# Climate Change and its Impact on Environmental Health

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**Abstract.** Climate change has become a global issue that has a significant impact on ecosystem balance and environmental health. This process not only involves increasing global temperatures, but also includes extreme phenomena such as changes in weather patterns, rising sea levels, and changes in the hydrological cycle. These phenomena directly threaten the sustainability of ecosystems, affect the balance of species, and impact human health. Rising temperatures and erratic weather patterns have accelerated the spread of infectious diseases, such as malaria and dengue fever, due to the expansion of the range of disease-carrying vectors. The method used in this article is a literature study that aims to analyze the impact of climate change on environmental health. This process involves collecting, evaluating, and synthesizing information from a variety of academic sources and current research relevant to the topic. By utilizing reports from international organizations such as the Intergovernmental Panel on Climate Change (IPCC), as well as studies conducted by research institutions and academics, this article will outline the various impacts of climate change, including ecosystem changes, phenomena related to climate change, the spread of disease, food security, and mitigation efforts.

**Key words: [**climate change, environmental health, global issue]

## INTRODUCTION

Climate change has become a global issue that has a significant impact on ecosystem balance and environmental health. This process not only involves increasing global temperatures, but also includes extreme phenomena such as changes in weather patterns, rising sea levels, and changes in the hydrological cycle. These phenomena directly threaten the sustainability of ecosystems, affect the balance of species, and impact human health. Increasing temperatures and erratic weather patterns have accelerated the spread of infectious diseases, such as malaria and dengue fever, due to the expansion of the range of disease-carrying vectors (Pörtner et al., 2022; Wills-Karp, 2024). In this context, a report by the Environmental Protection Agency (EPA) suggests that changing climate conditions may worsen air quality, causing more severe respiratory problems among vulnerable populations (EPA, 2023).

Food security and access to clean water become serious threats when rainfall patterns and planting seasons are disrupted. This impact has the potential to increase rates of malnutrition and disease caused by water that is not fit for consumption (Hertel & Rosch, 2010; FAO, 2021). This situation is further complicated by the inequality of resources and adaptive capacity in various regions, especially in developing countries, which tend to be more vulnerable to the impacts of climate change. Research by the World Bank (2022) emphasizes that social and economic injustice can exacerbate the impacts of climate change, creating a vicious circle that is difficult to break.

While ideal policies regarding climate change mitigation and adaptation have been formulated, the reality shows significant challenges in implementation. Difficulties in achieving shared commitments at local and global levels create a gap between what is idealized and what is happening in reality (IPCC, 2021). To deal with this problem, comprehensive and effective mitigation efforts are needed. Mitigation policies and actions must be designed to reduce greenhouse gas emissions and increase society's adaptive capacity. Technological innovation and international collaboration also play an important role in accelerating the transition process towards sustainability, including the use of renewable energy, adaptive agricultural technologies, and more efficient water management (CDC, 2020).

Environmental-related theories, such as ecological theory and the concept of sustainability, emphasize the importance of the relationship between humans and the environment in an interdependent system. In the context of climate change, a balance between resource exploitation and conservation is key to maintaining environmental health and reducing the negative impacts of climate change (Hertel & Rosch, 2010).

This article aims to analyze in depth the impact of climate change on environmental health, identify factors that influence the spread of disease and food and water security, and examine the role

of technological innovation and international collaboration in climate change mitigation efforts. It is hoped that this analysis can provide a comprehensive view and encourage awareness of the importance of real action to deal with the impacts of climate change for the sake of sustainable life in the future.

## METHODS

The method used in this article is a literature study that aims to analyze the impact of climate change on environmental health. This process involves collecting, evaluating, and synthesizing information from a variety of academic sources and current research relevant to the topic. By utilizing reports from international organizations such as the Intergovernmental Panel on Climate Change (IPCC), as well as studies conducted by research institutions and academics, this article will outline the various impacts of climate change, including ecosystem changes, phenomena related to climate change, the spread of disease, food security, and mitigation efforts. In conducting this analysis, a critical approach was taken to evaluate the gap between theory and practice, as well as to provide insight into the international collaboration and technological innovation required to effectively address these challenges. With this approach, it is hoped that a deeper understanding of the complex relationship between climate change and environmental health and the efforts needed to mitigate it can be created.

