Global Scientific JOURNALS

GSJ: Volume 11, Issue 1, January 2023, Online: ISSN 2320-9186
www.globalscientificjournal.com

GLOBAL WARMING AND ITS IMPACTS: A STUDY OF HIMACHAL PRADESH (WESTERN HIMALAYAS)

Dr R S Gill, Associate Professor Department of Geography, Government College of Teacher Education Dharamshala Kangra HP

ABSTRACT

Climate change is a global phenomenon and their impacts are observed globally. But the two areas are highly vulnerable, coastal areas and mountainous areas of the world. Himalayas are the one of highest mountain range in the world and have fragile eco-system). The climate of Himalayas is highly effected by various factors like seasonal wind systems(monsoon), western disturbances, upper air wind circulation like Jet Stream, physiography, alpine glaciations, latitudinal extension, orographic impacts abnormal heating of land and water, formation of troughs and depressions, formation of El-Nino La-Nino Conditions in pacific regions etc. Western part of the Himalayas comprises Uttarakhand, Himachal Pradesh and Jammu & Kashmir have experiences multiple adverse impact of global warming and climate change. Observed impacts are abnormal precipitation, cloud bursting, glacial lake burst, flash flood, land sliding, forest fire, extinction and altitudinal shift forest zones, altitudinal shift of horticulture and agriculture and nomadic activities, shrinking of glacial area, extinction of small eco-systems and gradual altitudinal shift of tourist destinations. The Himalayan region evidently prove the shifting of horticultural plants to higher elevation with climate change. The Documentary “weeping apple tree” has elaborately explained the extinction of apple plans on the low heights due to global warming and climate change.

Key words: global warming, melting, flooding, droughts and Anthropogenic.

ITRODUCTION:

Climate change is a global phenomenon and their impacts are observed globally. But the two areas are highly vulnerable, coastal areas and mountainous areas of the world. Himalayas are the one of highest mountain range in the world and have fragile eco-system. The word “Himalaya” means “Adobe of Snow” is a spectacular range of mountains located in the subtropical high-pressure belt region of the planet earth and encompasses parts of eight South Asian territories of Afghanistan, Pakistan, China, India, Nepal, Bhutan, Bangladesh, and Myanmar. The Himalayas, with an average width of 300 km, stretches across a length of ~ 2500 km along the northern border of the Indian subcontinent, is a hotspot of hundreds of sky-piercing mountains of height >7000 m (Karan, 1966; Gritzner, 2010). It stands as a great physical barrier for the chilled continental air masses of arid central Asia from entering the Indian subcontinent (Kennett, 2006; Sharma, 2007; Ramisch et al., 2016). Size of glaciated area of the Himalaya catchment is about 30,000 km^2, which makes it the most substantial body of ice outside the polar caps. Hence, it is also known as the 'Third Pole' and 'Water tower' of Asia. The glaciers present in the Himalayas feed water to the numerous rivers like the Indus, Ganga, Brahmaputra, Yellow, Mekong, and Yang-Tze flowing across its length and breadth (IPCC, 2007). The climate of Himalayas is strongly influenced by different types of wind systems like a mesoscale cyclonic storm, western disturbances, monsoon winds, snowstorm, and high-speed other winds along with cloudbursts resulting sudden floods, causing the climate of this region quite unpredictable (Nandargi and Dhar, 2011). Western part of the Himalayas comprises Uttarakhand, Himachal Pradesh and Jammu & Kashmir have experiences multiple adverse impact of global warming and climate change. Observed impacts are abnormal precipitation, cloud bursting, glacial lake burst, flash flood, land sliding, forest fire, extinction and altitudinal shift forest zones, altitudinal shift of horticulture and agriculture and nomadic activities, shrinking of glacial area, extinction of small eco-systems and gradual altitudinal shift of tourist destinations. The Himalayan region evidently prove the shifting of horticultural plants to higher elevation with climate change. The Documentary "weeping apple tree" has elaborately explained the extinction of apple plans on the low heights due to global warming and climate change.

LOCATION

Himachal Pradesh is a state of the Indian Union at the extreme north of the Indian sub-continent roughly between latitudes 30°22′N and 33°12′N and longitudes 75°45′E and 79°04′E, occupying a region of scenic splendour in the western Himalayas. Himachal means Snowy Mountain (hima, "Snow", achal, "Mountain"). The state (Pradesh) taking its name from Himalayas. The state has an area of 55,673 sq.km and consists of 12 districts. The state is bounded by Jammu and Kashmir on north, Nepal and Tibet on east, Uttaranchal on southeast, Haryana on south and Punjab on west and southwest. The climate of the state varies from place to place depending on the altitude. It varies from hot and sub-humid tropical (450-900 m) in the southern low tracts, warm and temperate (900-1800 m), cool and temperate (1900-2400 m) and cold alpine and glacial (2400-4800 m) in the northern and eastern high mountain ranges. The state may be broadly divided into 3 geographical regions, viz. outer Himalayas, the lesser Himalayas and the greater Himalayas or the Alpines. The outer Himalayas includes the districts of Bilaspur, Hamirpur, Kangra, Una and the lower parts of Mandi, Sirmaur and Solan. The lesser Himalayas includes the parts of Mandi, Sirmaur and parts of Chamba, Kangra and Shimla. The Alpine zone is at an altitude of 4500 m and beyond, includes Kinnaur and parts of Lahaul and Spiti, Chamba districts. Elevation of areas of the state increases as we move from west to east and from south to north. The hills in the outer Himalayas are about 600 m above sea level. The inner Himalayas are marked by gradual elevation towards the Dhauladhar and Pir Panjal ranges and abruptly rises in the Shimla hills, to the south of which is the high peak of Church-Chandni (3647 m) and the rise is gradual towards the north of river Sutlej.

