

Consequences of Climate Change at World Level: A Theoretical Review

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Abstract

IPCC defines climate change as any “change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or because of human activity” (IPCC, 2007a, p. 30). Climate change phenomena is very threatening which impacts the lifeforms and our livelihoods on this earth. The world has been experiencing frequent extreme environmental conditions. This phenomenon is not a frequent/instant event, it is a consolidated outcome of so many years due to anthropogenic and natural causes. The present paper reported the various causes and consequences of climate change at the world level. In fact, many organisation/committees/conferences were established to overcome the adverse effects of climate change and for the survival of the living organisms, respectively.

Secondary data is used to identify variability of climatic features and the same information from various reports, research articles, and other sources. This review is an assessment of climate change phenomena at the worldwide level. It is found that the government participation is necessary for the development processes. There should be some rules and regulations for developed and developing countries to overcome the variability of climate change. To sum up, mitigating the impacts of climate change must be of the utmost importance, and hence, this global threat requires global pledge to report its horrible consequences to safeguard global sustenance.

Keywords: anthropogenic factors, Climate change, Global warming, Greenhouse gases.

Introduction

The year of the Paris agreement witnessed severe environmental disasters (World Vision, 2015). That year was also reported to record the highest temperature during the 1880–2015 period (NOAA, 2015). According to the World Meteorological Organization (WMO, 2015) the human activities that brought harm to the Earth and strong El Niño effects could have aggravated the climate change effects in 2015. The increase in the severity and frequency of climate change disasters could attest to the urgency for all countries to step up their mitigation efforts. Anthropogenic global warming is caused primarily by emission of fossil fuels, most important amongst these carbon dioxides, which trap heat in the earth’s atmosphere. This warming is problematic for humanity for a variety of reasons, including rising sea levels, disruption of agriculture, extreme weather conditions, and loss of biodiversity (Anderson 2012;

Berners-Lee 2019; Klein 2014, 2019). The objective of the research paper analyses the theoretical review of consequences of climate change at world level.

The IPCC (IPCC, 2007a; 2007b) has provided international peer-reviewed scientific evidence for (amongst other findings) the following

- There is unequivocal evidence of the warming of the climate system, including increases in global average air and ocean temperatures, pervasive melting of snow and ice, and rising global average sea level
- Global mean temperature has risen approximately 0.76° Celsius since 1850 and continues to rise from decade to decade
- Changes in arctic temperatures and sea ice, widespread changes in precipitation amounts, ocean salinity and wind patterns are long-term changes already observed due to climate change; recent warming has already affected many natural systems on every continent and most oceans
- Concentrations of greenhouse gases (carbon dioxide, methane, and nitrous oxide) have increased strikingly since 1750 as a result of human activities (i.e., from deforestation, land use change, burning fossil fuels)
- Concentrations of other GHGs, including methane, nitrous oxide, and certain halogenated gases, have also increased as a result of human activities
- Increasing emissions will further enhance the greenhouse effect and result in an additional warming of the Earth's surface over the 21st century that will very likely be greater than the warming observed over the 20th century
- Climate models predict an increase of the global mean temperature between 1.1 to 6.4°C over the next 100 years, depending on future greenhouse gas emissions
- Extreme weather events including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones have also been observed and in many places are expected to become more frequent and/or intense as the climate warms
- Sea level is projected to rise by about 0.5m by 2100, and would continue to rise inexorably for many centuries in a warmer world (more recent studies suggest that this rise could occur even faster)
- The projected changes in climate will result in many negative impacts on ecological systems and socio-economic sectors, including e.g., food supply, water resources, and human health
- The impacts of climate change will be felt in all countries, but developing countries and some key ecosystems are generally most vulnerable

