, known as global warming. Additionally, greenhouse gas emissions trigger various feedback effects, such as reduced reflectivity from melting ice and snow which further absorbs heat, and warmer oceans releasing more methane, increasing greenhouse gas concentrations. These feedback mechanisms are also significant contributors to global warming caused by greenhouse gases. The IPCC's Sixth Assessment Report (AR6) explicitly states that human activities primarily cause global warming through greenhouse gas emissions. The warming caused by greenhouse gases is mainly attributed to carbon dioxide and methane. Although this warming is to some extent masked by the cooling effects of aerosols, the rise in global surface temperatures due to greenhouse gases is conspicuous. Future warming trends depend on future greenhouse gas emissions, with cumulative net carbon dioxide emissions playing a dominant role [4].

Volcanic activity has complex impacts on the global climate. It can cause short-term cooling and also potentially contribute to global warming to some extent. Volcanic eruptions are accompanied by the ejection of numerous aerosols into the atmosphere, like sulfur dioxide. These particles block and reflect sunlight, reducing solar radiation received at the surface and causing a short-term drop in near-surface temperatures. However, in the long term, volcanic activity accelerates global warming. On one hand, substances released during volcanic eruptions, such as

hydrogen chloride, can react with atmospheric ozone, depleting the ozone layer and enhancing surface solar radiation. On the other hand, greenhouse gases such as carbon dioxide, due to their stable chemical properties, can remain in the atmosphere for long periods, absorbing surface radiation heat, and enhancing the greenhouse effect, thereby driving global warming.

In addition, solar activity, changes in land surface properties, and aerosol emissions are also important factors affecting global warming. Solar activities, such as sunspots and flares, cause periodic changes in solar radiation. Changes in land surface properties affect the climate by altering the absorption and reflection of solar radiation. The melting of ice caps and glaciers not only triggers sea level rise but also releases greenhouse gases, exacerbating global warming and creating a vicious cycle. It is the impact of aerosol emissions that is more complex: although some aerosols can reflect solar radiation and temporarily bring about a cooling effect, they can also absorb radiation or deposit on ice and snow surfaces, accelerating melting and indirectly promoting global warming. Furthermore, aerosols affect cloud formation and precipitation distribution, further exacerbating climate change.

## **2.2 Extreme weather events**

In recent years, extreme weather events have become frequent, and these events are closely related to climate change. The occurrence rates of high temperatures and wildfires have notably increased. In 2023, various regions in the Northern Hemisphere experienced extremely high temperatures, especially in China, Europe, and the United States, where temperatures repeatedly set new records, with some areas in Europe even exceeding 40 degrees Celsius. The AR6 report also reveals that under the scenario of continuous global warming, extreme heat events will continue to increase in frequency and intensity [5]. Additionally, heatwaves can trigger droughts and fires, especially in regions with scarce water resources.

Simultaneously, another significant extreme weather event that cannot be ignored is precipitation and flood disasters. Climate change significantly increases the likelihood of extreme precipitation events. As the atmosphere warms, the content of water vapor in the air increases, leading to enhanced precipitation intensity and a rise in the frequency of extreme rainfall, thereby significantly increasing flood risks. Moreover, global warming also intensifies glacier melting and sea-level rise, further elevating the risk of flooding in coastal areas. A warming atmosphere can carry more moisture, releasing large amounts of water during precipitation processes, increasing the likelihood of local heavy rain and flooding.

## **2.3 Ecosystem changes**

Ecosystems have undergone extensive and profound alterations due to climate change. To begin with, biodiversity is facing significant threats. Climate change has intensified the risk of species extinction, particularly for those species that are extremely sensitive to climatic conditions of their habitats, such as cold-water fish and Arctic wildlife. Changes in temperature and climatic patterns hinder these species' ability to swiftly adapt to their current environments, leading to potential extinctions. Climate change also alters the foraging, reproduction, and migration behaviors and patterns of wildlife, causing some species to struggle to survive in the rapidly changing new environments. A decline in key species can trigger a domino effect due to food chain disruptions and migration shifts, potentially leading to the collapse of entire ecosystems.

Furthermore, the changes induced by climate change vary across different ecosystems. In forests, global warming and resultant temperature increases lead to more frequent droughts and extreme heat events. This not only increases the frequency and intensity of forest fires but also affects the growth cycles and distribution of plant species, reducing forest biodiversity. For wetlands, the sea level rise caused by global warming results in some coastal wetlands being submerged, posing habitat reduction risks for many wetland species and reducing their carbon

sequestration capabilities. In oceans, the increase in carbon dioxide levels due to climate warming causes ocean acidification, disrupting the pH balance in marine ecosystems and affecting the survival of coral and shellfish [6]. Additionally, rising temperatures lead to warmer sea waters, potentially altering the distribution of many fish species and marine mammals.