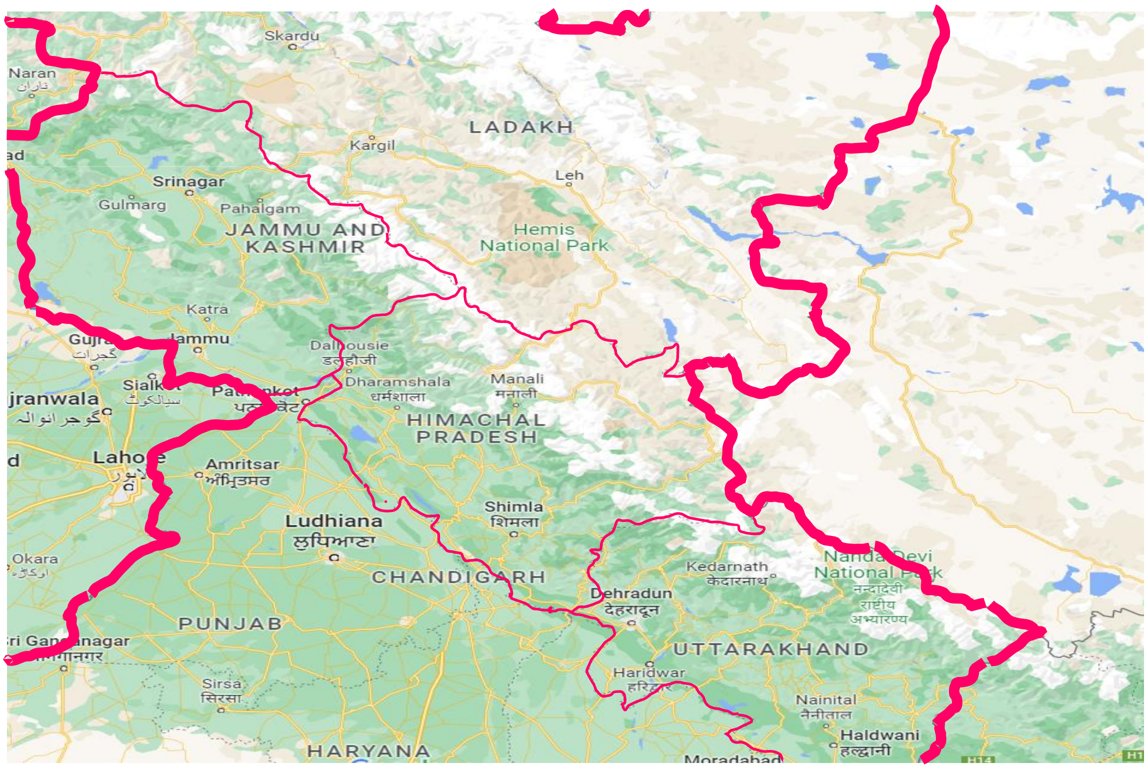

Figure 1 western Himalayan Region

Literature Review

Global warming is a climatic phenomenon that associated with rise in the temperature of atmosphere of earth. This associated with the abnormal increase in earth temperature. Changes in climate over short distances in mountains are reflected in large ecological gradients. AR5 reported new evidence that plant species of mid and low elevations were starting to colonise higher elevations in mountains, Since AR5, new studies have been published (e.g., Steinbauer et al., 2018; Payne et al., 2020), including in some previously less well studied areas such as the Andes (e.g., MoruetaHolme et al., 2015; Báez et al., 2016) and parts of Asia (e.g., Telwala et al., 2013; Artemov, 2018). There is now high confidence that many plant species' distributions have shifted to higher elevations in recent decades, consistent with climatic warming. In recent years publications have also started to show similar trends in some animal species, including birds (Freeman et al., 2018; Bani et al., 2019; Lehikoinen et al., 2019) and snails (Baur and Baur, 2013). Other climatic variables besides temperature can also affect elevational limits of species, and sometimes in ways that contrast with temperature, for example increasing precipitation can allow some species to occur at lower elevations in dry climates (Crimmins et al., 2011; Coals et al., 2018). Tsai et al. (2015) reported large changes in the montane bird community in Taiwan, which they link to changes in weather patterns, including more severe typhoons. Many studies available on the observed trends and variability of rainfall and also extreme rainfall events over India, but all the studies are based on past 100 years or more data and also the recent years are not included (Guhathakurta et al, 2015; Guhathakurta et al, 2011; Guhathakurta & Rajeevan, 2008 etc). Also, there are limited studies on district rainfall trends and variability of Uttar Pradesh state. In the present report all the analysis of observed rainfall patterns, trends and variability have been done based on recent past 30 years (1989-2018) that will help to have idea of the recent changes for climate change adaptation and management by the state authorities.

FACTORS AND THEIR EVALUTION

Change and rise in temperature, temperature (main controlling factors of water all weather phenomenon)

Rise of temperature has speedup the hydro-logical cycle-more evaporation→ more precipitation → more flowage (with increased runoff) →less recharge → less ground water and more damage to lives and property. The temperature of whole planet is rising (IPCC AR5 report shows an estimated warming of 0.85°C since 1880) Intergovernmental panel for climate change, AR4 estimated the average warming in the past century (1906-2005) was 0.74°C. Sharpest rise occurred between 1975-2010 (0.34°C). 1983-2013 was the warmest 30-year period for 1400yrs. By 2100 the temperature may exceed 1.5°C on earth surface. With the rise in the atmospheric temperature the solid form of water is highly affected (melting of huge ice block in high mountain reaches and polar areas). The Greenland, Antarctic ice sheets and Himalayan glaciers have losing mass in last decade. Resulted as rise in sea level. How precipitation and its extremes change as the climate changes are examined. There is a direct influence of global warming on changes in precipitation. Increased heating leads to greater evaporation and thus surface drying, thereby increasing intensity and duration of drought. However, the water holding capacity of air increases by about 7 % per 1ºC warming, which leads to increased water vapor in the atmosphere. Atmospheric temperature is an important factor that control the all phenomena on earth surface. As per IPCC AR 4 human influence has been dominant cause since 1950 for temperature rise. Recharge and input component is more important, Ozone depletion and increase in CFC Gases. Second increasement in the rate of evaporation and precipitation. High runoff erodes the upper permeable portion of the soil and affects the reserves of water resources.

