



CLIMATE CHANGE AND GLOBAL INITIATIVES: UNDERSTANDING THE CHALLENGE AND THE INTERNATIONAL RESPONSE

Dr. Odol Pertin

RESEARCH ARTICLE



Author Details:

Associate Professor in Geography,
Jomin Tayeng Government Model
Degree College, Jemi Notko, Roing,
Lower Dibang Valley, Arunachal
Pradesh, India

Corresponding Author:

Dr. Odol Pertin

Abstract

Climate change has emerged as one of the most consequential environmental, economic and developmental challenges of the twenty-first century. Its implications extend far beyond changes in temperature and weather patterns, affecting ecosystems, agriculture, water resources, public health, livelihoods, migration, economic stability and international security. Although the Earth's climate has always been influenced by natural processes such as variations in solar activity, volcanic eruptions, ocean circulation and changes in the Earth's orbital characteristics, contemporary scientific evidence demonstrates that the unprecedented warming observed in recent decades is predominantly associated with human activities, particularly the emission of greenhouse gases from fossil-fuel combustion, deforestation, agriculture, industrial production and unsustainable land-use practices (IPCC, 2021). The impacts of climate change are particularly severe for vulnerable populations that possess limited economic and institutional capacity to adapt. This article examines the meaning, major causes and consequences of climate change and traces the evolution of significant international initiatives undertaken to address the problem. It discusses the Brundtland Commission's contribution to the concept of sustainable development, the 1992 Rio Earth Summit and the establishment of the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC), the Kyoto Protocol, the Marrakesh Accords, the Bali Action Plan, the Copenhagen Accord and the Paris Agreement. The article argues that international climate governance has progressively moved from scientific assessment and framework-building towards legally and politically more ambitious approaches involving mitigation, adaptation, climate finance, technology transfer and capacity building. However, the effectiveness of these initiatives ultimately depends upon sustained political commitment, equitable burden-sharing, technological innovation, public participation and implementation at national and local levels.

DOI:

<https://doi.org/10.70096/tssr.260404026>

Keywords: *Climate Change, Global Warming, Greenhouse Gases, Sustainable Development, UNFCCC, Kyoto Protocol, Paris Agreement, Climate Governance, Mitigation, Adaptation*

Introduction

Climate change is no longer a distant environmental concern; it is a defining challenge for contemporary societies. Changes in the Earth's climate system influence virtually every dimension of human life, including food production, water availability, health, livelihoods, migration, economic development and international relations. The burden, however, is not distributed equally. Communities with the least historical contribution to greenhouse-gas emissions are frequently among those most exposed to droughts, floods, storms, sea-level rise, ecosystem degradation and other climate-related hazards. The scientific understanding of climate change has developed substantially over the past several decades. The Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), provides periodic scientific assessments of climate change, its implications and possible response strategies (IPCC, n.d.). The contemporary climate challenge therefore requires more than isolated environmental interventions. It demands coordinated action across economic, technological, political and social systems. International cooperation has consequently become a central pillar of climate governance.

Meaning and Nature of Climate Change

Climate change refers to long-term changes in the average state and variability of the Earth's climate system. These changes may occur because of natural processes as well as human activities. Natural variations in solar radiation, volcanic activity, ocean circulation and Earth's orbital characteristics have historically influenced the climate.

Contemporary climate change, however, is fundamentally different in its scale and dominant drivers. According to the IPCC, it is unequivocal that human influence has warmed the atmosphere, ocean and land, while widespread and rapid changes have occurred across the climate system (IPCC, 2021).

Observable manifestations include rising global temperatures, changing precipitation patterns, increasing frequency and intensity of certain extreme weather events, retreating glaciers, loss of polar and terrestrial ice, ocean warming and sea-level rise. These changes have implications not only for natural ecosystems but also for human settlements and economic systems. Climate change should therefore be understood as a multidimensional phenomenon. It is simultaneously an environmental problem, a development challenge, a public-health concern and an issue of social and intergenerational justice.

Major Causes of Climate Change

The causes of climate change can broadly be classified into natural factors and human-related factors.

Natural Factors: Natural processes have played an important role in shaping Earth's climate throughout geological history. Some of the major natural influences are discussed below.