## RESULTS AND DISCUSSION

Climate change is a global problem that not only impacts the environment but also affects many aspects of human life. This study aims to outline the impact of climate change on environmental health, focusing on several key factors that pose major threats. The six aspects that will be discussed include ecosystem changes, phenomena related to climate change, the spread of disease, food security and clean water, climate change mitigation efforts, as well as the importance of international collaboration and technological innovation. Each of these factors is interrelated and exacerbates the impacts of climate change, which demands serious attention to safeguard environmental health and human well-being in the future.

### 1. Impact of Ecosystem Change

Ecosystem changes caused by human activities and climate change have a broad impact on environmental health, with various direct and indirect implications for human well-being. In this study, some of the main impacts of ecosystem change on environmental health will be discussed in depth.

Decreasing Water Quality and Water Availability

Ecosystem changes, especially those related to deforestation, urbanization, and climate change, can affect the quality and availability of clean water. The decline in water quality occurs due to more frequent pollution due to changes in rainfall patterns and poor management of natural resources (Hasan et al., 2020). Ecosystem degradation leading to loss of vegetation cover reduces the soil's ability to filter water and control rainwater runoff. As a result, the availability of clean water is limited, which impacts human health through the risk of water-borne diseases, such as diarrhea, cholera and other parasitic diseases (Pecl et al., 2017).

Increase in Infectious and Parasitic Diseases

Ecosystem changes can increase the risk of the spread of infectious diseases, especially those transmitted by vectors such as mosquitoes and ticks. Changes in temperature and humidity caused by climate change have increased the distribution range of disease vectors such as malaria, dengue fever, and Zika virus (Pecl et al., 2017; Hernández-Delgado, 2015). In tropical regions, where ecosystems are frequently disturbed by human activities, these changes can create conditions that are more conducive to the spread of infectious diseases. Vector redistribution and increased extreme weather events may exacerbate these impacts.

Changes in Disease Patterns Due to Climate Change

Climate change not only affects patterns of vector-borne infectious diseases, but also diseases related to changes in temperature and weather. For example, the spread of allergic diseases

associated with air pollution and higher temperatures is increasing, as well as an increase in the incidence of respiratory diseases such as asthma due to pollution and an increase in the number of harmful particles in the air (Mcmichael & Woodruff, 2005). Water-borne diseases are also increasing, considering increasing temperatures and extreme weather that disrupt sanitation and clean water management (Confalonieri & Effen, 2019).

Decline in Food Production

Ecosystem changes also have a significant impact on the agricultural sector, which directly affects global food security. Soil degradation due to deforestation, climate change, and erratic weather patterns reduces agricultural yields and increases their vulnerability to pests and diseases (Pecl et al., 2017; Yee et al., 2020). Declining agricultural output threatens food supplies, which in turn contributes to health problems related to malnutrition and malnutrition, especially in developing regions that are highly dependent on the agricultural sector.

Vulnerability to Natural Disasters

Degraded ecosystems also have a lower ability to protect humans from natural disasters. For example, the loss of mangrove forests in coastal areas reduces the ability of these areas to withstand tropical storms and sea level rise. This increases their vulnerability to natural disasters, leading to damage to infrastructure, loss of housing, and increased health burden due to post-disaster injuries and illnesses (Schmeller et al., 2018; Yee et al., 2020).

**Figure 1.** Flood Natural Disaster

Species Redistribution and Its Impact on Health

Climate change has led to a geographic redistribution of species, disrupting natural ecosystems and influencing existing disease patterns. For example, some species normally found in tropical areas are now moving to previously colder areas, bringing with them diseases that were previously absent in those areas. These changes risk increasing the spread of vector-borne or zoonotic diseases that can be transmitted from animals to humans (Pecl et al., 2017). This redistribution can also change patterns of provision of important ecosystem services, such as crop pollination and natural pest control, that support food security and ecosystem sustainability.

Impact of Pollution and Pathogens in Mountain Water Ecosystems

Pollution and redistribution of pathogens in mountain water ecosystems are specific examples of the impact of ecosystem change on human health. Mountain water ecosystems are often a source of clean water for many populations, but pollution and climate change can cause significant damage to the quality of this water. Pathogens originating from agricultural pollution and industrial pollution can contaminate water sources, worsening human health, especially in areas that are highly dependent on water from mountain ecosystems (Schmeller et al., 2018).