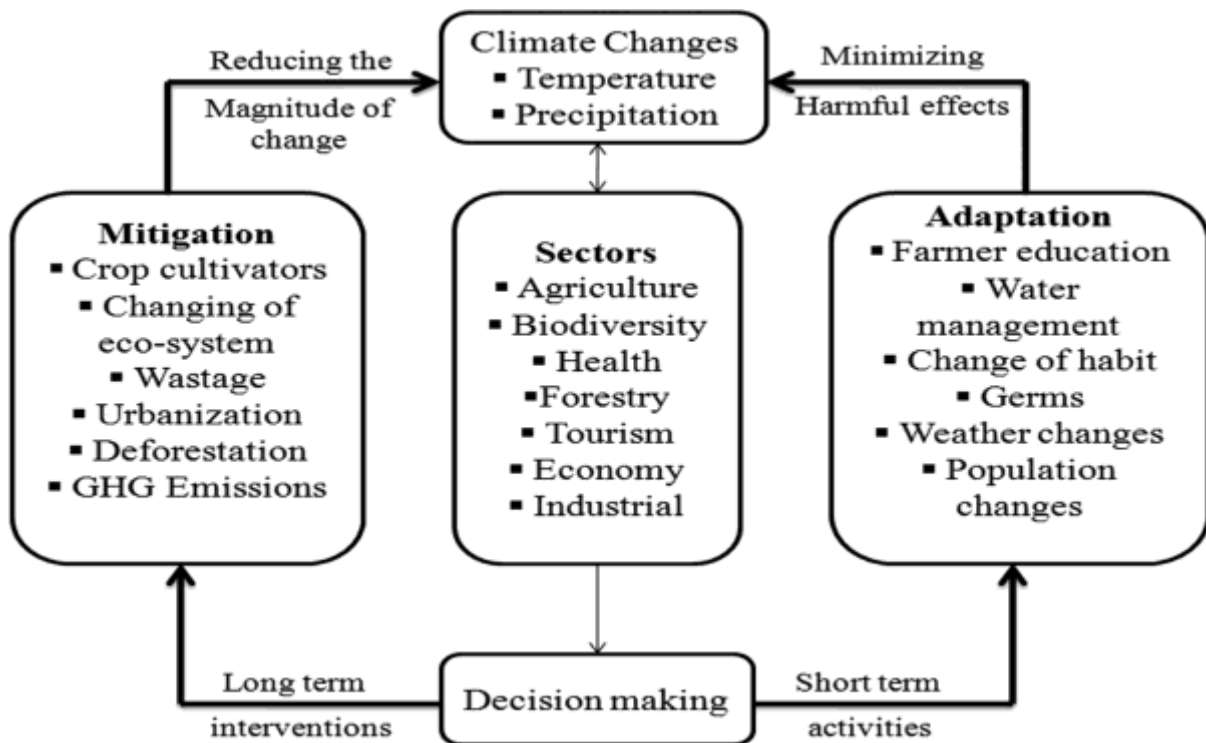
Indeed, IPCC revised its conclusion that most of the warming observed since the mid- 20th century is attributable to humans from *likely* (more than 66 percent probable) in the 2001 report to *very likely* (more than 90 percent probable) in the 2007 report (Collins et al., 2007). More worrying still is the fact that although very accurate, the 2007 IPCC report has been seen as too cautious as new scientific data is reported on unexpectedly rapid changes, such as the dramatic further reduction in Arctic Sea ice during 2007 and 2008 (Kintisch, 2009).

Nature also contributes to climate change by emitting CO₂ from volcanos. Volcanos do contribute to climate change by emitting CO₂. Secondly, Greenhouse gases are thought to be the main contributor to climate change (The Greenhouse Effect). They are very efficient in trapping heat into the atmosphere. Climate change has affected many aspects on the earth.

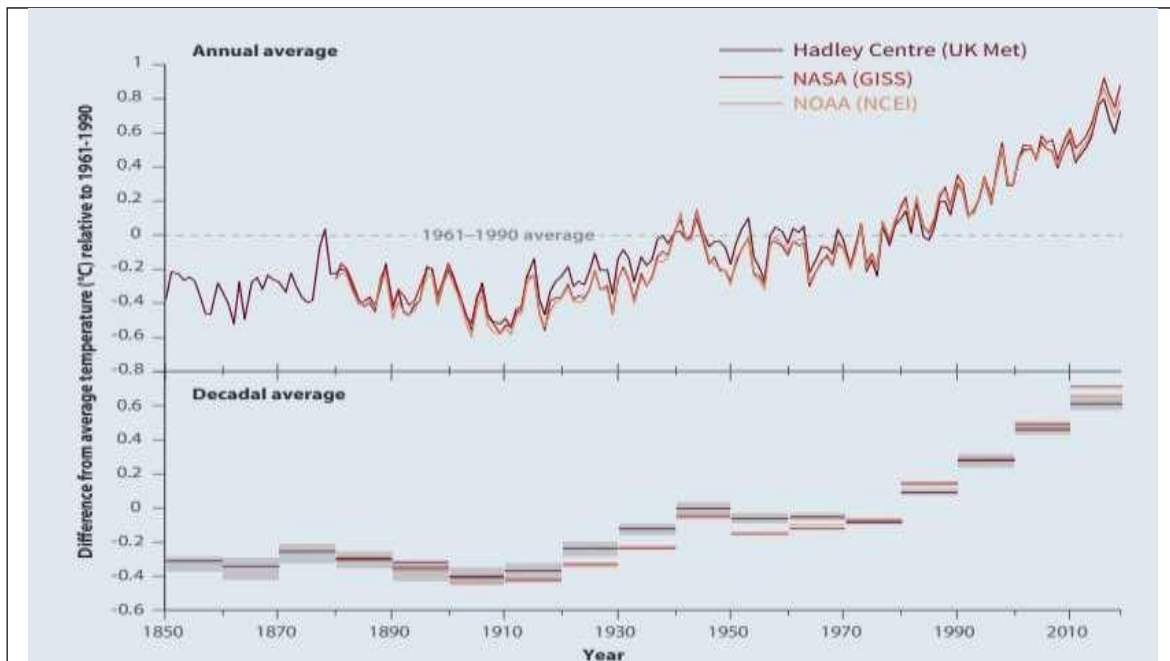
One aspect that has been greatly affected by climate change is the weather phenomena. It can be seen many areas in the form of tabular form (Table 1).

