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A STUDY ON THE CONSEQUENCES OF CLIMATE CHANGE WITH REFERENCE TO WESTERN HIMALAYAN REGION OF INDIA

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ABSTRACT

The serious problem of climate change has arisen due to the combustion of fossil fuels and over-exploitation of natural resources. If climate change is not stopped in time, millions of people will be victims of disasters like starvation , water crisis and floods. This crisis will affect the whole world. However, the most impactedregions by climate change will be poor countries. Along with this, such countries will suffer the most , which are least responsible for climate change. Backward and developing countries will be more prone to problems arising out of climate change.

Due to climate change and global warming, there is decrement in the average percentage of rainfall in the Western Himalayan region and also, the average temperature is increasing in every decade. The number of warm days has also increased as compared to those in last decades. It is a matter of concern for us that the glaciers of the Himalayan region are melting faster than the glaciers of other regions of the world. The current article highlights the consequences of climate change on the HimalayanWestern region.

KEYWORDS:

Himalayas, Climate, Environment

INTRODUCTION

The semi-western part of Himalayas is known as to be the Western Himalayas. It is particularly spread in the regions of north portion of Pakistan and some parts of North-West India. Its another name is Punjab Himalayas which is very popular in that region as four major rivers -Beas, Chenab, Jhelum, and Ravidrain through this part of Himalayas. The 5th river i.e. the Satluj river cuts through it.

The chief ranges of the Western Himalayas are Shiwalik, Dhauladhar, Zanskar Range, the Pir Panjal Range. Among these, Nanga Mountain is at the highest altitude with 8126m.

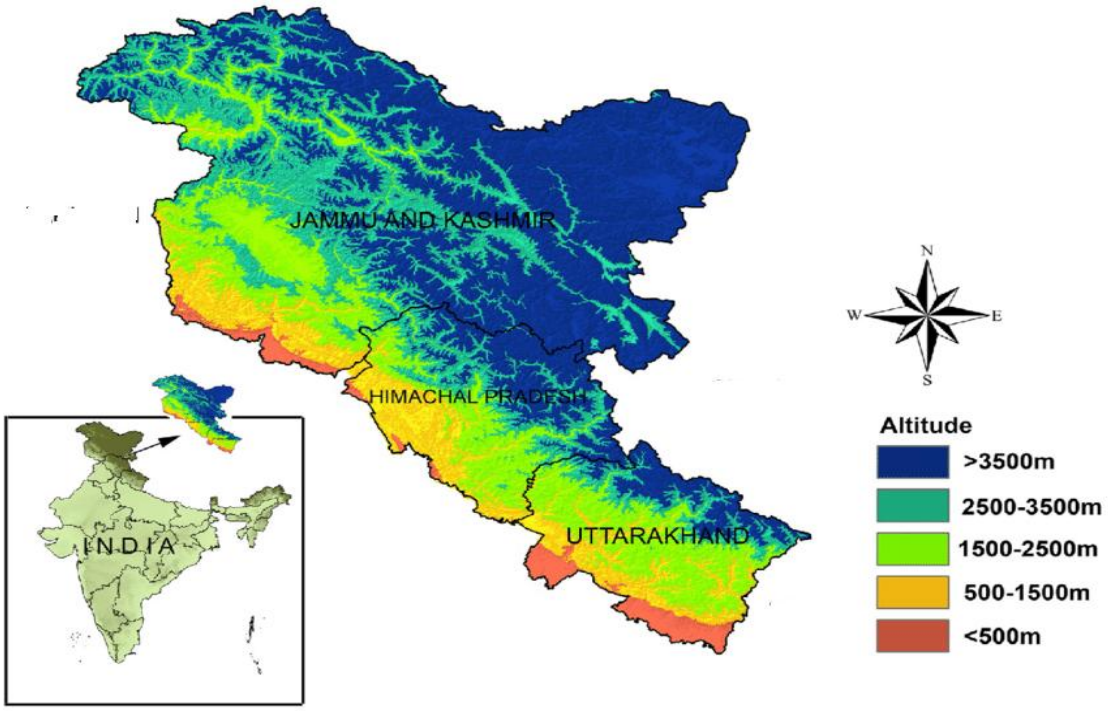

Figure 1: Location map of Western Himalayan

Source: https://www.researchgate.net/figure/Location-map-of-Western-Himalaya_fig1_276898758

A number of vegetations are found in the Western Himalayas. Most of the trees in this region are very long in height. The Shiwalik area is at a level of 500-1000m and some of the famous trees found here are Sal trees and rosewood.

In Ladakh, a number of dry steppes are found which are at a height of about 4000m. Above the level of 3000m, meadows are found. It mainly covers the areas of Uttrakhand and some parts of Himachal Pradesh.