Impact of Land Use Changes

Land use changes, such as the conversion of forests to agricultural land or settlements, directly reduce the capacity of ecosystems to provide essential services, such as water purification and carbon storage. This exacerbates the impacts of climate change and increases its vulnerability to natural disasters and disease. Reducing natural habitat also reduces biodiversity, which is important for maintaining ecosystem stability and preventing the spread of disease (Yee et al.,

2020; Confalonieri & Effen, 2019). Ecosystem changes caused by human activities and climate change have a broad and significant impact on environmental health and human welfare. These impacts include reduced water quality and availability, increased risk of infectious diseases, decreased food production, and vulnerability to natural disasters. In addition, the redistribution of species due to climate change and land use changes also contributes to changes in ecosystem services that are important for human health. Effective adaptation and mitigation efforts are needed to reduce these negative impacts and improve ecosystem resilience and public health.

## 2. Phenomena Related to Climate Change

Climate change and increasing pollution have a major impact on human health through direct and indirect influences, depending on environmental vulnerability and context. Extreme temperatures are one of the most prominent phenomena, where excessive hot and cold temperatures pose a high risk of cardiovascular and respiratory mortality, especially in countries such as China, where the number of deaths from these conditions is quite high (Chan et al., 2019). Climate change is also increasing the intensity and frequency of extreme weather, including heat waves, floods, and droughts, which directly affect low-income countries with higher levels of vulnerability (Haines et al., 2006).

Another phenomenon of major concern is the increasing incidence of infectious diseases, especially those transmitted by vectors, such as malaria and dengue fever, due to changes in the geographic distribution of vectors due to rising global temperatures. This impact exacerbates existing health problems in tropical countries and expands the spread of disease to previously unaffected areas. In the context of urban health, climate change also contributes to increased ultraviolet radiation, worsening air quality, and changes in rainfall patterns, all of which impact the health of urban communities (Bartholy et al., 2018).

Exposure to environmental changes, such as extreme temperatures, air pollution and natural disasters, has a significant direct impact on the health of mothers and newborns. For example, research in the United States shows that these conditions increase perinatal health risks, such as complications in pregnancy and preterm birth, indicating that the effects of climate change are intergenerational and have the potential to influence health throughout the life cycle (Veenema et al., 2023). These impacts show that climate change not only poses a direct threat to vulnerable groups, such as the elderly and low- income people, but also endangers the health of populations of various ages and social conditions.

Recognizing the urgency of the impacts of climate change on health, global nursing and health organizations have adopted resolutions aimed at mitigating these impacts through social justice approaches. This step emphasizes the importance of international collaboration to support the most vulnerable communities, including those living in areas at high risk of climate change. This approach not only pays attention to immediate impacts, such as disrupted physical health due to extreme weather conditions and natural disasters, but also takes into account the long-term impact on social and economic well-being. By strengthening public health in an inclusive and sustainable manner, this effort seeks to involve various stakeholders in creating community resilience to future climate risks (Nicholas et al., 2017).

## 3. Spread of Disease

Climate change has a profound impact on the spread of disease, affecting vital aspects such as ecosystems, disease hosts, and human and animal migration patterns. Any changes in temperature, rainfall, and extreme weather events play a large role in spreading diseases beyond their endemic areas, with an increased risk for the spread of infectious diseases such as malaria, dengue fever, and cholera.

For example, ENSO (El Niño Southern Oscillation)-related temperature increases have been linked to spikes in Rift Valley fever in Africa and increases in cholera in Asia and Latin America, where pathogens have better conditions to survive and reproduce during these weather phenomena (Flahault et al., 2016). This shows how an unstable climate creates a favorable environment for pathogens, especially in areas that are already vulnerable to infectious diseases.

Furthermore, climate change not only increases the incidence of existing diseases but also expands the geographic area in which they spread. Changes in temperature and rainfall have allowed

mosquitoes carrying diseases such as malaria and dengue fever to reach areas that were previously too cold for the pathogens to thrive (Caminade et al., 2018). In the UK, the risk of disease transmission by vectors such as mosquitoes, sandflies and ticks is expected to increase with warmer weather conditions, opening up new threats for a country that has not previously faced these problems (Baylis et al., 2017).