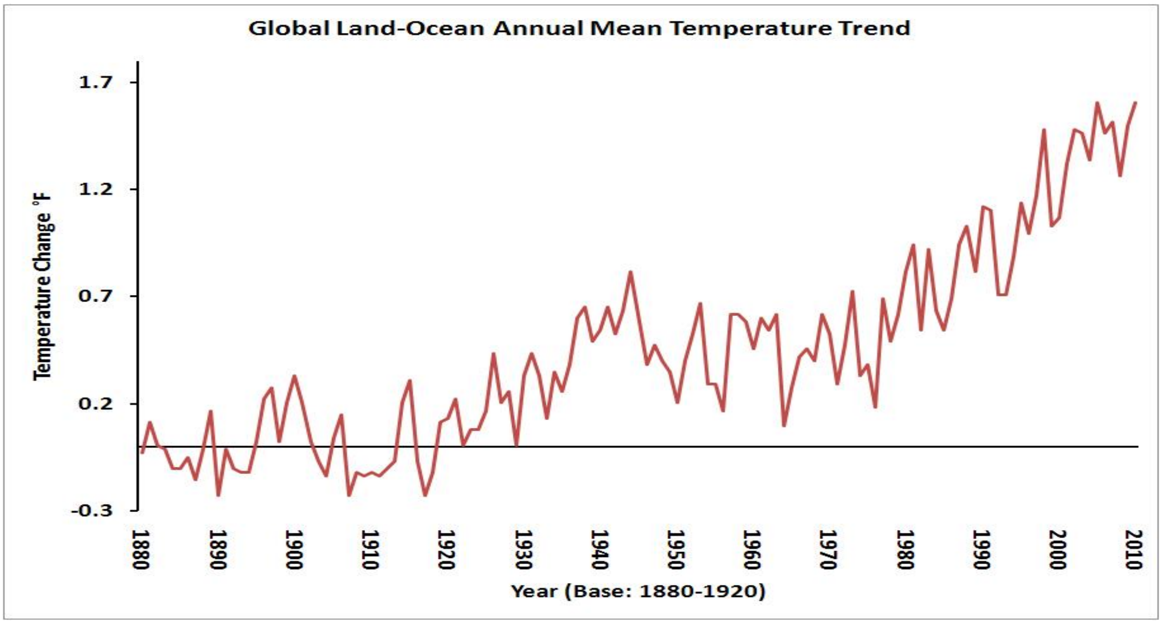

Figure 2

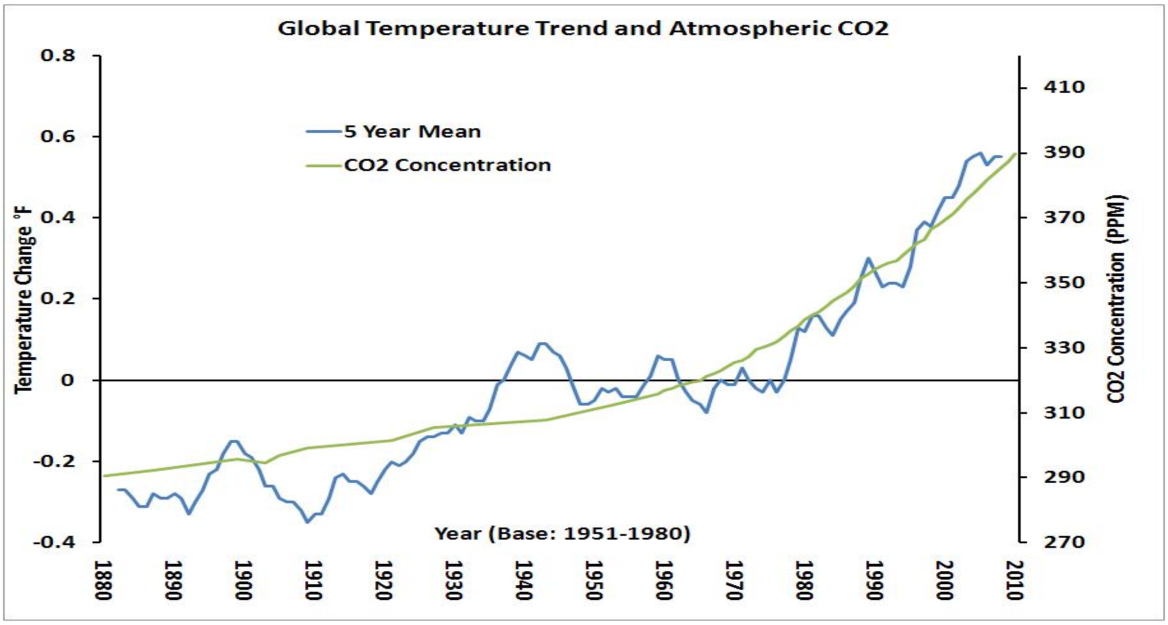

Figure 3

Impact and their Evaluation

Vegetation

Altitudinal shift of forest zones and mixing of different forest zones causes huge lose to mountain eco-systems. The Net effects of ongoing climate change with treeline advance and vegetation change on ecosystem carbon exchange, or possible effects on mountain hydrology, remain unresolved in the literature. Uncertainties remain regarding the effects of ecosystem-level carbon storage, given that above-ground biomass is higher in forests than in alpine vegetation and (new) trees may change soil carbon fluxes, for instance by introducing new soil organisms, thereby increasing soil carbon flux (e.g., Tonjer et al., 2021). The short- and long-term effects of combined warming and changed species cover on mountain soils are complex and insufficiently quantified (Hagedorn et al., 2019).

water

Sources of freshwater from mountains, such as rainfall, snow and glacier melt, and groundwater are strongly affected by climate change, leading to important changes in water supply in terms of quantity and, partly, quality and timing (e.g., shifts and changes in seasonality). In many cases, the effects on ecosystems and people are negative, e.g., creating or exacerbating ecosystem degradation, water scarcity or competition or conflict over water mainly in the foot hill areas. Many natural and gravitational kulh systems are badly affected. In middle and upper Himalayan region these gravitational irrigation channels dried due to climatic and human interferences in mountainous ecology.

Landslides and floods

People and Infrastructures are at Risks from Landslides and Flood. The amount of people and infrastructure at risk of landslides will increase in regions where the frequency and intensity of rainfall events is projected to rise (Gariano and Guzzetti, 2016; Haque et al., 2019). Extreme precipitation in major mountain regions is projected to increase, leading to consequences such as floods and landslide. Rain-on-snow events, which can accelerate all flood stages and result in widespread consequence for societies, are projected to increase between 2°C and 4°C GWL (but decrease afterwards) (SROCC Chapter 2 (Hock et al., 2019), AR6 WGI Chapter 12 (Ranasinghe et al., 2021)). There is high confidence that glacial retreat, slope instabilities and heavy precipitation will affect landslides and flood activities, although for landslides there are considerable uncertainties in the direction of change (Patton et al., 2019, AR6 WGI Chapter 12 (Ranasinghe et al., 2021) in case of Himalayas orographic impact also strengthen with the rise in temperature. Second with occasional formation of depression in the region may affect the intensity of precipitation in the area. The frequency of cloud bursts also increased.

ISSN 2320-9186

Figure 4.Kedarnath cloud burst Uttarakhand

Following events are also the result of direct or indirect impact of global warming and climate change. **Cloud Burst**: A **cloudburst** is an extreme amount of precipitation in a short period of time, sometimes accompanied by hail and thunder, which is capable of creating flood conditions. Cloudbursts can quickly dump large amounts of water, e.g., 25 mm of precipitation corresponds to 25,000 metric tons per square kilometre (1 inch corresponds to 72,300 short tons over one square mile). However, cloudbursts are infrequent as they occur only via orographic lift or occasionally when a warm air parcel mixes with cooler air, resulting in sudden condensation. At times, a large amount of runoff from higher elevations is mistakenly conflated with a cloudburst. The term "cloudburst" arose from the notion that clouds were akin to water balloons and could burst, resulting in rapid precipitation. Almost all areas of middle Himalayas are highly sensitive to cloud burst. Occasional incidents of cloud burst may be observed in other parts of Himachal Pradesh.