Ocean Currents: Oceans are fundamental components of the global climate system because they redistribute enormous quantities of heat around the planet. Ocean circulation influences atmospheric conditions, precipitation and regional temperatures. Phenomena such as El Niño demonstrate how interactions between the ocean and atmosphere can produce significant variations in climate conditions. The oceans also play an important role in the global carbon cycle by absorbing and releasing carbon dioxide. Changes in ocean circulation can consequently influence both climate patterns and atmospheric concentrations of greenhouse gases.

Volcanic Eruptions: Large volcanic eruptions can temporarily influence global and regional climate. Volcanic eruptions release sulphur dioxide, ash and other particles into the atmosphere. Sulphate aerosols can reflect a portion of incoming solar radiation back into space, producing a temporary cooling effect.

Volcanic activity is therefore an important natural climate forcing mechanism, although it does not explain the sustained warming observed in the contemporary period.

Changes in the Earth's Orbit: Variations in Earth's orbital characteristics and axial orientation can influence the distribution and intensity of solar radiation received by different regions. Changes in axial tilt, orbital configuration and related astronomical factors operate over long timescales and contribute to natural climate variability.

Solar Variability: The Sun provides the primary energy driving Earth's climate system. Variations in solar activity can therefore influence climate. However, contemporary scientific assessments indicate that recent global warming cannot be explained by changes in solar activity alone. The dominant cause of recent warming is human-induced greenhouse-gas accumulation (IPCC, 2021).

Human-Related Factors: Human activities have substantially altered the atmospheric concentration of greenhouse gases, particularly since the Industrial Revolution. Major anthropogenic sources include fossil-fuel combustion, deforestation, agriculture, industrial production and changes in land use.

Burning of Fossil Fuels: Coal, petroleum and natural gas are extensively used for electricity generation, transportation, heating and industrial activities. Their combustion releases substantial quantities of carbon dioxide into the atmosphere. The accumulation of greenhouse gases enhances the Earth's natural greenhouse effect and contributes to global warming.

Deforestation: Forests function as important carbon sinks. When forests are cleared or degraded, carbon stored in vegetation and soils may be released into the atmosphere. At the same time, the removal of forests reduces the capacity of terrestrial ecosystems to absorb atmospheric carbon dioxide.

Agriculture: Agricultural activities contribute to greenhouse-gas emissions through livestock production, rice cultivation, fertiliser use, soil management and land-use change. Agriculture is particularly significant because it produces carbon dioxide, methane and nitrous oxide.

Manufacturing and Industrial Production: The production of cement, steel, chemicals, plastics, electronics and other industrial goods requires substantial quantities of energy and raw materials. Industrial processes and energy consumption consequently contribute significantly to greenhouse-gas emissions.

Land-Use Change: Conversion of forests and other natural ecosystems into agricultural land, settlements and infrastructure can release stored carbon and reduce the capacity of ecosystems to sequester carbon. Sustainable land management is therefore essential to climate mitigation and ecological conservation.

Scientific evidence has established that human influence is the dominant driver of observed contemporary warming. The IPCC reports that human influence has warmed the atmosphere, ocean and land and has contributed to widespread changes across the climate system (IPCC, 2021).

Climate Change and Human Development: Climate change is closely connected with development. Its impacts can undermine progress in poverty reduction, food security, health, education and livelihood security. Poor and vulnerable populations are especially exposed because they often depend directly upon climate-sensitive resources such as agriculture, forests, fisheries and water.

Climate-related disasters can destroy homes, infrastructure, crops and productive assets, forcing communities to divert resources from long-term development towards recovery and reconstruction. Repeated climate shocks can therefore create cycles of vulnerability and poverty.

This relationship reinforces the principle that climate policy must be integrated with sustainable development. The World Commission on Environment and Development's *Our Common Future* (1987) placed sustainability at the centre of development thinking, emphasizing development that meets present needs without compromising the capacity of future generations to meet their own needs.

Evolution of Global Initiatives to Address Climate Change

International climate governance has evolved gradually from broad environmental awareness to a sophisticated framework involving scientific assessment, international law, national commitments, finance, adaptation and technology transfer.

The Brundtland Commission and *Our Common Future*, 1987: The World Commission on Environment and Development, commonly known as the Brundtland Commission, published *Our Common Future* in 1987. The report connected environmental protection with economic and social development and established sustainable development as a central principle of international environmental policy. Its contribution was particularly significant because it demonstrated that environmental degradation cannot be separated from questions of poverty, inequality, consumption, technology and development.