The Indian Himalayan region is dwelling to around 5 crore people and it has a wide hydropower latent and feeds different relentless streams which depend upon the moderate presence of cold masses.

The sensitive scenes of the Himalayan region are incredibly unprotected to average risks, and there is consistent stress over stream and overall ecology, which could result into integration of floodings, dry seasons and weighty slides.

Mountain typical frameworks are essential for monetary new turn of events and human accomplishment. They provide different works to public and things including new water, food, lifesaving restorative things, energy, Bio-assortment and related standard data. Mountains are among the most sensitive and are generally fragile against shocking events.

The Western Himalayan region is home to one-tenth of the world's known higher altitude plant and animalspecies, and half of India's native plant species(Padma 2014).

Particularly rich in biodiversity are the Western Himalayas that includethe Indianstates of Himachal Pradesh, Jammu andKashmir, Uttarakhand and Sikkim, where elevationsvary from 300 m to more than 6000 m and wherethe mountains thus act as a natural barrier to speciesmigration (Padma 2014).

CONSEQUENCES OF CLIMATE CHANGE ON THE HIMALAYAN WESTERN REGION

The rainfall patterns as well as hydrological cycles over the Western Himalayan region are altered by rapid and high winter warming. Many studies haveshown that the winter warming over the Himalayan region was more (~ 1.41 °C) compared to the global average rate.

High-altitude locations of WHR are more sensitive to increase in temperature in winter season compared to the lower elevation and foothills because of presence of finer black carbon, aerosol particles and very large area under snow cover.

Being a mountainous region, the Western Himalayan region is prone to the vagaries of nature and the human interference. Some of the major hazards prevailing in this region are – Thunderstorm, Cloudburst, Forest fires and Glacial Lake Outburst Flood (GLOF).

TABLE 1: Various Findings by Scholars showing change in temperature in Western Himalayan Region

Brohan et al. (2006), Diodato et al. (2012)	Dash et al. (2007)	Dimri and Dash (2012)	Bhutiyani et al. (2007)
0.5 °C increase in the average maximum temperature (Tmax) during 1971–2005 compared to 1901–1960	Average increase of 0.9 °C in temperature during 1901–2003	Increase in maximum temperature between 1.1 and 2.5 °C	Increase of temperature 0.16 °C per decade during the 20th century

Source- Climate change effects in the Western Himalayan ecosystems of India: evidence and strategies by VP Tiwari

TABLE 2: Various Findings by Scholars showing change in Rainfall Pattern in Western Himalayan Region

Bhutiyani et al. (2010)	Sontakke et al. (2009)	Dimri and Dash (2012)	Rajeevan (2008)
Downward trend in monsoon and average rainfall during 1866–2006	Decreasing trend in monsoon and average rainfall during 1960–2006	Decreasing winter precipitation during December–February, increase in number of warm days, decrease in number of cold days, and rising trend in number of consecutive dry days in winter during 1975–2006	Increase in pre-monsoon precipitation during 1901–2003

Source- Climate change effects in the Western Himalayan ecosystems of India: evidence and strategies by VP Tiwari

RAINFALL STATISTICS OF THE WESTERN HIMALAYAN REGION

TABLE 3 showing Percent seasonal and annual departure of rainfall in Himachal Pradesh during 2004–2012 based on IMD annual climate summaries

YEAR	WINTER (IN %)	PRE-MONSOON (IN %)	MONSOON (IN %)	POST-MONSOON (IN %)	TOTAL ANNUAL (IN %)
2004					
2005	2	-44	-8	-99	-21
2006	-48	-41	-24	-45	-32
2007	-38	-11	-36	-77	-34.8
2008	-20	-59	-5	-51	-20.8
2009	-51	-46	-34	-36	-39
2010	-46	-36	13	-18	-8
2011	-32	-32	-11	-83	-23
2012	-9	-51	-16	-62	-25

The above data (arithmetic mean) has been recorded at 36 stations by IMD, which covers all the districts of the state Himachal Pradesh.

