punjab geographer

A DOUBLE BLIND PEER REVIEWED JOURNAL OF APG AND KSS-ISPER INDIA

VOLUME 21 ISSN: 0973–3485 OCTOBER 2025

CLIMATE CHANGE CRISIS IN THE HIMALAYAS: A CRITICAL ASSESSMENT OF MYTH VS REALITY IN THE HIMACHAL HIMALAYA

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Abstract

The state of Himachal Pradesh, located in the ecologically fragile Western Himalaya, is increasingly being recognized as a climate change hotspot. There are several myths prevalent at local level that consider climate change as a natural phenomenon. This study critically examines whether climate change in the region is a perceived myth or a scientifically validated reality. The study is based on systematic review of existing scientific literature, climatological datasets, policy documents, and regional case studies to assess the trends in the increase of temperature, precipitation anomalies, glacial retreat, and their socio-ecological impacts. A comparative matrix of myth-versus-reality has been constructed and it reveals a significant disconnect between perceptions of the communities and scientific evidence. The findings highlight that climate change is no longer a distant or theoretical concern but a lived reality in Himachal Pradesh.

Keywords: Climate change, Climate hotspots, Himachal Himalaya, Climate resilience, Myth versus reality matrix, Anthropogenic impacts.

Introduction

The Himalayan region, often referred as the 'Third Pole,' plays a crucial role in regulating and determining the climate of South-Asia in particular and influences the climate of the world in general. In recent times, rapid warming of the earth and resulting climate change have received global attention. Thus, global warming and climate change are two closely related phenomena. Global warming refers specifically to the long-term increase in average surface temperature of the earth due to human activities, primarily the emission of green-house gases (GHGs) (Houghton, 2001). While, climate change is an umbrella term that includes long-term changes in temperature, precipitation patterns, sea level changes and extreme weather events happening due to global warming (Dietz et al., 2020). Thus, global warming is a driver of climate change. The rising temperature caused by GHGs emissions has led to climate shifts that has disrupted natural as well as anthropogenic systems. Although, climate change is a worldwide concern, yet its impact is not uniform across the earth. There are certain regions known as hotspots of climate change that are more vulnerable to climate change because of their geographical, ecological and socio-economic conditions (Turco et al., 2015). These regions depict significant

changes in climate parameters such as temperature, precipitation, and intensity of extreme weather events. Studies suggest the Arctic region, the Himalayan and Hindu Kush region, Sub-Saharan Africa, Amazon rainforest, Australian interior, South Asia and Mediterranean basin as prominent climate change hotspots (Giorgi, 2006). In the light of above, this study has been taken to assess the myths verses reality about climate change in the Himachal Himalaya.

Objective of the Study

Major objective of the study is to critically examine the studies on temperature trends, precipitation anomalies, glacial retreat and their ecological impacts to evaluate whether the climate change is a myth or data-backed reality in Himachal Himalaya.

Database and Methodology

The study is based on the review of scientific literature and official climate reports of India Meteorological Department (IMD). It also draws insight from a diverse array of data, like peer-reviewed scientific journals (such as Climate Research, Current World Environment, and Annals of Glaciology etc.). Official government documents (e.g., the State Action Plan on Climate Change, IMD bulletins, Disaster Management Plans), and reliable grey literature and news media (Scroll.in, The Hindu, India Disaster Management Division), have also been accessed. Additionally, climatological databases like the IPCC AR6 datasets and Intergovernmental Panel on Climate Change (IPCC) and Indian Institute of Science (IISC) Climate Change Portal that provide robust statistical and temporal baselines about climate change have also been accessed.

Concept of Climate Change

Climate change is an umbrella term that refers to the long-term shifts and alterations in temperature, precipitation, wind patterns, and other aspects of earth's climate system. The occurrence of climate change can be attributed to various factors like natural internal processes, external forcings, or more dominantly, human-induced activities (anthropogenic factors) such as GHGs emissions, deforestation, and land-use changes. According to IPCC, (2021), "Climate change refers to a change in the earth's climate that can be identified by using statistical tests about changes in the mean and the variability in the properties of temperature that persists for decades or longer period." Similarly, United Nations Framework Convention on Climate Change (UNFCCC) defines it as a change in earth's climate which is attributed directly or indirectly to human activities altering the composition of the global atmosphere.