Figure 5 Collapse of Chakki bridge 2022, Figure 6. flash flood after cloud Burst in Dharamshala 2021

- Glacial lake outburst.
- Torrential rain falls
- Land slide and Blockade in river channel.

Increase in run off of river water.

70% rise in concretised surfaces increased flooding in Mumbai: Report Mumbai News

Updated on Sep 25, 2019 05:49 AM IST

Researchers said over the past 45 years, concretisation and filling up of wetlands that worked as flood absorbers has led to a 40% increase in the amount of rainwater entering stormwater drains that have not been rebuilt to handle the increased flow. Same effect In Himachal Pradesh the urbanization trend is follows:

Table-1

Himachal Pradesh

Census year	*Urban Growth (%)*
1971	6.99%
1981	7.91%
1991	8.69%

2001	9.8%
2011	10.03%

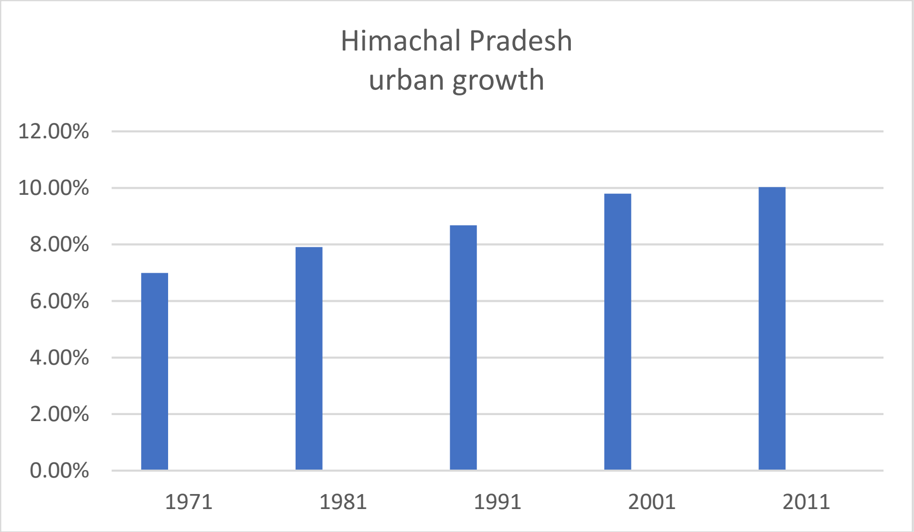

Figure 6

With rapid urbanization and concretization flowage and runoff gradually increased, and time water percolation process is also decreased. Over all in result……

- Rain-on-snow events (Leh and Kashmir flood, 6 August 2010 across a large part of Ladakh, Amarnath July 08, 2022 21:57:31 IST).
- Mixing of western disturbance with monsoon trough (Kedarnath cloud burst In June 2013).
- Altitudinal shift of snow line with rise in temperature, "The Weeping Apple Tree | Promote Documentary Film".
- Intrusion of riverine land scape in glacial land cape, when there is onset of rain in glacial areas with altitudinal shift of thermal zones in mountain areas with due effect of global warming. Outwash plain and morainal (recessional moraines) landscape converts in fluvial landscape. The huge debris flows with water causes blockade in river channels. This blockade and debris fill the river channel becomes cause of huge lose to property, lives, and landscape.

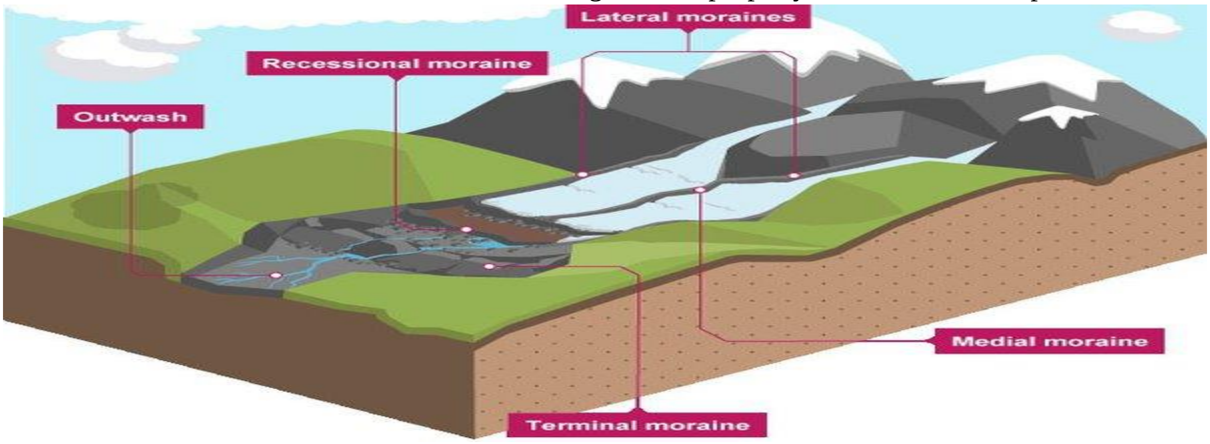

Figure 5. glaciated land scape

Shifting of agricultural/ horticultural zones

In Himachal Pradesh mainly Kullu valley evidently seen the impact of climate change, 30 years ago apple zone starts from Bajoura 1100mts and extended 80 kms towards Manali upto height of 1926mts and now this zone shifted 50 kms upward and starts from 1250mts Seubag and extends toward Manali lahual-spiti upto 3000mts. Farmer have started farming of palm, vegetables, peaches, cauliflower and tomatoes, this transition is very painful for farmer but the temperature is still rising. This is very harmful for the agricultural ecology. The Hurla village of kullu valley still remembering the whispering sound of apple trees. Now that event becomes horticultural history for the farmer as “A weeping apple tree”

– Changes in temperature and seasonal precipitation patterns are reported to affect nutrient depletion of soils and increased incidence of pest attacks in crops (e.g., in cases in the HKH and in Peru); however, there is generally limited evidence on directs links specifically to climate-related changes in mountain regions. This also observed in Himalayan off seasonal vegetable cultivation zones of Himachal Pradesh, e.g., Kullu-Manali and lahaul-Spiti etc.

