

# Research on Environmental Change and Sustainability

Hongqing Wang \*

Department of Geography, University of Wisconsin-Madison, Madison 53706, United States

\* Corresponding Author Email: hwang984@wisc.edu

**Abstract.** In the 19th century, the Industrial Revolution brought major changes to the environment as industrialization and urbanization accelerated. These changes will have a serious impact on the natural environment and human life. At present, how to mitigate environmental changes has become a problem that needs to be faced directly. This paper mainly studies the main causes of environmental change and puts forward corresponding countermeasures, and thus concludes that the main causes of environmental change include climate change caused by soil erosion and greenhouse gas emissions. Therefore, it is very necessary to carry out sustainable development. The whole world should work together to reduce greenhouse gas emissions to slow down climate change, switch from fossil fuels to renewable energy, improve energy efficiency and reduce deforestation to reduce soil erosion. Ultimately, by working together across society to address environmental change and sustainability, with the right policies, technologies, and social changes, we can create a more sustainable future for the planet and its inhabitants.

**Keywords:** Environmental change; Sustainability; Effect; Measure.

## 1. Introduction

Environmental change refers to changes in the natural environment over time due to natural processes and human activities. Sustainability is the practice of meeting current needs without leaving a huge carbon footprint. Environmental sustainability refers to using resources in a way that preserves their availability for future generations and does not harm ecosystems [1].

This includes reducing greenhouse gas emissions to combat climate change, protecting biodiversity and reducing pollution. A key area of environmental change research is climate change research, which examines the causes, effects and potential solutions of global warming and its effects on the planet. This research typically focuses on anthropogenic causes of environmental change. The most common causes include deforestation and the use of non-renewable energy sources, which contribute to climate change. Another important area of environmental change research is biodiversity loss research, which examines the causes and consequences of the decline in the diversity of life on Earth. This research typically focuses on the impact of human activities (such as habitat destruction and pollution) on biodiversity and potential conservation strategies to protect and restore ecosystems. Sustainability research, focusing on the relationship between economic growth and environmental protection, often emphasizes the need to balance these two goals to create a more equitable and sustainable society. Both environmental change and sustainability are complex and interrelated issues that require an interdisciplinary approach to understand and address.

## 2. Environment Changes

Not only China, but the deterioration of the natural environment has become a very serious environmental problem facing the world. It is mainly manifested in a series of problems such as climate change caused by excessive greenhouse gases produced by the extensive use of fossil resources, deforestation, deforestation and overgrazing caused by soil erosion and land desertification. Fig. 1 is the image depicting biodiversity loss.



**Fig 1.** Image depicting biodiversity loss.

## 2.1. Soil Erosion and Water Loss

Soil erosion and water loss are two important issues that contribute to environmental change. Water loss, also known as water scarcity, refers to the lack of access to clean and reliable water resources. This can be caused by factors such as population growth, urbanization, and climate change, which can lead to increased demand for water and reduced availability of water resources [2]. Water loss can also be caused by the degradation of water resources through pollution and over-extraction, which can make water less usable and less accessible.

Soil erosion is the gradual removal of topsoil. The topsoil is the richest part as it contains organic matter and other essential nutrients. Some of the most common causes of soil erosion are variety of factors, such as over-cultivation, urbanization, and deforestation. Soil erosion can lead to a decline in agricultural productivity and a loss of biodiversity, increased runoff and flooding. Both water loss and soil erosion can have significant impacts on the environment, as well as on human communities that depend on these resources. In arid and semi-arid regions, water loss can lead to desertification, which can make it difficult for people to grow crops and raise livestock [3]. Soil erosion can lead to a decline in agricultural productivity, which can make it difficult for people to grow enough food to meet their needs.

To address these issues, a variety of strategies can be implemented, such as increasing water conservation and efficiency, protecting and restoring watersheds, and implementing sustainable agricultural practices. Additionally, policies and regulations can be put in place to reduce water and soil degradation, such as regulations on water use, and incentivizing conservation and best practices. In general, water loss and soil erosion are two critical environmental problems that are caused by human activities and have significant impacts on both the environment and human communities. Addressing these issues is essential for achieving sustainability and preserving natural resources for future generations.

## 2.2. Greenhouse Gas Emission

Greenhouse gases play a crucial role in environmental change, specifically in climate change. Methane, nitrous oxide, and fluorinated gases are additional greenhouse gases in addition to carbon dioxide, which is the most well-known one. [4]. these gases trap heat in the atmosphere, causing the planet to warm up, which is referred to as the greenhouse effect.