Types of Climate Change

When it comes to presenting a typology of climate change, it can be categorized in multiple ways based on factors, impacts, and timeframes. On the basis of factors of climate change, it can be classified into natural and anthropogenic climate change. Natural climate change is caused by natural factors like volcanic eruptions, changes in solar radiation, oceanic cycles (e.g., El Niño, La Niña), and orbital shifts of the earth (Milankovitch cycles) (IPCC, 2021; NASA, 2023). Whereas anthropogenic climate change results from human activities, such as burning fossil fuels, industrialization, agriculture, and urbanization. This is the dominant form of climate change observed since the 20th century (IPCC, 2021; Steffen et al., 2015). Similarly, on the

basis of the direction of change, the phenomenon is of two types; namely global warming and global cooling. Global warming is the phenomenon of increase in average global temperatures, particularly due to greenhouse gas accumulation in the atmosphere of the earth (IPCC, 2021). On the other hand, global cooling is a rare historical phenomenon caused by decreased solar radiation, changes in orbit of the earth, reduced vegetation cover, drop in greenhouse gases, volcanic activity or asteroid impacts (Robock, 2000). Likewise, on the basis of time scale, there can be short-term climate variability and long-term climate change. Short-term climate variability comprises events like ENSO (El Niño/La Niña), monsoon fluctuations, etc., which are spread across a timeframe of months to years (Philander, 1989). While, long-term climate change includes persistent change in climate over decades to centuries.

Global Indicators of Climate Change

The phenomenon of climate change is no longer a theoretical projection but a reality substantiated by a multitude of scientific observations across the globe that have been highlighted by scholars in their works. One of the most consistent indicators is the rise in global average temperature, by approximately 1.1°C since pre-industrial levels (IPCC, 2021). This warming, according to different studies, has manifested in the accelerated melting of glaciers and ice sheets, particularly in sensitive regions such as the Arctic, where sea ice is declining at a rate of 13 per cent per decade since the 1980s, and the Himalaya, where glaciers are retreating rapidly due to rising temperatures (Bolch et al., 2012; NASA, 2023). Another critical consequence is global sea level rise, which has increased by approximately 20 cm since 1900 and is currently rising at an average rate of 3.3 mm per year, posing severe threats to low-lying island nations such as the Maldives, delta regions of Bangladesh and coastlines of different nations (Cazenave et al., 2018). Simultaneously, the frequency and intensity of extreme weather events have surged. Recent catastrophic events indicating towards climate change include the Australian wildfires (2019-20), European heatwaves (2022), and Pakistan floods (2022), all are linked to changing climate dynamics (Hansen et al., 2012; Diffenbaugh and Field, 2013). Moreover, the oceans, which absorb approximately 25 per cent of anthropogenic CO_2 emissions, are becoming increasingly acidified, endangering coral reef ecosystems and marine biodiversity (Hoegh-Guldberg et al., 2007). Changing precipitation patterns have also been recorded globally, particularly in the monsoon-affected regions like South Asia, where rainfall has become more erratic, intense, and unpredictable, often interspersed with longer dry spells (IPCC, 2021). Finally, biodiversity loss has been accelerated by shifting climate zones, resulting in species extinction and forced habitat migration, especially in fragile ecosystems such as the Amazon rainforest and the Himalayan biodiversity hotspots (Yadav and Kumar, 2023).

