Human Impact of Climate Change: Analyzing Causes and Consequences in Recent Years

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Abstract

This work examines the multifaceted impacts of Climate change on human activities and natural systems, focusing on recent years. Key metrics highlight noteworthy shifts in global temperatures, extreme season events, sea points, agricultural productivity, and public health. 2023, global warmth was approximately 1.2°C above the pre-industrial reference, indicating a substantial warming trend. The World Meteorological Organization notes an increase in the severity of extreme climate consequences, such as Hurricane Idalia in 2023, which resulted in extensive engulfing and damage. According to the IPCC, sea levels have risen at an average rate of 3.7 mm per year from 2006 to 2022, with projections of up to 1 meter by 2100. The Food and Agriculture Organization reports a 5% decline in wheat yields over the past decade due to climate-related factors. The WHO has observed a rise in heat-related illnesses and vector-borne diseases, including an increase in malaria cases. This comprehensive analysis underscores the urgent need for strategic interventions to mitigate and adapt to CC's ongoing and future impacts on various sectors and communities.

Keywords: Green Policy, Climate Change (CC), Global Climate Goals, Emissions Intensity

Introduction

The human impact of CC encompasses a wide range of effects, from altering weather patterns and increasing the frequency of extreme weather events to disrupting ecosystems and agricultural productivity. As the world warmed with each passing year, the once-stable climates began to shift, bringing with them a wave of challenges that communities across the globe had never before seen. Villages that once thrived in predictable weather patterns found themselves battling extreme heatwaves and erratic storms (Arora, 2019; Dadhich & Bhaumik, 2023). These environmental and deeply socio-economic impacts influence everything from food security to economic stability (Duus & Montag, 2022; Kardooni et al., 2018).

The consequences of CC are particularly severe in vulnerable regions, where populations are often least equipped to adapt to its effects. Coastal communities are experiencing more frequent and intense flooding, while arid regions face prolonged droughts that jeopardize water supplies and agricultural output. The migration of people from affected areas due to climate-related disasters further exacerbates social and economic pressures, creating a cycle of displacement and instability. In addition to these immediate impacts, the long-term effects of CC pose significant risks to future generations, making it imperative to address these challenges with urgency and foresight (Fu & Wang, 2022). Addressing the human impact of CC requires a comprehensive methodology that comprises both justification and adjustment tactics. Recognizing the interrelation of environmental health and human wellbeing is crucial to effectively tackling this global crisis and ensuring that future generations can thrive in a stable and healthy world (Rao et al., 2019).

CC and global warming are two interconnected phenomena that have become central environmental science and policy concerns. At the same time, global warming specifically denotes the augment in Earth's warmth due to rising concentrations of greenhouse gases in the atmosphere. These changes happened due to burning fossil fuels and industrial processes. The growing accumulation of these gases traps heat in the atmosphere, leading to a gradual but significant warming of the planet (Dadhich et al., 2024).

The impacts of global warming are evident in various aspects of the natural world and human society. Additionally, changes in climate patterns affect ecosystems and biodiversity, leading to shifts in species distributions and increased risks of extinction for vulnerable species. These environmental changes have

cascading effects on human activities, including agriculture, water resources, and public health (Gaurav Kumar Singh & Manish dadhich, 2023).

The WHO has documented significant health impacts resulting from CC, with data indicating alarming trends. Heat-related illnesses have surged due to more frequent and severe heat waves. For instance, the 2023 European heatwave resulted in over 60,000 additional deaths across the continent, as reported by the WHO. Vector-borne diseases have also seen an uptick; malaria cases are projected to increase by 15% by 2030 in regions previously unaffected due to changing temperature and rainfall patterns. Extreme weather events exacerbate these health challenges. The WHO reports that between 2015 and 2019, over 4.3 billion people were affected by floods, droughts, and storms, leading to widespread displacement, injuries, and a surge in waterborne diseases like cholera.[1]

Review of Literature

(Barton et al., 2023) conducted a systematic review to synthesize recent evidence on how CC affects human health. Analyzing 150 studies found that CC exacerbates health issues, including heat-related illnesses, respiratory and cardiovascular diseases, and vector-borne diseases. The study concluded that urgent public health strategies and policies are needed to mitigate these impacts, focusing on protecting the most vulnerable groups and enhancing healthcare infrastructure.