The amount of greenhouse gases in the atmosphere has increased as a result of human activities like burning fossil fuels, deforestation, and industrial operations. [5]. This increase in greenhouse gas

concentrations has caused the Earth's average temperature to rise, resulting in a variety of impacts such as more frequent and severe heatwaves, droughts, and extreme weather events, sea-level rise, loss of biodiversity and changes in ecosystems, among others. The increase in greenhouse gas concentrations, primarily CO<sub>2</sub>, has been the most significant cause of this warming.

A number of tactics can be used to solve this problem, including reducing greenhouse gas emissions and slowing the rate of climate change [4]. They include boosting the use of sources of clean energy such as solar and wind power, putting energy-saving measures into place, and encouraging sustainable land use and transportation. Additionally, carbon pricing mechanisms and regulations can be put in place to reduce emissions from industry and transportation. Overall, the role of greenhouse gases in environmental change is significant, as their increasing concentrations in the atmosphere are causing the Earth's climate to change, resulting in a variety of negative impacts on the planet [4]. Reducing greenhouse gas emissions is an essential step towards mitigating the effects of climate change and achieving a more sustainable future.

### 3. Effects of Environmental Change

Environmental change can have a wide range of effects on the planet, including impacts on the natural environment, as well as on human communities and economies. Climate change also affects the natural environment by altering the distribution and abundance of plant and animal species, leading to loss of biodiversity and changes in ecosystems. This can disrupt food chains and can lead to the extinction of many species.

Environmental change can also lead to the displacement of human populations, as people are forced to leave areas that are affected by droughts, floods, sea-level rise, and other environmental changes [2]. This displacement can lead to a variety of social and economic problems, such as increased poverty, conflict, and political instability. As the result, environmental change can have a wide range of effects on the planet, including impacts on the natural environment, as well as on human communities and economies. Addressing these issues is essential for preserving natural resources and protecting the planet for future generations.

#### 3.1. Natural Ecology

Environmental change can have a significant impact on natural ecology. The effects can be observed in different levels, from the genetic, population, community and ecosystem levels. Climate change is one of the most significant drivers of environmental change, and it can have a wide range of effects on natural ecology. The timing of seasonal occurrences, such the emergence of insects, can vary as a result of rising temperatures. The flowering of plants, and the migration of birds, which can disrupt the timing of interactions between species and cause cascading effects throughout ecosystems.

Rising temperatures and changes in precipitation patterns can also affect how different species of plants and animals are distributed. It's possible for some species to adjust to these modifications. This can lead to changes in the composition of ecosystems, and loss of biodiversity. Ocean acidification caused by the absorption of carbon dioxide by the oceans can also have a significant impact on marine ecosystems. Acidification can reduce the ability of marine organisms to build and maintain their shells and skeletons and can negatively affect the organisms that rely on coral reefs and other calcium-carbonate structures.

Habitat destruction, pollution, and over-exploitation of natural resources can also cause significant impacts on natural ecology [6]. These factors can lead to the loss of biodiversity, as well as changes in the composition and functioning of ecosystems. These impacts can cause cascading effects throughout ecosystems, leading to a reduction of ecosystem services, such as pollination, pest control, and water purification, which can negatively impact human communities and economies. Overall, environmental change can have a significant impact on natural ecology. Addressing these issues is essential for preserving natural resources, and the health and functioning of ecosystems.

### 3.2. Human's Quality of Life

Environmental change can severely influence how well people live their lives all across the world. The effects can be both direct and indirect and can vary depending on factors such as a person's location, socio-economic status, and access to resources [7]. The increased occurrence and severity of extreme weather events, such as heatwaves, droughts, floods, and storms, have a large direct impact on quality of life. These disasters can inflict infrastructure damage and disrupt wealth creation, resulting in a loss of revenue and cost increases for people and their communities. Fig. 2 is the reduced quality of life due climate change.