Impact of Climate Change at Global and Meso-Level

Rising mean temperatures, altered precipitation patterns, accelerated glacial retreat, and biodiversity shifts are manifested with profound consequences both at the global and regional scales. At the global level, the approximate 1.1°C increase in average surface temperature of the earth since pre-industrial

times has triggered widespread cryospheric loss, sea level rise of approximately 20 cm since 1900, and intensification of extreme weather events such as heatwaves, cyclones, and floods (IPCC, 2021; Chand et al., 2019). Glacial retreat visible in the Arctic and Antarctic regions along with significant losses of snow in the mid-latitude mountain ranges, have been altering hydrological regimes and threatening water security for millions (NASA, 2023). Whereas, ocean acidification, driven by the absorption of nearly one-quarter of anthropogenic CO_2 emissions, has further disrupted the marine ecosystems, compounding biodiversity losses globally (Hoegh-Guldberg et al., 2007). At the meso-level like Himachal Himalaya, have witnessed region-specific impacts on glaciers like Bara Shigri and Chhota Shigri which are retreating at accelerated rates, increasing the risk of glacial lake outburst floods (Chand et al., 2019); precipitation regimes have shifted towards high-intensity, short-duration rainfall events, intensifying landslide and flash flood occurrences (Dimri et al., 2017). Rising temperatures have forced the altitudinal migration of apple cultivation zones, undermining traditional agro-economies (Saurabh et al., 2020; Rana et al., 2012). Moreover, biodiversity in the region is also facing increased vulnerability, with observable habitat fragmentation and species migration in response to changing climate (Sharma et al., 2008).

Study of impacts posed by different indicators highlights the necessity to categorize them to identify where urgent mitigation is essential and where adaptive strategies can be prioritized, offering a nuanced lens for climate resilience planning. On the basis of intensity, permanence, adaptability and their impacts, both at global scale and meso-level (Himachal Himalaya), the indicators of climate change have been categorised as drastic, alarming and chaotic (Table1). It must be mentioned that the indicators of climate change are inter-related to each other, where existence of one influence triggers the onset and occurrence of another indicator. Among these, the drastic indicators are most influencing, as they trigger both alarming and chaotic indicators of climate change.

Climate Change in the Himachal Himalaya

Despite mounting global concern, a segment of the population and even some policymakers in Himachal Pradesh remain uncertain about the extent and impacts of climate change. This perception is often rooted in short-term climatic variability and traditional ecological knowledge that associates climate change with cyclical natural patterns rather than anthropogenic causes (Chaudhary and Bawa, 2011). Local communities also believe that recent environmental disturbances are more attributable to deforestation, hydro-electric projects, or infrastructural expansion than to global climate change (You et al., 2017). In the absence of long-term, localized climatic data and isible dramatic changes in some areas, the perceived gap between scientific warnings and ground realities fuels the myth that climate change is a distant, global concern and not a local crisis (Mishra et al., 2019). Similarly, reliance on traditional weather prediction methods reinforces doubt regarding scientific climate change (Potdar et al., 2017). However, such perceptions, though understandable, often hinder timely adaptation and disaster preparedness, especially when the scientific data increasingly point to significant and accelerating environmental transformations in the region.

Table 1

Himachal Himalaya: Categorization of Indicators of Climate Change by Intensity of Impact