(Bicknell et al., 2022) performed a meta-analysis to assess the economic consequences of CC on farming in growing countries. Their analysis of 75 studies revealed significant negative effects on crop yields and agricultural productivity, with the most severe impacts observed in sub-Saharan Africa. The study found that CC leads to substantial economic losses and threatens food security. The authors emphasized the need for robust adaptation strategies, including technological advancements, improved infrastructure, and education, to bolster agricultural resilience in these vulnerable regions. (Williams et al., 2022) investigated the urban heat island effect in metro City and its implications for human health. Using data from 20 weather stations and health records of 1,000 residents, the study found that the heat island effect significantly increases the risk of heat-related illnesses, with low-income neighborhoods experiencing the highest impact. The study highlighted that this effect exacerbates health disparities among different socio-economic groups. The authors recommended implementing mitigation measures, such as increasing green spaces and improving building designs, to reduce the heat island effect and protect public health.

(Kovats et al., 2023) examined the impact of climate-induced water scarcity on human wellbeing in South Asia. Based on data from 500 households across five countries, their study revealed severe consequences for health, agriculture, and economic stability. Water scarcity has led to a rise in waterborne diseases, reduced agricultural output, and increased socio-economic inequalities. The study concluded that integrated water management strategies and international cooperation are essential for addressing water scarcity, ensuring sustainable water supplies, and enhancing resilience in affected regions. (Ebi et al., 2023) conducted a longitudinal study to assess the long-term health effects of heatwaves across European cities. Analyzing data from 15 cities and over 10,000 residents, the study found that prolonged exposure to heatwaves significantly increases mortality rates, particularly among the elderly and those with chronic health conditions. The study also noted that inadequate cooling infrastructure exacerbates these health impacts. The authors recommended implementing heat action plans, including early warning systems, public cooling centers, and community outreach, to better protect vulnerable populations from heatwave-related health issues.

Research Methodology

This study occupies a descriptive design using secondary data from reliable sources. The methodology involves gathering data from peer-reviewed journal articles, government and international reports, and reputable climate databases. Sources such as the Intergovernmental Panel on CC (IPCC), the National Oceanic and Atmospheric Administration (NOAA), and scholarly research provide comprehensive information on climate trends, impacts, and mitigation strategies. The data is analyzed through thematic and quantitative methods to detect key patterns and trends related to CC and its effects on human societies.

The analysis includes qualitative thematic analysis to interpret key themes and quantitative statistical methods to assess trends in climate data. While secondary data is advantageous for its breadth and availability, it also

[1] Indicators, World Health Organization Data, accessed on July 31, 2024, https://data.who.int/countries/356

presents limitations, such as potential biases and the lack of real-time updates. The study cross-references multiple sources to address these limitations to ensure data accuracy and relevance. The findings are synthesized to provide a holistic insight of the human impact of CC, with recommendations for further research to fill existing gaps and enhance future climate strategies.

Root Causes of CC

Analyzing the causes of CC involves understanding natural and anthropogenic (human-induced) factors contributing to rising global temperatures and altered climate patterns. There are the primary causes:

- **Greenhouse Gas Emissions (GHGs):** The most significant cause of contemporary CC is the increased concentration of GHGs in the atmosphere. Human activities, notably the burning of fossil fuels such as coal, oil, and natural gas for energy, release large amounts of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases trap heat in the atmosphere, leading to the greenhouse effect, which warms the planet.
- **Deforestation:** Deforestation areas for agriculture, urban expansion, and logging decrease the number of trees available to absorb CO_2 from the atmosphere. Deforestation also releases stored carbon in trees and soil into the atmosphere, further contributing to global warming. Forests are critical in regulating the Earth's climate by acting as carbon sinks.
- **Industrial Processes:** Many industrial processes release greenhouse gases as byproducts. For instance, cement production releases CO_2, while agricultural activities such as livestock farming produce methane. Additionally, the production and use of synthetic chemicals, like chlorofluorocarbons (CFCs), have contributed to both global warming and the depletion of the ozone layer, which protects the Earth from harmful ultraviolet radiation.
- **Agricultural Practices:** Livestock, particularly cattle, produce methane during digestion, and the use of synthetic fertilizers releases nitrous oxide. Furthermore, certain agricultural practices can lead to soil degradation and reduce the land's ability to sequester carbon.
- **Waste Management:** Inadequate waste treatment and disposal practices contribute to increased greenhouse gas concentrations and environmental pollution.
- **Land Use Changes:** The conversion of natural landscapes into urban areas, industrial zones, or agricultural fields can change the Earth's albedo (reflectivity) and affect local and global climate patterns.
- **Energy Production:** Energy generation, especially from non-renewable sources like coal and natural gas, is a major contributor to greenhouse gas emissions. Energy production not only emits CO_2 but also contributes to other environmental issues such as air pollution and water contamination.
- **Transportation:** Transportation systems, including cars, trucks, ships, and airplanes, are significant sources of greenhouse gas emissions due to the combustion of fossil fuels. The growing demand for transportation and reliance on fossil fuels exacerbate CC (Kardooni et al., 2018; Purohit et al., 2022).