Rio Earth Summit, 1992: The United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, represented a major turning point in international environmental governance. The Summit emphasized that economic development, social well-being and environmental protection are interconnected.

The United Nations Framework Convention on Climate Change was adopted in 1992 and opened for signature at the Rio Earth Summit. It subsequently became the principal international framework for global cooperation on climate change.

United Nations Framework Convention on Climate Change: The UNFCCC established the foundation for continuing international negotiations on climate change. The Convention entered into force on 21 March 1994. Its objective is to stabilize greenhouse-gas concentrations at a level that prevents dangerous human interference with the climate system.

The Conference of the Parties (COP) became the central decision-making forum under the Convention. Annual COP meetings have subsequently provided the institutional setting for negotiating and strengthening international climate action.

Intergovernmental Panel on Climate Change: The IPCC was established in 1988 by UNEP and WMO to provide policymakers with authoritative assessments of scientific knowledge concerning climate change.

Its assessment reports have played an essential role in informing international negotiations and national climate policies. The IPCC does not prescribe particular policies; rather, it assesses scientific evidence regarding climate change, its impacts, risks, mitigation and adaptation options.

Kyoto Protocol, 1997: The Kyoto Protocol was adopted on 11 December 1997 at COP3 in Kyoto, Japan. It represented an important development because it established legally binding emission-reduction commitments for industrialized countries and economies in transition under the Convention's framework. The Protocol entered into force on 16 February 2005.

The Kyoto framework also introduced market-based mechanisms, including emissions trading and other mechanisms intended to provide flexibility in achieving emission-reduction objectives.

Marrakesh Accords, 2001: The Marrakesh Accords developed detailed rules for implementing the Kyoto Protocol. They addressed areas such as compliance, carbon-market mechanisms, reporting, finance and institutional arrangements.

The Accords also emphasized technology transfer, capacity building and support for developing countries. They represented an important step in transforming the broad commitments of the Kyoto Protocol into operational arrangements.

Bali Action Plan, 2007: The Bali conference marked another important stage in the evolution of climate negotiations. The Bali Action Plan promoted long-term cooperative action and emphasized four major pillars: mitigation, adaptation, technology and financing. This framework recognized that addressing climate change requires both reduction of greenhouse-gas emissions and assistance to countries and communities that are already experiencing climate impacts.

Copenhagen Accord, 2009: The Copenhagen climate conference placed the issue of limiting global temperature increase at the centre of international attention. The Copenhagen Accord acknowledged the need for ambitious efforts to keep global warming below 2°C and strengthened international discussion concerning mitigation, adaptation, finance and transparency.

Although the Copenhagen process did not produce the comprehensive legally binding treaty many had anticipated, it contributed to the political foundations of subsequent international climate negotiations. The UNFCCC identifies Copenhagen as an important milestone in the evolution of the international climate regime.

Paris Agreement, 2015: The Paris Agreement represents a major transformation in international climate governance. Adopted at COP21 on 12 December 2015, it created a legally binding international treaty applicable to all participating countries. It entered into force on 4 November 2016. The central objective of the Paris Agreement is to hold the increase in global average temperature to well below 2°C above pre-industrial levels while pursuing efforts to limit the increase to 1.5°C. Unlike the Kyoto Protocol's differentiated structure, the Paris Agreement requires all Parties to formulate and communicate national climate plans, known as nationally determined contributions (NDCs), and to progressively strengthen their efforts. The Agreement also recognizes the importance of adaptation, climate finance, technology development and capacity building, particularly for developing countries.

From International Commitments to Effective Climate Action

The development of international agreements demonstrates that climate governance has become progressively more comprehensive. However, the existence of agreements alone cannot solve the climate crisis. Their effectiveness depends upon implementation. Three interconnected priorities are particularly important. First, mitigation must remain central. Countries need to reduce greenhouse-gas emissions through renewable energy, energy efficiency, sustainable transportation, low-carbon industry and protection of natural carbon sinks. Second, adaptation must receive greater attention. Even with strong mitigation, some climate impacts are already unavoidable. Communities therefore need resilient agriculture, water management, disaster preparedness, climate-resilient infrastructure and strengthened health systems. Third, climate justice and international cooperation must remain integral to climate policy. Developing countries often face significant climate risks despite having contributed relatively less to historical emissions. International finance, technology transfer and capacity building are therefore essential components of a fair and effective response.