Table1: Aspects of Climate Change and perceived implications		
Climatic Features		Implications of Change
Global Warming	GHG concentration	Emission of Green House Gases thorough industrialization, travelling etc. is increasing the GHG concentration in the atmosphere. At this moment CO2 concentration is at its highest concentration in 650 000 years – 393 ppm [NASA, 2012]
	Change in world temperature	GHG concentration along with some other issues leads to warming the world. Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981 and with all 10 of the warmest years occurring in the past 12 years [NASA, 2012] Being central to the issue predominantly, Global warming brings about change in following different features of the human environment
Ozone layer depletion		A slow, steady decline of about 4 percent per decade in the total volume of ozone in Earth's stratosphere (the ozone layer) since the late 1970s is estimated which is likely to bring health implications (different cancerous diseases), augmenting extreme weather events (desertification, drought) through opening the curtain that was protecting earth from hazardous sun rays
Shrinking ice sheets		Greenland lost 150 km ³ to 250 km ³ (36 mi ³ to 60 mi ³) of ice per year between 2002 and 2006 and Antarctica lost about 152 km ³ (36 mi ³) of ice between 2002 and 2005 [NASA, 2012]. This on the other hand contributing to the next problem sea level rise.
Rise in Sea Level		Global sea level rose about 17 cm (6,7 in) in the last century [NASA, 2012]. Continual increase is very likely to inundate many island states, low-lying delta regions leaving their population having no land to inhabit.
Ocean Acidification		Since 1750 the CO2 content of the Earth's oceans has been increasing and it is currently increasing about 2 billion tons per year which has increased ocean acidity by about 30 % [NASA, 2012].
Warming Oceans		With the top 700 m (about 2300 ft) of ocean showing warming of 0,16 °C since 1969 due to absorbed increased heat of the Earth [NASA,2012]. These two changes are likely to bring massive change/destruction in ocean habitations.

Source: Table collected from Rahman, M. I. (2013). *Climate Change: A Theoretical Review, Interdisciplinary Description of Complex Systems* 11(1), 1-13, 2013, pp 4.



Source: Sectoral impacts of climate change with adaptation and mitigation measures. Abbass, K. et.al. I. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. Environmental Science and Pollution Research (2022) 29:42539–42559, pp. 42551



Earth’s global average surface temperature has risen, as shown in this plot of combined land and ocean measurements from 1850 to 2019 derived from three independent analyses of the available data sets. The top panel shows annual average values from the three analyses, and the bottom panel shows decadal average values, including the uncertainty range (grey bars) for the maroon (HadCRUT4) dataset. The temperature changes are relative to the global average surface temperature, averaged from 1961–1990. Source: NOAA Climate.gov, based on IPCC AR5. Data from UK Met Office Hadley Centre (maroon), US National Aeronautics and Space Administration Goddard Institute for Space

Studies (red), and US National Oceanic and Atmospheric Administration National Centers for Environmental Information (orange)

With reference to Himachal Pradesh, which recently endured *a tumultuous period battling extreme weather situations* leading to devastating landslides, widespread damage and collapse of several buildings. The hill state faced a challenging two months, marked by excessive rainfall in July, followed by two unprecedented spells in August. With over 400 lives lost, this was Himachal’s one of the worst disasters in the past 100 years. (The Indian Express, 2023). Three extreme spells (8 to 11 July, 14 to 15 August, and 22 to 23 August) and 163 identified landslides and 72 flash floods have been responsible for most of the impact. Kullu, Mandi, Shimla, Sirmaur, Solan and Chamba districts were some of the worst affected. It is the outcome of anthropogenic factors such as deforestation, unsustainable construction resulting in maximum damage in the rain-related events. We should not always see climate change as a factor to natural calamities.” Commercial felling of trees has been banned in the state since the 1980s but construction of local roads, national highways, four-lane highways, hydropower and other commercial projects are the major activities that are causing deforestation and biodiversity loss.