– Climate-induced hazards, such as erratic precipitation (rain, snow and hail), floods, droughts and landslides, have negatively affected the stable supply and transport of agricultural products and horticultural products in and out of remote mountain areas, such as Kullu-Manali and lahaul-Spiti etc.

– Warming temperatures and changes in the timing of seasons and frost conditions needed for seeding certain tree crops (Apple) impact lower-elevation mountain areas, such as in lower belts of middle Himalayas in western Himalayan region.

– Drought conditions negatively affect mountain grasslands (medium confidence), as reported in cases in western Himalayan region.

– In some cases, climate-related hazards lead to outmigration in mountain areas, with indirect negative impacts on labour deficits to support agricultural practices and productivity in mountain areas (medium confidence) (e.g., Uttarakhand, Himachal Pradesh and Jammu & Kashmir)

– Positive impacts (favourable growing conditions) are reported for the production of some fruits and vegetables in Higher reaches of the middle and greater Himalayan regions due to rise in Temperature new areas of cultivation emerges on high altitudinal zones. Same as in Gilgit-Baltistan province of Pakistan and for the production of traditional crops (e.g., local beans) in the Karnali region of Nepal.

– Impacts on pastoralism include changes in growing conditions associated with warming temperatures and declining precipitation, which in turn lead to negative impacts on livestock productivity, food security and livelihoods of pastoralist communities, including drought-induced degradation of rangelands (medium confidence) in huge part of western Himalayas including Himachal Pradesh, which exacerbate impoverished conditions in pastoral communities

Forest Fire

The long-term implications of a warmer global climate, coupled with more frequent and/or severe fires in mountain ecosystems, are expected to be transformative for mountain biota. Fire-sensitive montane forests, such as Australia’s alpine ash (Eucalyptus delegatensis), are expected to become highly susceptible to population collapse and local extinction as intervals between fire events contract and become too short for species to reach reproductive maturity (Bowman et al., 2014; Enright et al., 2015)—an impact that will likely be further exacerbated by recruitment failure caused by post-fire drought and moisture deficiencies (Davies et al., 2019; Halofsky et al., 2020; Rodman et al., 2020). Fire and climate change are also likely to act synergistically in mountainous ecosystems, via positive feedbacks that increase fire frequency by changing vegetation composition to more flammable fuel types, thereby increasing landscape susceptibility to future fire (Camac et al., 2017; Tepley et al., 2018; Zylstra, 2018; Lucas and Harris, 2021). More frequent fires in these ecosystems will also exacerbate native and exotic species invasions (Catford et al., 2009; McDougall et al., 2011; Gottfried et al., 2012; Kueffer et al., 2013), faunal population declines (Ward et al., 2020), poor air quality (de la Barrera et al., 2018; Burke et al., 2021) and soil erosion and landslide risk (de la Barrera et al., 2018) and reduce freshwater catchment volumes and quality (Rust et al., 2018; Niemeyer et al., 2020), all of which will impact negatively on human health and well-being (Ebi et al., 2021). Himalayan areas are also most vulnerable to forest fire mainly in Autumn and summer season, coniferous forests are very much prone to forest fire. With the rise in temperature, unprecedented droughts in the area and less precipitation days fire incidents becomes more frequent in the region.

ISSN 2320-9186

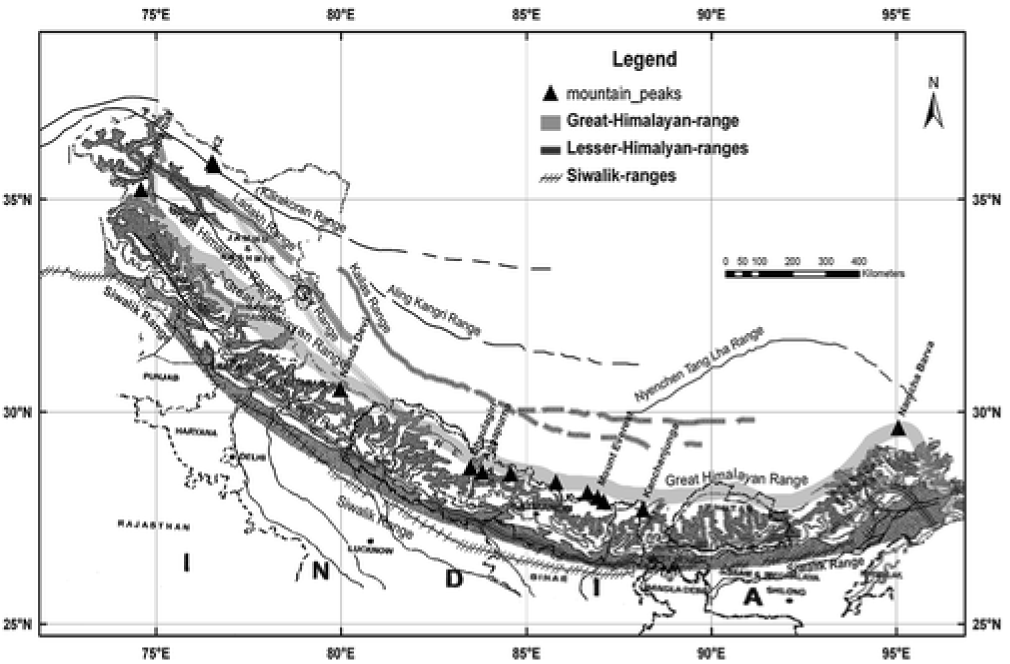

Figure 7

Precautions

– Recharging groundwater and adopting rainwater harvesting (including appropriate tillage methods to improve soil moisture),

restoration and rehabilitation of land,

diversification of agricultural crops (including introduction of stress resistant crop varieties), promotion of in situ (protected areas, conservation areas) and

ex situ (nurseries, gene banks, home gardens) conservation strategies,

afforestation and agroforestry.

Local knowledge is used to help maintain the productive and cultural value of mountain agriculture and pastoralism, such as in the French and Italian Alps, Western Himalaya in India and the mountains of northern Morocco. Fassio et al. (2014), Kmoch et al. (2018), Das (2021) Ecosystem- and community-based adaptations contribute to supporting the diversity and complementarily of management options, permaculture, and local capacities to adapt and support ecosystem functions vital for agrobiodiversity (medium confidence).