### **3 Problems caused by climate change**

#### **3.1 Impact on agricultural production**

Climate change has a significant and complex impact on agricultural production, primarily through changes in key climatic variables such as temperature, precipitation, and sunlight. These changes directly affect the growing environment, growth cycles, yield and quality of crops.

Firstly, rising temperatures have increased heat resources in many regions. For crops in cooler regions, such as wheat and potatoes, excessively high temperatures may inhibit growth, leading to reduced yields or even crop failures. Secondly, frequent extreme heat events not only increase the risk of heat damage to crops but may also accelerate soil moisture evaporation, exacerbating drought conditions. Thirdly, changes in precipitation patterns bring challenges to agricultural production. In some areas, reduced rainfall exacerbates drought issues, increasing irrigation demands for crops. Moreover, increased rainfall in other areas, particularly through extreme weather events like heavy rain and floods, can directly destroy farmland and crops and may lead to soil erosion and fertility decline. Changes in sunlight conditions also impact agricultural production. Excessive sunlight can cause leaf burns, affecting photosynthesis efficiency. Changes in cloud cover and foggy conditions brought about by climate change may also affect the intensity and duration of sunlight, further influencing crop growth and yields.

The impacts of climate change on agriculture are multifaceted, featuring both positive stimulatory effects and negative inhibitory effects. It is necessary to enhance research and application of agricultural climate adaptability and to improve the stability and sustainability of agricultural production. Moreover, strengthening meteorological monitoring and early warning systems is crucial to providing timely and accurate meteorological information and services to agriculture.

#### **3.2 Impact on socio-economic stability**

Climate change also impacts socio-economic stability, including economic fluctuations triggered by issues like reduced agricultural production and water scarcity, and potentially exacerbating social conflicts and poverty. Climate change may lead to reduced agricultural yields and water shortages. In recent years, increased extreme weather events and more frequent meteorological disasters, such as flooding, severely damaged farmlands and agricultural infrastructure. Long-term flooding can cause oxygen deprivation in plant roots, while droughts lead to insufficient soil moisture and substantial reductions in food production. On one hand, reduced crop yields decrease farmers' incomes. On the other hand, reduced food production and water shortages may lead to higher food prices, raising living costs for the general populace and sparking socio-economic tensions. Some scholars have researched the relationship between climate change and regional conflicts, finding that climate change indeed correlates with an increased rate of military conflicts [7]. Frequent extreme weather events can severely damage arable land, destroy urban infrastructure, and even damage urban buildings, causing substantial economic losses to governments and people, and exacerbating poverty issues.

### **3.3 Impact on human health**

The impact of climate change on human health is multi-layered and complex. Firstly, frequent extreme weather events caused by climate warming pose direct threats to human health. Heatwaves significantly increase the incidence and mortality rates of heat-related illnesses, such as heatstroke, particularly affecting vulnerable groups like the elderly, children, and those with chronic illnesses. Secondly, natural disasters like floods not only cause casualties but also lead to water pollution and outbreaks of infectious diseases, further exacerbating health risks. Additionally, climate change may also worsen air quality. With rising temperatures, pollutants in the atmosphere are more likely to form and accumulate, such as ozone pollution, which is particularly severe in the summer and can damage the respiratory and cardiovascular systems. Extreme events like forest fires also release a large number of harmful substances, affecting air quality and threatening human health. Furthermore, the indirect effects of climate change are even more profound, involving the instability of food supplies, water shortages, pollution, and the degradation of ecological environments. These changes not only weaken basic human survival conditions but also erode human health defenses through food chain contamination, the spread of waterborne diseases, and the emergence of new pathogens.