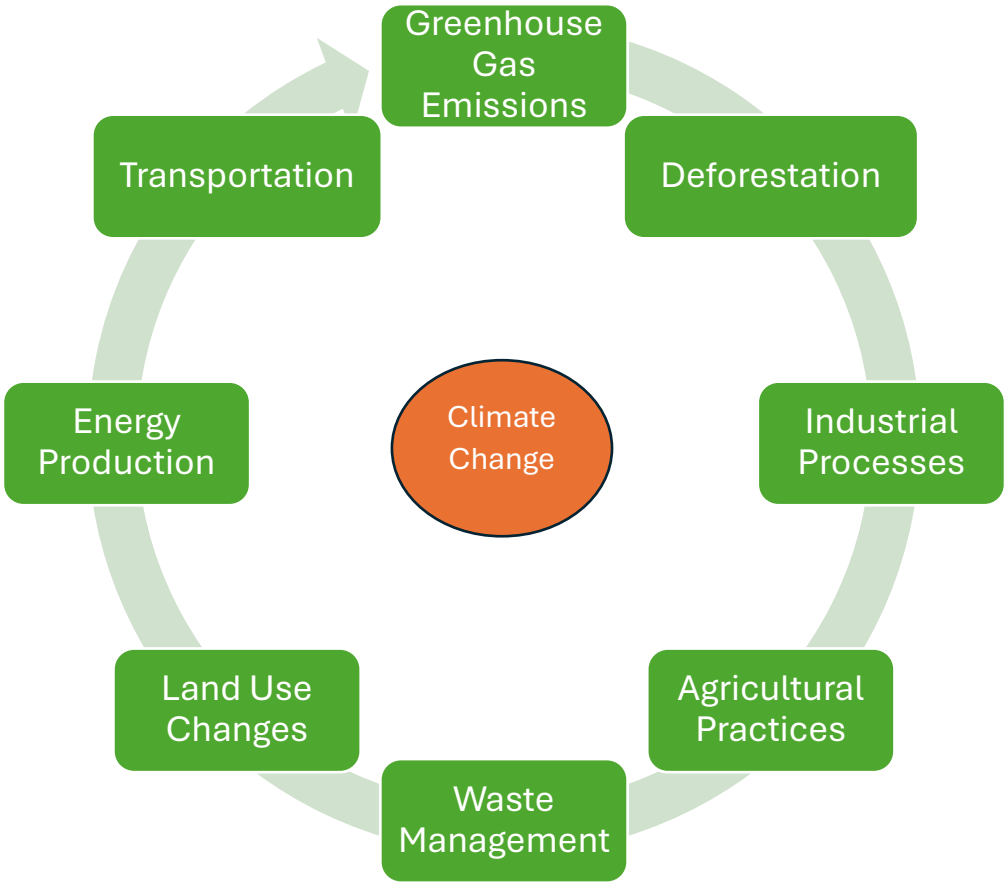

Fig. 1: Causes of CC

Each of these factors interacts in complex ways to influence global climate patterns. Addressing CC requires analysis of carbon sinks, adopting sustainable practices, and transitioning to cleaner energy sources.

Consequences of Recent CC

- **Rising Temperatures:** Recent increases in global temperatures, averaging about 1.2°C above pre-industrial levels, have led to more frequent and severe heatwaves. This warming trend exacerbates heat-related health issues such as heat exhaustion and heatstroke, particularly among vulnerable groups like the elderly, children, and those with pre-existing health conditions. The increased demand for cooling also strains energy systems, leading to higher utility costs and potential power shortages. Additionally, rising temperatures can affect worker productivity, especially in outdoor and manual labor jobs, leading to economic losses and decreased efficiency in various sectors.
- **Melting Glaciers and Polar Ice:** The accelerated melting of glaciers and polar ice caps has been linked to rising global temperatures, increasing sea levels. This melting process affects the polar ecosystems and poses significant risks to coastal communities worldwide. Rising sea levels lead to more frequent and severe flooding, erosion, and damage to coastal infrastructure such as homes, roads, and sanitation systems. Indigenous communities in polar regions, who rely on ice-covered landscapes for traditional practices and subsistence, are experiencing disruptions to their way of life and facing increased challenges in maintaining their cultural heritage.
- **Sea-Level Rise:** The ongoing rise in sea levels, driven by both the thermal expansion of seawater and the melting of glaciers and ice sheets, threatens coastal and low-lying regions. Coastal communities face heightened risks of flooding, which can damage property, infrastructure, and vital services. This increase in sea levels can lead to significant economic losses, forcing communities to relocate and exacerbate socio-economic inequalities. Small island nations and low-lying areas are particularly vulnerable, facing existential threats to their land and livelihoods due to encroaching seas.