**Fig 2.** Reduced quality of life due climate change.

Climate change can also have an impact on human health, as it can increase the incidence of heat-related illnesses, air pollution, and the spread of disease through insects and pests. Additionally, sea-level rise can contaminate freshwater resources, increasing the risk of water-borne diseases. Environmental change can also lead to the displacement of people, as people are forced to leave areas that are affected by droughts, floods, sea-level rise, and other environmental changes. This displacement can lead to a variety of social and economic problems, such as increased poverty, conflict, and political instability, which can have a harmful influence on the performance of life for impacted persons and communities. Additionally, environmental change can have an indirect impact on the quality of life through its effects on natural resources, such as food and water. Climate change can disrupt crop growth, causing food shortages and price increases, which can have a significant impact on the food security for people in affected areas [3]. Changes in the environment will have a major effect on how well the live for people around the world. Addressing these issues is essential for preserving natural resources and protecting the planet for future generations, and for ensuring a good quality of life for all people.

Climate change can have a significant impact on the incidence and spread of diseases. The relationship between climate change and diseases is complex, and can involve a variety of factors, including changes in temperature, precipitation, and humidity, as well as changes in the distribution and abundance of disease-carrying organisms. One of the most significant ways that climate change can impact disease is through changes in the distribution and abundance of disease-carrying organisms, such as mosquitoes and ticks [6]. As temperatures rise, the range and distribution of these organisms can expand, allowing them to carry diseases into new areas. For example, rising

temperatures have led to the expansion of the range of the *Aedes* mosquito, which carries the dengue fever virus, into new areas, including parts of the United States. Climate change can also have an impact on disease through changes in precipitation patterns. For example, heavy rainfall can increase the risk of water-borne diseases, such as cholera and typhoid fever, by contaminating freshwater resources. Droughts, on the other hand, can increase the risk of disease by causing water shortages, which can lead to the use of contaminated water sources. Climate change is also increasing the frequency and severity of heatwaves, which can lead to a rise in the prevalence of heat-related disorders like heat stroke and exhaustion, especially in vulnerable groups like the elderly and those with pre-existing medical issues. The relationship between climate change and diseases is complex, but climate change can have a significant impact on the incidence and spread of diseases. Addressing climate change is essential for protecting human health and well-being.

#### **4. Measures**

Variety of measures and policies exist that can be implemented to reduce environmental change and its impacts on human health and the planet. There are some of the most effective measures. First, reducing greenhouse gas emissions is one of the most important ways to reduce environmental change is to reduce the amount of greenhouse gases, such as carbon dioxide, that are released into the atmosphere [8]. This is able to be done by taking a number of steps, such as using more sources of clean energy, like wind and solar energy, and using less fossil fuels, like coal and oil. Second, improve energy efficiency in buildings, vehicles, and industrial processes can be done by implementing energy-efficient technologies and practices, such as using energy-efficient light bulbs, appliances, and building insulation. Third, encouraging environmentally friendly modes of transportation can lower emissions of greenhouse gases and enhance air quality. Examples of these modes of transportation include walking, cycling, and public transportation [8].

Fourth, conservation and protection of natural resources is one of the most important ways to reduce environmental change is to conserve and protect natural resources, such as forests, wetlands, and oceans [9]. This can be done by implementing policies and regulations to protect these areas, as well as by promoting sustainable land use practices, such as reforestation, and sustainable fisheries management. Fifth, adaptation measures are also important to reduce the negative impacts of climate change that are already happening or are likely to happen [8]. These measures include building sea walls, drought-resistant crops, and early warning systems for extreme weather events. Sixth, education and awareness. Raising awareness and educating people about the causes and impacts of environmental change can help to encourage individuals and communities to take action to reduce their environmental impact.

It is high time that government bodies and environmental activists implemented the above-mentioned factors to reduce environmental change and its impacts on human health and the planet [10]. Addressing these issues requires the cooperation of governments, businesses, and individuals to create a sustainable future for all.

#### **5. Recommendation**

Using renewable energy sources is one of the most effective ways to reduce environmental change and its impacts on the planet [6]. Solar, wind, hydro, and geothermal energy are examples of renewable energy sources that provide electricity without adding any greenhouse gases or other pollutants to the atmosphere. To be more specific, solar power is the most widely available and cost-effective renewable energy source, and it can be used to generate electricity, heat homes and buildings, and power vehicles. Wind power is another renewable energy source that can be used to generate electricity, particularly in areas with strong winds. Wind turbines convert the kinetic energy of the wind into electricity. Hydroelectric power is generated by using the energy of falling water to drive turbines and generate electricity. Geothermal energy is heating energy generated and stored in the

Earth, it can be used to generate electricity and heat buildings. Biomass energy is generated by burning organic materials such as wood, crops, and waste, to generate electricity or heat.