## **4 Coping strategies for climate change**

### **4.1 Measures to mitigate climate change**

In the face of increasingly severe climate change, a series of measures, such as promoting energy conservation and emission reduction in production and daily life, enhancing ecosystem protection, and formulating policies to promote international cooperation, can effectively mitigate the phenomenon of climate change. First, the development of clean energy sources such as solar, tidal, and wind energy can effectively curb the emissions of greenhouse gases like carbon dioxide and methane. According to a report by the International Energy Agency, global wind power capacity has significantly increased, with a projected additional growth of over 200% by 2030. In the first half of 2023, China's wind power construction rapidly developed, with cumulative power generation increasing by 20% compared to the previous year. By the end of June 2023, China's wind power capacity reached approximately 390 million kilowatts, a year-on-year increase of 13.7% [8]. Second, protecting ecosystems is crucial for mitigating climate change. Forests, oceans, and wetlands can store and absorb atmospheric carbon dioxide through photosynthesis and store it in plants and their soil. Thus, greenhouse gases accumulated in the atmosphere can be effectively absorbed. Local governments need to encourage forest and wetland conservation efforts, regularly clean up garbage pollutants in ecological reserves to prevent erosion and soil degradation and strengthen personnel supervision by enforcing strict forest conservation regulations to prevent rampant deforestation. Third, promoting global climate governance cooperation and strengthening the construction of international regulations help share the responsibility for climate among countries. For example, in the 2015 Paris Agreement, countries discussed and set their own energy conservation and emission reduction targets and implemented climate change response measures, working together to keep warming within 1.5 degrees Celsius. China promotes green and low-carbon infrastructure construction through the "Belt and Road" initiative, encouraging partner countries to implement environmentally friendly development policies through green investments and the development of renewable resources, achieving low-carbon development.

## **4.2 Measures to accommodate to climate change**

Climate change has become one of the severe challenges facing the globe, with average global temperatures and extreme weather events continuously increasing, affecting all facets of society and human life. Therefore, adapting to climate change is especially crucial while efforts to mitigate it are ongoing.

First, the development of agricultural adaptability strategies such as crop planting structures, improved irrigation systems, and the development of drought-resistant crops are essential. These strategies enable crops to better adapt to a climate change environment characterized by global warming and increased extreme drought and precipitation. Since 2004, Shandong Province has actively implemented late harvesting of summer corn and late planting of wheat. At the beginning of September each year, the Shandong Provincial Climate Center produces a forecast for the suitable initial sowing period for winter wheat, guiding farmers to scientifically select the sowing period based on the current year's climate, laying a solid foundation for achieving a bountiful harvest the following year [9].

Second, in response to the increase in extreme precipitation events, local governments need to enhance urban drainage system capabilities. By constructing flood prevention facilities, cities can ensure normal operations during extreme precipitation. Further dredging of urban rivers and connecting urban rivers with natural rivers and lakes can achieve rapid rainwater discharge. For undeveloped urban low-lying areas, the construction of artificial lakes can enhance the city's water retention capacity. In the surrounding areas of key cities, the construction of flood storage and detention areas is strengthened to leave space and routes for floodwaters, enhancing the overall regional capacity to defend against floods [10].

Additionally, improving public health security is urgent. Governments can enhance the capacity to respond to extreme weather events and the spread of infectious diseases by strengthening public health systems, ensuring the safety of people's lives. For example, establishing a comprehensive infectious disease prevention and control system, and enhancing the construction of medical infrastructure, especially in remote rural areas where medical resources are scarce.

## **4.3 Technological innovation and policy support**

In terms of technological innovation, technologies such as clean energy, carbon capture and storage, climate-smart agriculture, green building and smart city technologies are rapidly evolving. Continuous breakthroughs in these technologies not only improve resource utilization efficiency and reduce greenhouse gas emissions but also provide robust technical support for the sustainable development of human society. At the same time, policy support plays an indispensable role in guiding, incentivizing, and ensuring the research and application of these technologies. Governments establish clear emission reduction targets and timetables, creating a solid legal foundation for climate change response through relevant laws and regulations. Financial subsidies, tax incentives, a green financial system, and a carbon emission trading market effectively reduce the costs for businesses and individuals to engage in climate change responses, stimulate market vitality, and promote the widespread application of low-carbon technologies.

Moreover, public education and participation are also supported by policies. By disseminating knowledge about climate change, enhancing public awareness and participation, a favorable societal atmosphere for jointly addressing climate change is formed. This comprehensive effect not only helps mitigate the trend of climate change but also lays a solid foundation for achieving sustainable economic and social development. Therefore, strengthening the integration of technological innovation and policy support will be an important path for addressing climate change and promoting global sustainable development in the future.

## 5 Conclusion

Climate change is a complex and urgent global issue that not only affects the natural environment worldwide but also profoundly impacts all aspects of human society. This paper, through an analysis of the current status of climate change, reveals its extensive impacts on agricultural production, socio-economic stability, and human health. To tackle this challenge, a series of measures for mitigating and adapting to climate change have been proposed, including the development of clean energy, protection of ecosystems, technological innovation, and policy support. The paper emphasizes that international cooperation, public education, and participation are crucial for effectively responding to climate change. In the future, it is necessary to further enhance technological innovation, improve the policy support system, and heighten public awareness to achieve effective climate change responses and global sustainable development.

## Authors contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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