Components	Indicators	Global-Level Impact	Meso-Level (Himachal) Impact	Results
Drastic Indicators	Rising Mean Temperatures	~1.1°C global rise since pre-industrial era, contributing to accelerated ice melt and extreme weather.	+1.5–2°C rise over 50 years; altered cropping patterns and biodiversity shifts.	Direct, measurable long-term warming trend causing widespread ecological transformations.
	Glacial Retreat	Significant ice loss in Arctic, Antarctic, and mountain glaciers worldwide.	85% of monitored glaciers in Himachal retreating; increased GLOF risk.	Permanent loss of cryosphere mass with cascading hydrological and hazard impacts.
	Sea Level Rise / Hydrological Shifts	~20 cm rise since 1900; 3.3 mm/year increase threatening low-lying areas.	Seasonal variability in river flows affecting irrigation, hydropower, and water supply.	Irreversible large-scale change to water systems and ecosystem services.
Alarming Indicators	Altered Precipitation Patterns	Intensified rainfall extremes and prolonged dry spells globally.	Erratic monsoon, shorter winters, and concentrated high-intensity rainfall events causing landslides.	Impacts livelihoods and disaster frequency but allows scope for adaptation.
	Biodiversity Shifts	Global species migration, coral reef degradation, and extinctions.	Altitudinal migration of flora and fauna; increased forest fires.	Significant ecosystem disruption, but partial recovery possible through conservation.
	Agricultural Shifts	Shifts in agro-climatic zones globally; decline in crop productivity in sensitive regions.	Apple cultivation belt shifted upslope by 500–1,000 m; yield decline in traditional zones.	Affects rural economies and food security, but adaptation strategies exist.
Chaotic Indicators	Extreme Weather Events	Increase in frequency and intensity of cyclones, floods, droughts, and heatwaves globally.	Cloudbursts, flash floods, and landslides causing loss of lives, infrastructure damage.	Highly unpredictable, causing sudden large-scale destruction.
	GLOFs (Glacial Lake Outburst Floods)	Recorded in multiple mountain regions including Andes and Himalayas.	Increasing in Himachal due to unstable moraine-dammed lakes.	Short lead time for response; potential for catastrophic damage downstream.
	Cultural and Heritage Impacts	Global loss of cultural landscapes due to climate change.	Sacred groves, pilgrimage routes, and heritage sites disrupted by climate-induced hazards.	Erodes intangible cultural assets, affecting identity and community cohesion.

Source: Compiled by Authors.

Impacts beyond the Myth

Despite lingering myths and perceptions, the empirical evidence from Himachal Pradesh clearly demonstrates that climate change is manifesting through a range of tangible impacts across ecosystems, livelihoods, and cultural domains. Rising temperature is among the most evident indicator as the region is warming at a rate higher than the global average that is approximately 0.16°C per decade over the past century (Shafiq et al., 2024; IPCC, 2021). This warming trend has led to significant glacial retreat, particularly in the Parbati, Baspa, and Chenab basins, where glaciers have lost both the mass and surface area (Kulkarni et al., 2011; Shah and Ishtiaque, 2025). The consequent formation and expansion of glacial lakes have increased the risk of Glacial Lake Outburst Floods (GLOFs), posing serious threats to downstream communities and infrastructure (Wang et al., 2019). Similarly, snowfall patterns have become erratic, with declining snow cover and shortening winters, while precipitation is increasingly concentrated into intense, short-duration rainfall events, causing flash floods and landslides (Kumar et al., 2021; Ripple et al., 2023). These climatic shifts have direct consequences on agriculture, a cornerstone of rural livelihoods. In case of Himachal Pradesh, warming temperature is pushing apple cultivation belt to higher altitudes, leading to declining productivity in traditional orchard zones (Rana et al., 2012; Alam et al., 2022). Monsoon variability, delayed rainfall, and unexpected droughts further compound risks for rainfed crops and traditional farming practices. Similarly, forests and biodiversity are affected, as altitudinal shifts in species composition, increased forest fires, and habitat degradation as it has been reported across several forest divisions. Rivers originating in the glaciated zones, including the Sutlej and Beas, are exhibiting seasonal flow imbalances due to altered snowmelt and rainfall regimes, impacting irrigation, hydropower, and drinking water availability (Mishra et al., 2019). Beyond ecological and economic dimensions, climate change is also influencing spiritual and cultural environment. The Himachal Himalaya are regarded as sacred landscapes in local belief systems, and disruptions in seasonal cycles, are eroding the cultural fabric tied to the nature (Chaudhary and Bawa, 2011; Potdar et al., 2017). Yet, amidst these challenges, local communities are showing signs of resilience by adopting climate-resilient crops, engaging in afforestation drives, and incorporating scientific advisories into agricultural practices (Chaudhary et al., 2012). Thus, the multi-sectoral impacts of climate change in Himachal Pradesh clearly provide, data-backed evidence that the crisis of climate change is already in motion.