The Role of Education and Public Awareness

Climate action cannot be achieved through governmental policies alone. Education has an important role in developing environmental responsibility, scientific understanding and sustainable lifestyles. Climate education can help learners understand the causes and consequences of climate change, evaluate misinformation, develop environmentally responsible behaviour and participate meaningfully in community decision-making. The international climate regime itself recognizes the importance of education, training and public awareness in responding to climate change. Educational institutions can therefore become important centres for climate awareness, research, innovation and community engagement. Integrating climate literacy into curricula at school and higher-education levels can contribute to long-term behavioural and institutional change.

Challenges Ahead

Despite considerable progress in international climate governance, several challenges remain. These include continuing greenhouse-gas emissions, dependence on fossil fuels, uneven access to clean technologies, inadequate climate finance, geopolitical tensions, differing national priorities and the difficulty of reconciling economic growth with ecological sustainability. Another major challenge is the gap between international commitments and actual implementation. Scientific assessments increasingly demonstrate the urgency of rapid and sustained emission reductions. The IPCC has emphasized that human-induced climate change is already affecting climate extremes and that risks increase with every increment of warming (IPCC, 2021). The challenge, therefore, is not merely to create additional international agreements but to strengthen implementation, accountability, cooperation and social participation.

Conclusion

Climate change represents one of the most profound challenges confronting humanity in the twenty-first century. Although natural processes influence the Earth's climate, contemporary scientific evidence clearly establishes that human activities are the dominant cause of recent global warming. Fossil-fuel combustion, deforestation, agriculture, industrial production and unsustainable land-use practices have significantly altered atmospheric greenhouse-gas concentrations. The international community has responded through a gradual but significant institutional evolution—from the sustainability principles articulated by the Brundtland Commission to the Rio Earth Summit, UNFCCC, IPCC, Kyoto Protocol, Marrakesh Accords, Bali Action Plan, Copenhagen process and Paris Agreement. Each initiative has contributed to the development of the global climate regime. The Paris Agreement represents an important milestone because it brings countries together around a common temperature goal while recognizing the need for mitigation, adaptation, finance, technology and capacity building. Yet international commitments must be translated into concrete action at national, regional, local and individual levels. Ultimately, climate change is not solely an environmental problem. It is a question of development, justice, health, security and intergenerational responsibility. A sustainable response requires scientific knowledge, political commitment, technological innovation, responsible consumption, environmental education and genuine international cooperation. The success of global climate initiatives will ultimately be measured not by the number of declarations adopted, but by their ability to protect people, ecosystems and future generations.

Acknowledgment: No

Author's Contribution: Dr. Odol Pertin: Literature Review, Data Collection, Methodology, Analysis, Drafting, Referencing

Funding: No

Declaration: The author has given consent for the publication.

Competing Interest: No

References:

1. Intergovernmental Panel on Climate Change. (2021). *Climate change 2021: The physical science basis*. Cambridge University Press.
2. Intergovernmental Panel on Climate Change. (n.d.). *History of the IPCC*. IPCC.
3. United Nations. (1987). *Report of the World Commission on Environment and Development: Our common future*. United Nations.
4. United Nations Framework Convention on Climate Change. (1992). *United Nations Framework Convention on Climate Change*. UNFCCC.

5. United Nations Framework Convention on Climate Change. (1997). *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. UNFCCC.
6. United Nations Framework Convention on Climate Change. (2001). *Marrakesh Accords*. UNFCCC.
7. United Nations Framework Convention on Climate Change. (2007). *Bali Action Plan*. UNFCCC.
8. United Nations Framework Convention on Climate Change. (2009). *Copenhagen Accord*. UNFCCC.
9. United Nations Framework Convention on Climate Change. (2015). *Paris Agreement*. UNFCCC.
10. World Commission on Environment and Development. (1987). *Our common future*. Oxford University Press

Publisher's Note

The Social Science Review A Multidisciplinary Journal remains neutral with regard to jurisdictional claims in published data, map and institutional affiliations.

©The Author(s) 2026. Open Access.

This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>