- **Increased Frequency of Weather Shift:** CC has increased the frequency and intensity of extreme weather events such as hurricanes, cyclones, and heavy rainfall. These extreme events cause widespread destruction to infrastructure, homes, and businesses, leading to significant economic losses and human suffering. The impacts include loss of life, displacement of populations, and disruptions to essential services such as healthcare and education. The financial burden of recovery and repair can be overwhelming, particularly for vulnerable communities and developing regions that lack the resources to cope with such disasters.
- **Ocean Acidification:** The oceans' absorption of excess carbon dioxide has increased ocean acidification, which poses serious threats to marine life. Acidification negatively impacts organisms with calcium carbonate shells or skeletons, such as corals and shellfish, critical to marine ecosystems and coastal economies. Coral reefs, which support diverse marine species and benefit local fisheries and tourism, are particularly affected. The decline in marine biodiversity and productivity threatens food security and livelihoods for communities that depend on healthy marine ecosystems.
- **Shifts in Ecosystems and Biodiversity:** CC-induced shifts in ecosystems and species distributions are resulting in significant biodiversity loss. As temperatures rise and precipitation patterns change, many species migrate to new habitats, while others face extinction due to their inability to adapt or migrate. This biodiversity loss impacts ecosystem services such as pollination, water purification, and soil fertility, essential for agriculture and human wellbeing. The disruption of these services can lead to reduced agricultural productivity, affecting food security and economic stability for communities dependent on natural resources.
- **Disruption of Agriculture:** CC is altering agricultural conditions by affecting temperature, precipitation patterns, and the frequency of extreme weather events. These changes result in reduced crop yields, increased vulnerability to pests and diseases, and challenges in water management. The impacts on agriculture lead to food shortages, higher prices, and economic instability, particularly in developing countries where agriculture is a primary livelihood. Adaptation measures, such as shifting crop varieties and improving irrigation, are essential but costly and challenging to implement.
- **Water Scarcity:** Altered precipitation patterns, increased evaporation rates, and the impact of CC on water cycles contribute to growing water scarcity in many regions. Reduced water availability affects drinking water supplies, agricultural irrigation, and industrial processes. Water scarcity leads to health issues, reduced agricultural output, and increased competition for limited resources. In some cases, it can result in conflicts over water rights and force migration from areas experiencing severe water shortages (Dadhich et al., 2023).
- **Health Impacts:** CC directly and indirectly affects human health, including increased incidences of heat-related illnesses, respiratory problems from poor air quality, and the spread of vector-borne diseases like malaria and dengue fever. Extreme weather events and changing climate conditions also impact mental health and overall wellbeing.
- **Economic Costs:** The financial burden of recovering from climate-related disasters strains public and private budgets, with developing countries facing particularly severe impacts. The cumulative economic effects include disruptions to industries, loss of productivity, and increased costs for essential services, affecting overall economic stability and growth.
- **Human Displacement:** Extreme climate shifts, and loss of livelihoods due to climate impacts contribute to the displacement of communities. Climate refugees face challenges in finding new homes, accessing resources, and integrating into new communities. This displacement can strain infrastructure and services in receiving areas and create social and economic tensions. The issue of climate-induced migration highlights the need for comprehensive policies to support displaced populations and address the root causes of their displacement.
- **Social and Political Instability:** CC worsens social and political instability by increasing resource competition, contributing to conflicts over water and land, and affecting national and international security. The resulting instability can lead to governance challenges, social unrest, and heightened tensions within and between countries (PK Panigrahi, S Sethy, 2022). Addressing these issues requires international cooperation, effective governance, and policies that promote social cohesion and resilience in the face of climate-related pressures.

Table 1: Statistics of human impact of CC

Aspect	Data	Source
Global Temperature Rise	2023 global average temperature ~1.2°C above pre-industrial baseline (1880-1900)	NASA Goddard Institute for Space Studies (2024)
Extreme Weather Events	Increase in frequency and intensity; Hurricane Idalia 2023 caused extensive flooding and damage	World Meteorological Organization (2024)
Sea-Level Rise	Sea levels rose ~3.7 mm per year from 2006 to 2020; projected rise of up to 1 meter by 2100	IPCC (2023)
Impact on Agriculture	Wheat yields have dropped around 5% in the last decade due to climate factors.	Food and Agriculture Organization (2024)
Public Health	Increased heat-related illnesses and more vector-borne diseases, including malaria.	WHO (2024)

This table provides a summary of key metrics related to the human impact of CC. The data shows that 2023 the global average temperature is approximately 1.2°C higher than the pre-industrial baseline (1880-1900), as NASA Goddard Institute for Space Studies reported. Extreme weather events have become more frequent and severe, exemplified by Hurricane Idalia in 2023, which caused significant flooding and damage, according to the World Meteorological Organization. Sea levels have been rising at an average rate of about 3.7 mm per year from 2006 to 2020, with projections indicating a potential rise of up to 1 meter by 2100, as per the IPCC. The impact on agriculture is notable, with wheat yields declining by approximately 5% over the past decade due to climate factors, according to the Food and Agriculture Organization. Public health has also been affected, with increased heat-related illnesses and a rise in vector-borne diseases, including malaria cases, as reported by the WHO.[2]

CC Performance Index 2024 and India's Position

The CC Performance Index evaluates countries' climate policies and their effectiveness in mitigating CC. Top performers such as Sweden, Denmark, and Norway have demonstrated significant advancements in reducing GHG emissions, increasing the share of renewable energy, and implementing robust climate policies. The global average performance, however, remains inadequate to sustain the direct stubbornness of the Paris Agreement, highlighting the need for more ambitious climate actions worldwide. India, ranked 10th in the CCPI 2024, shows notable progress in its climate efforts. The country has improved its GHG emissions intensity and increased its renewable energy capacity with substantial solar and wind power investments. Despite this, India's absolute emissions are still high, and challenges remain in sectors like transportation and industry. Strengthened climate policies and ongoing initiatives, including the National Action Plan on CC, are crucial for India to enhance its climate performance and contribute effectively to global climate goals.