Himachal Pradesh: Unprecedented Monsoon, 2023	
	
Flood Thunag market on July 09, 2023.	Rescue work at Summer Hills, Shimla.
	
Himachal surpasses average rainfall for entire monsoon in 54 days (July 7 to 10)	Kullu: Landslide in Aani (24 th August, 2023)

Anthropogenic factors are the main reasons for highly destruction in the state such as The National Disaster Management Authority (NDMA) report highlights the strain of overpopulation in Shimla, originally designed for 25,000 but now accommodating around 300,000 residents. The report points to unsuitable planning for hilly regions and the adoption of Delhi Master Plans, criticized for neglecting environmental factors. Authorities should focus on systemic fixes instead of quick remedies for issues like landslides, as long-term benefits outweigh upfront costs. The report urges a shift from short-term engineering approaches to more sustainable solutions for landslide prevention.

State's Principal Secretary (Disaster Management) Onkar Sharma says that haphazard development is certainly a reason behind the state facing the worst natural calamity with the continuous cycle of cloudbursts (*A cloudburst has a very specific definition: Rainfall of 10 cm or more in an hour over a roughly 10 km x 10 km area is classified as a cloudburst event. By this definition, 5 cm of rainfall in a half-hour period over the same area would also be categorised as a cloudburst*), rains, landslides, and deaths. Officials in the state Disaster Management authority admit that the experts had warned the authorities repeatedly against mega development projects including four-lane projects that involved massive cutting and destabilization of mountain strata. The governments of the day ignored the warnings justifying the need to build road infrastructure to promote tourism, transport horticulture produce and build dams for power generation. The impact of climate change on the temperature in Himachal Pradesh and Uttarakhand is also significant with over 1 °C warming compared to the long-term average. Himachal Pradesh's average annual mean land surface air temperature during 2022 was 1.2°C warmer than its long-period average for the period 1981-2010. (The Hindustan Times, 2023)

Wadia Institute of Himalayan Geology (Dehradun) director Kalachand Sain reported that "The monsoon trough is very active over the Himalayas. There is often also a confluence or interaction with westerly disturbances which accentuates rainfall. Due to climate change, some high-altitude regions are recording significant rises in temperatures and hence a rise in the water-vapour holding capacity. There is a lot of moisture available." Hence when it rains, it pours. Sain added that across the region, the top part of the soil is environmentally weathered in most parts. "Very warm temperatures followed by cold temperatures—a cycle of thawing and freezing—is further degrading the topsoil. There is a lot of anthropogenic activity which can further put these regions at risk such as hill cutting, slope instability, heavy load, etc in areas where load bearing capacity is not assessed."

Himachal witnessed eight periods of extreme rainfall from mid-July 2023 to the end of August, 2023, breaking 100-year-old records in some districts, according to the state's weather bureau. According to Dericks P Shukla, Associate professor at the Indian Institute of Technology Mandi reported that "Due to global warming, the monsoon winds now carry more moisture from the sea along with dust and pollution from the plains. Himachal's bowl-like topography captures those moisture-laden clouds. This leads to excess monsoon rainfall in less periods. The result is flooding," Shukla explained.

Conclusion

To overcome the effects of climate, change the world must switch to renewable sources of energy are considered among the efficient solutions. Everyone individual must adopt the sustainable development goals to save the earth as it is directly or indirectly interlinked to safeguard the surrounding environment at developed and developing nations. The amount of warming is expected to increase with the cumulative amount of GHGs emitted, and thus the chances of encountering dangerous climate impacts grows with every extra ton we emit. At the same time, national and world demand for energy is on the rise, and new investments in energy infrastructure are inevitable (NASM, 2011).

Government of every nation take suggestive measures and introduce strict action at this level as decade to decade the temperature rises tremendously due to the manmade actions. Environmental and moral education should be taught at the school as well as college and university level so that the habits of caring our earth can be inculcate very early stages. Finally, researchers and organisation time to time share the potential areas of energy sources that cannot harm our earth.

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