The use of renewable energy sources can also have other benefits, such as creating jobs and economic growth, improving energy security, and reducing dependence on fossil fuels [6]. Governments, businesses, and individuals can all play a role in increasing the use of renewable energy by investing in renewable energy projects, implementing policies and regulations to support the growth of the renewable energy sector, and incorporating renewable energy into their energy mix.

Using sustainable buildings is another important way to reduce climate change and its impacts on the planet. Sustainable buildings are designed and constructed in a way that reduces their environmental impact and improves their overall energy efficiency. There are some of the key features of sustainable buildings. First, Energy-efficient design sustainable buildings are designed to minimize energy consumption and reduce greenhouse gas emissions. This can be achieved by energy-efficient technologies, such as high-efficiency heating and cooling systems, and by incorporating natural light and ventilation into the building design. Second, many sustainable buildings are designed to incorporate renewable energy sources, such as solar or wind power, into their energy mix. This can help to reduce the building's overall greenhouse gas emissions and improve energy security. Third, sustainable buildings are also designed to conserve water, through features such as low flow plumbing fixtures, rainwater harvesting systems, and greywater systems. Fourth, sustainable building use sustainable materials and products, such as low-emitting adhesives, sealants, paints and coatings, carpets, and flooring systems, as well as Forest Stewardship Council (FSC) certified wood products. Fifth, sustainable buildings are designed to improve indoor environmental quality by providing good ventilation and air quality, natural light, acoustical comfort, and temperature control [11]. Governments, businesses, and individuals can all play a role in promoting sustainable buildings by investing in sustainable building projects, implementing policies and regulations to support sustainable building practices, and incorporating sustainable building practices into their building design and construction.

## 6. Conclusion

In conclusion, environmental change and sustainability are critical global issues that have far-reaching impacts on the planet and its inhabitants. Climate change, caused by the release of greenhouse gases into the atmosphere, is one of the most pressing environmental challenges of our time, with severe consequences for natural ecosystems, human health, and the global economy. Reducing greenhouse gas emissions and slowing climate change will require a concerted global effort to shift away from fossil fuels and towards renewable energy sources, improve energy efficiency, and reduce deforestation. Additionally, sustainable practices in areas such as building, agriculture, and water management can also play a key role in reducing environmental change. Governments, businesses, and individuals all have a role to play in addressing environmental change and sustainability. Governments can implement policies and regulations to support renewable energy and sustainable practices, while businesses can invest in sustainable technologies and practices, and individuals can make conscious choices in their consumption and lifestyle to reduce their environmental impact. Ultimately, it will take a collective effort from all sectors of society to address environmental change and sustainability, with the right policies, technologies, and social changes, we can create a more sustainable future for the planet and its inhabitants.

## References

- [1] Hallam T. (2004). Climate change. Catastrophes and Lesser Calamities.
- [2] Telesetsky A. (2021) Loss and damage, disaster law, and climate change, Research Handbook on Climate Change Law and Loss & Damage, pp. 267–286.

- [3] Watts G. (2010) Water for people: Climate change and water availability, modelling the Impact of Climate Change on Water Resources, pp. 86–127.
- [4] Lawrence A. K. (2014). Offset systems and greenhouse gases. *Global Environmental Change*, 561–570.
- [5] Ntinyari W., Gweyi-Onyango J. P. (2021). Greenhouse gases emissions in agricultural systems and climate change effects in sub-Saharan Africa. *African Handbook of Climate Change Adaptation*, 1081–1105.
- [6] Romm J. (2018). Climate change and you. *Climate Change*.
- [7] Rohling E. J. (2019). Causes of climate change. *The Climate Question*.
- [8] Qiao F., You B., Li Q., & Yu L. (2017). Mitigation measures and recommendations in the USA to reduce environmental impacts of transportation infrastructure on wildlife. *Environment Pollution and Climate Change*, 01(03).
- [9] Harris F. (2012) Conserving Biodiversity and Natural Resources, *Global Environmental Issues*, pp. 105–130.
- [10] Jones S. (2017) City governments and climate change, *Cities Responding to Climate Change*, pp. 27–56.
- [11] Shealy T. (2016) Do sustainable buildings inspire more sustainable buildings? *Procedia Engineering*, 145, pp. 412–419.