Since SROCC, the literature on climate change impacts on winter skiing tourism has remained dominated by studies focused on future climate change impacts and projected risks due to decreasing seasonal snow reliability (CCP5.3.1), most relevant when considering snow management and snow-making. Hock et al. (2019), Sauri and Llurdés (2020), AR6 WG1 Sections 9.5.3 and 12.4.10.4 – Climate-induced hazards in mountains, such as rockfalls, negatively affect access to some climbing, mountaineering, and hiking routes in summer (medium confidence), with cases mainly reported in the European Alps. Same as in Himalayan areas, Hock et al. (2019), Mourey et al. (2019, 2020)

Higher temperatures and extreme heat conditions at lower elevations have made some mountain destinations more appealing for human comfort, increasing the potential summer visitation demand and opportunities for tourism and recreation in mountains, such as in the European Alps and the Catalan Pyrenees (medium confidence) Himalayan regions. However, there is limited evidence on similar trends in mountain regions outside of Europe. Serquet and Rebetez (2011), March et al. (2014), Pröbstl-Haider et al. (2015), Steiger et al. (2016), Juschten et al. (2019a, b) CCP5 2288 Mountains The characteristics of natural hazards in mountain areas have been widely explored, and evidence suggests that conditions favouring cascading impacts are a common feature (high confidence) (Section 8.2.1.1) (Zimmermann and Keiler, 2015; Huggel et al., 2019; Kirschbaum et al., 2019; Schauwecker et al., 2019; Terzi et al., 2019; Motschmann et al., 2020a; Shugar et al., 2021).

Compound and cascading impacts have affected people, ecosystems and infrastructure and generate significant spill overs across numerous sectors, resulting in destructive impacts (Nones and Pescaroli, 2016; Kirschbaum et al., 2019; Schauwecker et al., 2019). Most adaptation responses to natural hazards in mountain regions are reactive to specific climate stimuli or post-disaster recovery (robust evidence, medium agreement) (McDowell et al., 2019; Rasul et al., 2020). Hard structural measures such as dikes, dam reservoirs and embankments have been widely employed to contain hazards, along with early warning systems, zonation, and land management (Box 4.1, 10.4.4.5, 12.5.3 and 13.2.2). Awareness raising, preparedness and disaster response plans are increasingly used in the context of more unpredictable hazard trends (see Cross-Chapter Box DEEP in Chapter 17) (Allen et al., 2016, 2018; Hovelsrud et al., 2018). Ecosystem-based adaptations (EBAs) are widely implemented to mitigate risks from shallow landslides (e.g., afforestation and reforestation and improved forest management), floods (e.g., river restoration and renaturation) (Renaud et al., 2016; Klein et al., 2019b) and droughts (e.g., adapting watershed) (Renaud et al., 2016; Klein et al., 2019b; Palomo et al., 2021). Evidence from different mountain regions shows that adaptation and risk reduction efforts are less successful if they focus on hazards or risks without considering diverse risk and value perceptions of the affected people (medium confidence) (French et al., 2015; Allen et al., 2018; Hovelsrud et al., 2018; Kadetz and Mock, 2018; Klein et al., 2019 b).

Previous experience and local social contexts of exposure to climate-related disasters affect people's perceptions and influence the patterns associated with disaster risk management and associated coping strategies (high confidence) (SROCC Chapter 2 (Hock et al., 2019)), (Kaul and Thornton, 2014; Shijin and Dahe, 2015; LanderosMugica et al., 2016; Wirz et al., 2016; Carey et al., 2017; Adler et al., 2019). Important synergies exist between disaster risk reduction, climate change adaptation and sustainable development in mountain regions (medium confidence) (Zimmermann and Keiler, 2015), where the multiple and diverse perceptions of risk and risk tolerance for natural hazards are relevant considerations (Schneider bauer et al., 2021).

Global agreements for integrated disaster risk management and climate change adaptation (Alcántara-Ayala et al., 2017), including the Sendai Framework for Disaster Risk Reduction 2015–2030 (UNISDR, 2015), the SDGs (UN, 2015), the Paris Agreement (UNFCCC, 2015) and the New Urban Agenda-Habitat III (UN, 2016), create opportunities for synergies to address disaster risks (see also Section 6.3). Although these agreements are well established in international agendas, there is limited evidence of their implementation to address disaster risk reduction and adaptation in mountains (Alcántara-Ayala et al., 2017). CCP5.2.7 Synthesis of Observed Impacts and Attribution and Observed Adaptations CCP5.2.7.1 Observed Impacts and Attribution to Anthropogenic Climate Change The assessment of observed impacts identified a large number of impacts across all major mountain regions of the world and for a large variety of systems, based on more than 300 references (SMCCP5.2). Overview of key observed impacts and adaptation on select livelihood activities and economic sectors References and relevant AR6 WGII sections Responses and adaptation

Diversification of tourism activities to non-snow activities has been reported as an adaptation approach to maintaining economic viability in some winter ski areas, partly due to the high cost of running snow-making infrastructure in winter, for example in the Pyrenees (Europe) and Australian Alps. Morrison and Pickering (2013), Sauri and Llurdés (2020) – In some cases, managing water resource availability and demand for snow-making is reported, with destination and large-scale governance highlighted as critical aspects for managing trade-offs, including overcoming conflicts arising from competing demands for environmental resources and land use (e.g., in French Alps and in Scandinavia). Demiroglu et al. (2019), Gerbaux et al. (2020) – For snow management, examples exist of dedicated climate services designed to enable better-informed decision- making on appropriate long-term adaptation (e.g., through a dedicated Copernicus Climate Change Service or real-time early was Climate change and mountain social-ecological systems

CLMIATE CHANGE DIRECT IMPACT INDIRECT IMPACT ADAPTATION OPTIONS IN MOUNTAIN REGIONS:

ISSN 2320-9186

- People in and around mountain regions depend on these services for livelihood, income generation, food, health, and well-being Mountain ecosystems provide vital services, including water, forest, carbon storage and cultural values
- Precipitation changes (e.g., drying up springs, erratic rainfall, cloud burst)
- Decreasing regeneration potential
- Threatening native and endemic species Shortage of fodder
- Declining livestock populations Climate induced hazards (e.g., landslides)
- Altering habitat conditions Increasing wildfire weather
- Decreasing quality and quantity of ecosystem products
- Decreasing pollinator diversity
- Promote conservation of native flora and fauna and their habitat restoration
- Promote water harvesting (roof top, rain water) and multi-purpose projects for disaster risk management
- Promote mountain products (wild edibles, medicinal plants, cash crops, ecotourism)
- Restoration of degraded land/wasteland
- Promote agroforestry practices Crop diversification/ crop change
- Education and awareness building
- Poverty Food, nutrition, and health insecurity
- Outmigration Increase in area of fallow land Help species to adapt and protect refugia.
- Impact of climate change on mountain social-ecological systems, including ecosystem services and products, livelihoods of mountain