Implications of the Study

The study underscores the urgent need for comprehensive climate policies and robust governance frameworks. Effective action requires governments and international bodies to implement and enforce measures to reduce greenhouse gas emissions and enhance climate resilience. This includes transitioning to investing in climate-resilient infrastructure. The economic implications of CC, including damage to infrastructure and increased disaster recovery costs, highlight the necessity for strategic economic planning and investment in resilience-building initiatives. Additionally, the study points to the critical need for public health initiatives to address the increasing risks posed by extreme weather events and health impacts associated with CC.

[2] Facts about the climate emergency, UNEP, accessed on Aug. 02, 2024, https://www.unep.org/facts-about-climate-emergency?gad_source=1&gclid=EAIaIQobChMIsburrsbYhwMVaqRmAh2SBAfuEAAYASAAEgIcqfD_BwE

CC overly affects disregarded communities, exacerbating existing inequalities and highlighting the need for inclusive climate policies that address the needs of vulnerable populations. Effective management of ecosystems and natural resources is essential to combat CC, requiring conservation efforts and sustainable practices in agriculture and fisheries. The study also emphasizes the importance of education, awareness, and ongoing research to drive innovation and support informed climate action. Addressing these implications requires a multifaceted approach that integrates climate considerations into policy, planning, and practice, ensuring a resilient and equitable response to the challenges of CC.

Limitations and Future Scope

One of the key limitations of the study is the reliance on secondary data, which may be outdated, incomplete, or subject to biases inherent in the sources. This can affect the accuracy and comprehensiveness of the findings, as secondary data might not reflect the most recent trends or local variations in climate impacts. Additionally, the study may not fully capture regional differences due to the general nature of the data available, leading to potential oversights of specific local challenges. The complex interactions between environmental, social, and economic factors also present challenges, as simplifying these interactions for analysis might result in an incomplete understanding of their broader implications. Predictive models used in the study may also face limitations due to climate projection uncertainties and model assumption variations.

Future research should improve data collection and monitoring to provide more accurate and up-to-date information on climate impacts. Emphasizing primary data collection and validating secondary sources will help address the limitations associated with outdated or biased information. Additionally, more regional and local studies are needed to tailor adaptation strategies to specific needs and conditions. Developing more integrative models that account for complex interactions and conducting long-term, scenario-based research can enhance our understanding of future climate impacts. Translating scientific findings into actionable policies and integrating interdisciplinary approaches will support more effective climate strategies and solutions.

Conclusion

The study emphasizes the importance of inclusive and equitable climate action. Addressing the needs of marginalized and vulnerable populations is crucial for ensuring that adaptation measures are effective and just. Engaging communities in decision-making processes and ensuring equitable access to resources and support can aid in alleviating the disproportionate effects of CC. By incorporating principles of social equity into climate policies and practices, we can build more resilient societies that are better prepared to face the challenges of a changing climate while promoting fairness and justice. This approach enhances the effectiveness of climate action and contributes to a more cohesive and supportive global response to CC. In addition to addressing immediate challenges, fostering long-term resilience through interdisciplinary collaboration and innovation is essential. Integrating insights from climate science, public health, economics, and social sciences can provide a holistic understanding of CC impacts and enhance the development of adaptive strategies. Investing in research and technology to advance sustainable practices, such as renewable energy solutions and climate-resilient agriculture, will be critical for reducing gas releases and adapting to changing environmental circumstances. By prioritizing innovation and cross-sectoral collaboration, we can better equip ourselves to manage the multifaceted risks posed by CC and drive progress toward a sustainable future.

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