Rising temperatures directly affect health in unique ways. In southern China, a 1°C increase in temperature increased cases of bacillary dysentery by 14.8%, while in western China, a 5.9% increase in cases of hand, foot and mouth disease (HFMD) occurred due to the same temperature increase (Yi et al., 2019). Additionally, deteriorating air quality due to pollution, especially in big cities, worsens respiratory conditions such as asthma and other lung diseases, which especially impacts vulnerable groups, including children and the elderly.

Climate change also causes stress on hosts and pathogens living in certain ecosystems. In this context, warm weather can lengthen the active season for vectors, while changes in rainfall can create more breeding habitat. On the other hand, wildlife from warmer climates may experience a lower risk of infection as they migrate to new areas, while native species become more susceptible to pathogens new to their habitat (Cohen et al.,2020). In addition, anthropogenic activities such as deforestation and urbanization change the environments in which humans and animals live, which increases interactions between humans and disease hosts, creating conditions for the spread of new diseases (Wu et al.,2013).

This phenomenon highlights that international collaboration is key to mitigating the complex and transboundary impacts of climate change on health. Global efforts that emphasize social justice are essential for the protection of vulnerable populations – such as low-income communities and regions with high climate risk – to be realized. These initiatives need to focus on empowerment, including access to adaptive medical technologies and resources, that enable communities to better face the health risks of climate change.

The development of technological innovation is also an important priority in addressing this climate health challenge, especially environmental health monitoring technology, disease prediction, and early warning systems for extreme weather. This improvement can strengthen the global health system to be more responsive in dealing with potential outbreaks and disasters triggered by climate change. For example, digital technology that can monitor weather changes and disease patterns helps in carrying out rapid responses in areas vulnerable to climate extremes.

Additionally, support from the health community, such as nursing organizations focused on social responsibility, is important to ensure that any mitigation and adaptation efforts are inclusive. This focus supports the creation of a global health system that is not only responsive, but also responsive to urgent social and health needs at various levels. Through this approach, global health risks triggered by climate change can be reduced significantly (Nicholas et al., 2017).

**4. Food Security and Clean Water**

Climate change is having a serious impact on global food security, which can be seen from the potential increase in the number of people at risk of starvation. It is estimated that between 5 and 170 million additional people will face the threat of famine by 2080, depending on socio-economic developments and climate change mitigation responses (Schmidhuber et al., 2007). Climate change impacts food security through increasing temperatures, changing rainfall patterns, and the frequency of extreme weather, all of which disrupt agricultural productivity and require greater reliance on irrigation, especially in already vulnerable regions (Liu et al., 2013; Farooq et al., 2022).

Investment in future food security is urgently needed, especially in overcoming land degradation, developing crop varieties that are resistant to extreme climates, and conserving increasingly threatened water resources (Hanjra et al., 2010). Soil degradation due to intensive agricultural practices and the impacts of climate change are also exacerbating the situation, with South Asia and Sub-Saharan Africa identified as the regions most vulnerable to food insecurity (Lal et al., 2013).

In the fisheries and livestock sectors, climate change is changing aquatic ecosystems and fish migration patterns and affecting livestock production through its impact on feed availability and water quality. Shifts in the distribution of pests and diseases due to climate change also increase threats to food security by disrupting food supply chains from primary crop sources (Campbell et al.,

2016). Therefore, proactive mitigation and adaptation measures, including technological innovation and training for local communities, are critical to improving food security and ensuring sustainable food supplies.

## 5. Climate Change Mitigation Efforts

In facing the challenge of climate change, mitigation is the key to reducing its increasingly widespread impacts. Various mitigation strategies, including greenhouse gas (GHG) emission reduction, geoengineering, and negative emissions technologies, have been developed to slow global warming. Conventional mitigation, which relies on energy efficiency and the transition to renewable energy, remains the main step that can be implemented immediately. However, more innovative approaches are now also being introduced, such as the large-scale cultivation of microalgae for $CO_2$ biofixation, which has great potential to sequester carbon directly from the atmosphere and reduce $CO_2$ concentrations (Panepinto et al., 2021). This shows that mitigation efforts are not just about reducing emissions, but also about managing the carbon already in the atmosphere.