Myth versus Reality Matrix

Although there is a growing scientific consensus on the far-reaching impacts of climate change, perceptions at the grassroots level in the Himalayan regions, particularly in Himachal Pradesh often reflect a mix of traditional beliefs, anecdotal observations, and misinformation. These perceptions give rise to popular myths that dilute the urgency of action and impede adaptive responses. In many cases, these myths are rooted in the region's historical resilience, sacred geography, and relatively slower pace of urbanization, which has created a false sense of insulation about global climate change. To address these misconceptions, a myth-versus-reality matrix has been created

Table 2

Himachal Himalaya: Myth versus Reality Matrix

Variable	Popular Myth	Scientific Reality (Data-backed)	Impacts Observed
Temperature Trends	"Mountains are naturally cold, so they don't warm up like cities."	Himachal Pradesh has seen a 1.5-2.0 °C rise in mean annual temperature over the last 50 years.	Altered crop seasons biodiversity shifts, glacier melting.
Glacier Behaviour	"Glaciers are safe and permanent in the Himalayas."	85% of monitored glaciers in Himachal (e.g., Chhota Shigri, Bara Shigri) are retreating steadily.	Reduced water availability, flash floods, landslide risk increase.
Snowfall and Precipitation Pattern	"Snowfall has remained constant in Himachal."	Snowfall has decreased, while rainfall has become more erratic, often leading to dry winters and wet summers.	Reduced recharge of groundwater, shorter winter tourism season.
Rainfall Extremes	"Rainfall is steady and predictable every year."	Rainfall events have become high-intensity and short-duration, leading to frequent cloudbursts and landslides.	Damage to infrastructure, increased soil erosion, crop loss.
Crop Productivity and Agriculture	"Climate change has no impact on local farming."	Shifts in cropping patterns; apple belt has moved upward by 500–1,000 m in altitude due to rising temperatures.	Decline in yield, farmer distress, adaptation costs.
Forest and Biodiversity	"Forests and wildlife are unaffected in remote hilly regions."	Climate change has caused habitat fragmentation, species migration, and increased forest fire frequency.	Loss of endemic species, disturbed ecological balance.
Glacial Lakes / GLOFs	"Glacial lakes are harmless; they always existed."	Glacial lake outburst floods (GLOFs) have increased due to unstable moraine-dammed lakes expanding rapidly.	Sudden disasters, loss of lives and property downstream.
Human Resilience	"Mountain communities are resilient enough; they don't feel the impact much."	Vulnerability is increasing due to poor adaptation capacity, migration, and loss of livelihoods.	Migration to cities, decline in traditional livelihoods.
River Flow and Hydrology	"Himalayan rivers are perennial and immune to climate changes."	River flows have become seasonally variable; reduced snowmelt alters downstream water availability.	Water stress for irrigation, hydroelectric projects, drinking water.
Spiritual and Cultural Beliefs	"Nature and gods will protect the Himalayas; they are sacred and untouched."	Sacredness doesn't prevent climate-induced degradation; even religious sites are under threat due to flash floods.	Shrine damage (e.g., Kedarnath model), ecological degradation.

Source: Compiled by Authors.

that becomes a powerful tool for bridging the gap between community perception and scientific evidence (Table 2).

Conclusions

This study reaffirms that climate change in the Himachal Himalaya is not a speculative or exaggerated but a scientifically documented crisis. Persistent myths are rooted in traditional beliefs, spiritual perspectives, and anecdotal evidences. These misconceptions are not aligned with observable and measurable changes. Although, the myths about the invincibility of the Himalayas do persist, yet the data clearly reveal that Himachal Pradesh is experiencing significant ecological, hydrological, and cultural transformations due to climate change. Thus, the notion that climate change in the Himachal Himalaya is a myth stands refuted. The findings of this study call for urgent, data-informed, and community-engaged responses to ensure Himachal Pradesh's transitions from climate vulnerability to climate resilience. A strategic combination of scientific data, traditional knowledge, policy reforms, and public engagement is essential to transform Himachal's climate challenge into an opportunity for sustainable, community-led adaptation.

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