The Tribune

HIMACHAL PRADESH

Gram pradhan loses life saving others, 7 of his f

Was sending WhatsApp messages to villagers when his house collapsed after being hit by landslide

Rain fury claims 22 lives in Kangra

DEATHS AND DAMAGE CAUSED

22 dead

₹128 crore

1,634

₹121.66 crore


अमर उजाला

हिमाचल में बारिश ने बरपाया कहर

21 लोगों की मौत, चक्की रेलवे पुल ढहा, 79 मकान गिरे, मणिमहेश यात्रा रोकी

333 MM IN 24 HOURS HIGHEST-EVER RAINFALL IN DHARAMSALA

316 MM ON AUGUST 6, 1958 THE LAST HIGHEST RECORDED

COLONIAL-ERA BRIDGE COLLAPSES

- Built by the British in 1928, a portion of the rail bridge over Chakki river in Kangra was washed away after a flash flood
- Seven trains would transverse daily between Pathankot and Jogindernagar on the track that was declared unsafe recently

A portion of the British-era railway bridge over the Chakki river in Kangra collapsed after flash floods in Kangra on Saturday. PTI

Landslips, flash floods kill 20 in HP

TRIBUNE NEWS SERVICE

SHIMLA, AUGUST 20

Twenty persons were killed while six others were missing in incidents of landslide and flash floods triggered by heavy rain in Mandi, Chamba, Kangra, Shimla, Kullu and Una districts of Himachal Pradesh since Friday night, officials said.

As many as 743 roads, including the Kalka-Shimla National Highway-5 (at Shoghi), have been blocked for traffic due to landslides.

In Mandi district alone, 11 persons were killed, the officials said. The bodies of eight members of a family were retrieved from the debris of their house after a four-hour long search operation by the National Disaster Response Force (NDRF) and the police at Kashan village in Gohar block. The bodies of two of the five members of a family washed away in flash floods at Sandoa village under Darang area were recovered. Another body was found at Bagi village.

Three members of a family were buried alive under the debris of a house, which collapsed at Chudana village falling in Banet area of Bhattiyat tehsil in Chamba district due to the downpour.

A 10-year-old child and migrant labourer were kille...

MONSOON MAYHEM 8 OF FAMILY AMONG 11 DIE IN MANDI | 743 ROADS BLOCKED

Vehicles hit by flash flood near Bagi nullah in Mandi. PHOTO: JAI KUMAR

मुल्थान, मणिकर्ण में फटे बादल, ब्यास में बाढ़ से मनाली में 30 मकान खाली कराए

कुल्लू के गोशाल में पुल बहा, वशिष्ठ में हेलिपैड क्षतिग्रस्त, ब्यास में फंसे तीन लोग बचाए, मंडी के दवाड़ा में आपात टनल से आवाजाही

प्रदेश में 44 सड़कें बंद, रात को मनाली की ओर से दारचा और लेह की ओर से सरचू में यातायात रहेगा बंद, 100 ट्रांसफार्मर भी ठप

मनाली में ब्यास में आई बाढ़ से बाहंग में खतरे की जद में आए मकान, जिन्हें प्रशासन ने खाली करवाया।

4 अगस्त तक भारी बारिश का येलो अलर्ट जारी

The Sunday Tribune
JALANDHAR | SUNDAY | 24 JULY 2022

HIMACHAL

Lease area not defined, illegal mining thrives in Paonta Sahib

DEEP NEXUS

AMBIKA SHARMA

SOLAN, JULY 23

Illegal mining on the Yamuna riverbed in Paonta Sahib subdivision of Sirmaur district is thriving in the absence of a defined mining lease area between Himachal and neighbouring Uttarakhand.

The leased area of Uttarakhand includes the left bank of the Yamuna. Though mining material is to be lifted only at night, shorter escape routes from Himachal, which is barely 10 m away, are used by illegal miners to carry quarry material on the sly during the day to Uttarakhand.

They end up exploiting the area in Himachal in the absence of a well-defined boundary. As such the mining area often overlaps in both states, causing disputes when officials from Himachal try to stop vehicles carrying quarry material from Uttarakhand.

Undefined leased area on the Yamuna riverbed often leads to dispute between HP and Uttarakhand.

EXPLOITING HIMACHAL

- The leased area of Uttarakhand includes the left bank of Yamuna
- Though mining material is to be lifted only at night, shorter escape routes from Himachal, which is barely 10 m away, are used by illegal miners to carry quarry material on the sly in Uttarakhand
- They exploit the riverbed in Himachal in the absence of a well-defined boundary.

TAKE UP ISSUE WITH U'KHAND

We have apprised the state government about ambiguities in the revenue records and requested it to take up the issue with the Uttarakhand Government. Though pillars are erected to demarcate the mining lease area, these are often damaged. Vivek Mahajan, SDM, PAONTA SAHIB

Rainfall 3 pc deficient, but losses highest in five years

TRIBUNE NEWS SERVICE

SHIMLA, AUGUST 28

Notwithstanding the devastation and damages worth Rs 1,721.35 crore caused by rains and landslides, the highest in last five years, the monsoon still remains 3 per cent deficient in the state this year.

Shimla district (over 46 per cent) has received the highest rainfall above the normal. It is followed by Kullu (over 42 per cent) and Bilaspur (over 12 per cent) districts. Meanwhile, Lahaul and Spiti district has received scanty rainfall with 61 per cent deficiency, followed by Una (-28 per cent) and Sirmaur (-24 per cent).

Interestingly, though the state has received 3 per cent deficient rains as compared to -13 per cent in 2021, -26 per cent in 2020, -10 per cent in 2019, the damage in terms of monetary loss has been the highest in the last five years.

A house that collapsed in Chudana village of Chamba district.

MONSOON DATA FOR PAST 5 YEARS

Year	2018	2019	2020	2021	2022*
Rainfall (in %)	+17	-10	-26	-13	-3
Human loss	343	218	240	476	270
House damage	5,160	3031	1346	1,976	902
Loss (in ₹ crore)	1,520.36	1,202.69	872.32	1,151.72	1,721.35

*FROM JUNE 29 TO AUGUST 26

The state had received 17 per cent surplus rains in 2018. While all the state highways have been restored, 76 link roads still remain disrupted as restoration work is being undertaken on a war footing.

The highest loss of 476 human loss was suffered in 2021 monsoons, followed by 343 in 2018, 240 in 2020 and 218 in 2019.