The application of GHG mitigation technology has the potential to produce very significant additional benefits. Apart from reducing emissions, this mitigation strategy also helps improve air quality, which has a direct impact on improving public health. By reducing air pollution, we not only slow climate change but also reduce the risk of respiratory diseases often associated with air pollution (Deng et al., 2017). More structured and data-based mitigation efforts, such as through greenhouse gas emissions inventories, provide the basis for more effective mitigation policies and enable better monitoring and evaluation of implemented policies (Sporchia et al., 2022). This shows that mitigation not only serves to reduce the direct impacts of climate change but also provides opportunities for improving public health and resource efficiency.

Additionally, adaptive mitigation strategies based on information feedback from global temperature changes have the potential to optimize economic and environmental performance. This approach not only responds to the already observed global temperature changes but also reduces the risk of overinvestment and avoids excessive warming. By utilizing more accurate data on temperature and climate change, this strategy has the potential to provide solutions that are more flexible and responsive to changing conditions, thereby maintaining a balance between reducing the impacts of climate change and sustainable resource management (Marangoni et al., 2021).

Equally important, the protection and preservation of natural and semi-natural ecosystems plays a huge role in mitigating climate change. Natural ecosystems, such as forests and wetlands, have a great ability to absorb carbon and store energy, which directly reduces carbon concentrations in the atmosphere. This approach that focuses on preserving biodiversity and ecosystem sustainability also supports adaptation to climate change, because a healthy ecosystem can reduce the negative impacts caused by natural disasters, such as floods and drought. Therefore, ecosystem protection is not only important to reduce the impacts of climate change, but also to strengthen society's adaptive capacity to the increasing risks due to climate change (Morecroft et al., 2019).

## 6. International Collaboration and Technological Innovation

In facing the climate change crisis, international collaboration and technological innovation play an important role in creating effective and sustainable solutions. Cooperation between countries through various mechanisms, such as Transfer of Agreement (TOA), has the potential to increase the efficiency and effectiveness of climate change mitigation efforts globally, although the direct environmental impacts of these mechanisms are often limited (Coninck et al., 2008). Therefore, broader and more sustained collaboration is needed to ensure long-term success in overcoming this crisis.

The development and transfer of climate change mitigation technologies, which are now increasing, require concerted efforts to ensure effective implementation, especially in developing countries. Research shows that international cooperation based on domestic innovation and international assistance can create a new paradigm for addressing climate change. Xiang et al. (2016) propose that the integration of local innovation and global technological collaboration can create more appropriate solutions and lead to better sustainability in facing these global challenges. The system of international technological cooperation, based on the concept of ecological civilization,

is considered crucial to ensure the development and dissemination of technologies in accordance with the principles of sustainability and ecological equality (Jiang et al., 2017).

On the other hand, collaboration between universities and research institutions in various countries is also an important pillar in creating cutting-edge technology to overcome climate change. Policies that support inter-university collaboration have the potential to produce innovative solutions that are more applicable and able to have a positive impact on sustainable technology development (Arifin et al., 2023). Joint research between developed and developing countries can be an important bridge to ensure the effective implementation of GHG mitigation technologies in developing countries, which often experience limited resources to access the latest technologies (Ockwell et al., 2015).

It is also important to emphasize that to accelerate the development and transfer of mitigation technologies, multilateral collaboration involving energy markets, trade and intellectual property management will be essential. Such efforts can help create more inclusive and sustainable markets for environmentally friendly technologies, which in turn can accelerate the global transition to a low-carbon economy (Newell et al., 2009). Therefore, broad international collaboration based on cutting-edge technology is the main key to accelerating solutions to climate change.

## CONCLUSION

Climate change and the resulting ecosystem impacts have affected almost all aspects of life on earth. Climate change-related phenomena, such as extreme temperatures, floods and droughts, further exacerbate the spread of infectious diseases that affect humans and wildlife, and worsen food and clean water security. In mitigation efforts, various strategies such as reducing greenhouse gas emissions, developing negative emissions technology, and geoengineering are being advanced to reduce the impact of climate change, although their implementation requires sustainable international cooperation.

The importance of international collaboration in addressing climate change is becoming increasingly clear, with an emphasis on developing sustainable technologies and innovations that can spread widely in developing countries. By adopting a more inclusive and equitable approach, and integrating research and technology, the world can more effectively respond to the increasingly complex challenge of climate change. The combination of climate change mitigation, technological innovation, and global cooperation will be the key to mitigating the impacts of climate change and maintaining the sustainability of life in the future

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