TABLE 4

HIMACHAL PRADESH: DEPARTURE FROM NORMAL RAINFALL IN MONSOON SEASON(2017-2021)

YEAR	ACTUAL RAINFALL (IN mm)	NORMAL RAINFALL (IN mm)	Percentage (%) Departure from the normal
2017	717.3	763.5	-6%
2018	927	763.5	+21%
2019	686	763.5	-10%
2020	567.2	763.5	-26%
2021	686.4	763.5	-10 %

SOURCE: METEOROLOGICAL CENTRE, SHIMLA

TABLE 5

UTTARAKHAND: DEPARTURE FROM NORMAL RAINFALL IN MONSOON SEASON (2015-2019)

YEAR	ACTUAL RAINFALL (mm)	NORMAL RAINFALL (mm)	Departure from normal (%)
2015	881.6	1229.2	-28%
2016	1102.7	1229.2	-10%
2017	1199	1229.2	-2%
2018	1194.3	1229.2	-3%
2019	960.4	1176.9	-18%

SOURCE: INDIAN METEOROLOGICAL CENTRE, NEW DELHI

RESULTS &DISCUSSION

The current study presents that due to climate change, the temperature level of Western Himalayan region is increasing from last few decades. The research shows that during the years of 1971-2005, there was a rise in average maximum temperature of 0.5 degree Celsius as compared to the average maximum temperature observed in the years 1901-1960. (Brohan, 2012).

On the other hand, if we observe the rise in the temperature in Western Himalayas during the years of 1901-2003 then we get the information that during these years, the rise in average maximum temperature was about 0.9 degree Celsius. (Dash, 2007)

A study done by Dash et al. (2012) suggested that avg. max temperature is between 1.1 and 2.5 degreeCelcius.

According to the research work done by Bhutiyani et al. (2007), there was an average increase in the temp in Western Himalayas was 0.16^0C per decade during the century. He further added that if the trend of increasing temperature still goes on then it would result in disaster in the end.

Previous research works done on the impact of climate change on the rainfall in the Western Himalayan region indicates that the level of rainfall is decreasing slowly slowly per year.

Bhutiyani et al. (2010) describe that there was fall in the tendency of Monsoon and average rainfall during the years 1866 to 2006 in Western Himalayan region.This was due to global warming and change in climate conditions.

Dash et al. (2012) mentioned that during the years of 1975 to 2006, there was serious fall in the winter precipitation during the months of December to February in Western Himalayas region. Also, during these years, there was mount in the number of warm days.

A study conducted by Rajeevan et al. (2008) revealed that during the years of 1901 to 2003, there was increasing trend of monsoon precipitation because of change in climate in Western Himalayas region.

In year 2005, there was collectively -21% decrement in the rainfall where the change in rainfall % during winter was +2% and the decrement was observed to be -44% and -8% during Pre-Monsoon and Monsoon season respectively.

In year 2006, there was collectively -32% decrement in the rainfall where the change in rainfall % during winter was -48% and the decrement was observed to be -41% and -24% during Pre-Monsoon and Monsoon season respectively and in year 2007, there was collectively -34.8% decrement in the rainfall where the change in rainfall % during winter was -38% and the decrement was observed to be -11% and -36% during Pre-Monsoon and Monsoon season respectively.

In year 2008, there was collectively -20.8% decrement in the rainfall where the change in rainfall % during winter was -20% and the decrement was observed to be -59% and -5% during Pre-Monsoon and Monsoon season respectively and in year 2009, there was collectively -39% decrement in the rainfall where the change in rainfall % during winter

was -51% and the decrement was observed to be -46% and -34% during Pre-Monsoon and Monsoon season respectively.

In year 2010, there was collectively -8% decrement in the rainfall where the change in rainfall % during winter was -46% and the decrement was observed to be -36% and 13% during Pre-Monsoon and Monsoon season respectively and in 2011, there was collectively -23% decrement in the rainfall where the change in rainfall % during winter was -32% and the decrement was observed to be -32% and -11% during Pre-Monsoon and Monsoon season respectively.

In year 2012, there was collectively -25% decrement in the rainfall where the change in rainfall % during winter was -9% and the decrement was observed to be -51% and -16% during Pre-Monsoon and Monsoon season respectively.

After analysing the rainfall pattern in Uttarakhand during monsoon season, it can be concluded that in the last 7 to 8 years, the actual rainfall has been negatively departing from the normal rainfall in the state. The departure from normal rainfall in 2015 was -28%. In 2018, it decreased to -3%. In 2019, a large departure of -18% was observed.

CONCLUSION

The current article is about impact of climate change on the Western Himalayas region. We concluded from this work that the problem of global warming and climate change is increasing in this region as the temperature is going in upward direction year by year. In the studies, it is found that there is a serious increase in the average temperature during the decadesin this region.

As a consequence of this climate change, the annual percentage of rainfallisdecreasing on yearly basis from past century. Thehuman pressure on the natural ecosystems of the Western Himalayas is intensifying, and this requires new research efforts, techniques and effective management strategies.

Also, thenegative environmental impacts of hydroelectric projects, whose numbers have continuously increased in the recent past in the Western Himalayan region, need to be assessed because it can escalate the process of climate change in the region.

If immediate actions are not taken to control this situation then its consequences would be dangerous for this Himalayan region as the number of floods would tend to increase due to melting of snow and rise in the water level in the rivers.

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