Heavy to Very Heavy Rainfall Events >= 204.5 mm in year 2021 Month-wise Rainfall during Monsoon Season-2021

Table-2

Serial no	Station name	Date	Rainfall Amount(mm)	Month	District
01	Shahpur	13-07-2021	264.0	July	Kangra
02	Dharamshala	13-07-2021	2296	July	Kangra
03	Palampur	13-07-21	210.2	July	Kangra
04	Palampur	19-07-21	230.0	July	Kangra

The average annual snowfall recorded in the state for all IMD stations for the year 2021 was 68.3 cm with the highest snowfall recorded as 460 cm in Gondhla in district Lahul Spiti.

SIGNIFICANT WEATHER EVENTS

Extreme weather events such as Extremely heavy Rainfall, Very Heavy Snowfall, lightning, thunderstorm, Hailstorm, Cold Wave occurred in HP during 2021.

Impacted Extreme Weather Events:

1. Heavy rainfall and flood-related incidents claimed over 55 lives in Himachal Pradesh ϖ There was loss of 55 lives in total due to floods, Heavy Rains and Landslides on account of Heavy Rainfall on 12,25,27 July and 11 August. Some other events led to the loss of 4 lives. There was no loss of Life on account of Lightning and Thunderstorm.
2. There were total of 11 Landslides as reported with the maximum occurrence in High hills with a annual frequency of 8. The number of occurrences has been maximum in Monsoon Season. A Total of 5 Cloud Bursts occurred during 2021 with the maximum occurrence observed in Kinnaur. The number of occurrences has been maximum in Monsoon Season.
3. Frequency of Occurrence of Landslides 2021 Frequency of Occurrence of Cloudbursts 2021 Low Hills Mid Hills High Hills Major Impact of Heavy Precipitation during Monsoon Season in HP District Place Damage Source Kangra Mcleodganj (Dharamshala) Car, bikes washed away. Shop destroyed Hindustan times/Outlook Magazine
4. Lahul Spiti Brahma Ganga NH-5 Block News/Media Lahul Spiti Mooring, Kwang and Kamring nullah SH-26(Tandi, Udaipur, Kadhu nullah) got blocked SDMA
5. Kinnaur Charang Khad near Rishpa village Two bridges got damaged SDMA

Annual District-wise Occurrence of Majors Extreme Weather Events Districts

Name of District	No Land slide	Lightning incidents	Cloud Brust	Flash flood
Bilaspur	2	1		
Chamba	4	1	3	2
Lahul-spitil	13	1	2	3
Kinnaur	9			
Mandi	14			
Kullu	6	1	2	
Shimla	25			
Simuar	3	1		
Kangra	5	1		
Solan	4			

6. Lahul Spiti Shakoli nallah (udaipur) Road Block SDMA
7. There were a total of 70 Western Disturbances (WDs) that impacted HP, with the maximum occurrence of 26 in the Pre monsoon season, followed by Monsoon season (20), Post monsoon (17), Winter season (10) ϖ The maximum number of WDs has been observed in the Pre Monsoon season. ϖ The thunderstorm activity was most frequent in Monsoon Season.

References

1. Range croft et al. (2013), Kaboosi and Kordjazi (2017), Hussain et al. (2018), Kalbali et al. (2019), Zkhiri et al. (2019), Beltrán-Tolosa et al. (2020), Torres-Batlló and Martí-Cardona (2020)
2. Oliver-Smith (2014), Hussain et al. (2016b)
3. Hussain et al. (2016b), Thapa and Hussain (2020)
4. Met Monograph No.: ESSO/IMD/HS/Rainfall Variability/10(2020)/34 CLIMATE RESEARCH AND SERVICES INDIA METEOROLOGICAL DEPARTMENT MINISTRY OF EARTH SCIENCES PUNE Observed Rainfall Variability and Changes over Himachal Pradesh State Pulak Guhathakurta, Nitin Narkhede, Preetha Menon, Ashwini Kumar Prasad and Neha Sangwan
5. (SROCC Chapter 2 (Hock et al., 2019), AR6 WGI Chapter 12 (Ranasinghe et al., 2021)).
6. SDMA Himachal Pradesh.
7. T. P. Sabin, R. Krishnan, Ramesh Vellore, P. Priya, H. P. Borgaonkar, Bhupendra B. Singh & Aswin Sagar 13 June 2020, Assessment of Climate Change over the Indian Region pp 207–222Cite as Climate Change Over the Himalayas.
8. EFFECT OF GLOBAL WARMING ON THE HIMALAYAN CRYOSPHEREA.V. KULKARNI Earth sciences and Hydrology Divis ion, M ESG/RESIPA, S pace Appli cations Centre (ISRO), Ahmedabad *(18) (PDF) EFFECT OF GLOBAL WARMING ON THE HIMALAYAN CRYOSPHERE*. https://www.researchgate.net/publication/238762849_ .
9. The Weeping Apple Tree (Vijay Jodha) - UKEFF 2005
10. Alford, D (1992) Hydrological Aspects of the Himalayan Region. Kathmandu (1994) Paraglacial slope adjustment and re-sedimentation following recent glacier retreat, Fabergstolsdalen, Norway'. Arctic and Alpine Research 26(3): 255-269.
11. J; Gyawali, D (1994) 'Himalayan water resources: ecological and political aspects of management'. Mountain Research and Development 14(1): 1-24
12. Barnett, Becker, A; Bugmann, H (eds) (1997) Predicting global change impacts on mountain hydrology and ecology: integrated catchment hydrology/altitudinal gradient studies, Workshop Report 43. Stockholm: International Geosphere-Biosphere Programme (IGBP)
13. Beniston, M (2003) 'Climatic change in mountain regions: a review of possible impacts. Climatic Change 59: 5-31
14. Bush, ABG (2000) 'A positive climate feedback mechanism for Himalayan glaciation'. Quaternary International 65-66: 3-13
15. Campbell, BD; Stafford Smith, BD (2000) 'A synthesis of recent global change research on pasture and rangeland production: reduced uncertainties and their management implications'. Agriculture, Ecosystems and Environment 82: 39–55
16. Chalise, SR; Khanal, NR; (2001) An introduction to climate, hydrology and landslide hazards in the Hindu Kush-Himalayan region.
17. In Tianchi, L; Chalise, SR; Upreti, BN (eds) Landslide Hazard Mitigation in the Hindu Kush-Himalayas, pp 51-62. Kathmandu
18. ICIMOD (2007b) Inventory of Glaciers, Glacial Lakes and Identification of Potential Glacial Lake Outburst Flood (GLOFs) Affected by Global Warming in the Mountains of the Himalayan Region (DVD ROM). Kathmandu:
19. ICIMOD IPCC (2007a) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.