

# **Climate Change and its impact on Himalayan-Ganga Ecosystem: Past, Present and Future**

**R.B. SINGH AND SUBODH KUMAR**

**Department of Geography  
Delhi School of Economics  
University of Delhi, Delhi-110007  
E-Mail- rbsgeo@hotmail.com**

## TRENDS OF CLIMATE CHANGE THROUGH IPCC

- According to a 2001 Report of the Intergovernmental Panel on Climate Change (IPCC), scientists estimate that surface temperature could rise by 1.4° C to 5.8° C by the end of twenty-first century.
- The increase in the global temperature in the twentieth century was observed as  $0.6^{\circ} \pm 0.2^{\circ}$  C. This has started to affect the glaciers all over the world.
- Globally, the 1990s were the hottest decade, and 1998 was the hottest year since 1861. Moreover, the seven hottest years since 1861 all fell in the 1990s.
- Around the world, glaciers are thinning and retreating and sea levels are rising. During the 20<sup>th</sup> century, the sea level rose by 10 cm to 20 cm as perceived by Brown, 2001.

## TRENDS IN CLIMATE VARIABILITY

- Slight variation in mean climatic conditions can bring about large-scale changes in the environment in terms of increased frequency and intensity of the commonly occurring extreme weather events.
- In India, temperature increase was found mainly during post monsoon and winter seasons. The monsoon temperatures do not show a significant trend in any part of the country except for significant negative trend over Northwest India. Temperature shows cooling trend in the northeast and northwest India.
- Pant and Kumar (1997) have analysed the seasonal and annual air temperature from 1881 to 1997 and show that there has been increasing trend of mean annual temperature at the rate of  $0.57^{\circ}\text{C}$  per hundred years.
- Based on GCMs analysis, Lal (2001) suggests substantial increase of temperature and rainfall over India in next 100 years.

## Climate change projections for the Indian sub-continent

Scenarios	Increase in temperature (°c)	Change in rainfall (%)
<b>2020s</b>	<b>Annual</b>	<b>1.00-1.41</b>
	<b>Winter</b>	<b>1.08-1.54</b>
	<b>Monsoon</b>	<b>0.87-1.17</b>
<b>2050s</b>	<b>Annual</b>	<b>2.23-2.27</b>
	<b>Winter</b>	<b>2.54-3.18</b>
	<b>Monsoon</b>	<b>1.81-2.37</b>
<b>2080s</b>	<b>Annual</b>	<b>3.53-5.55</b>
	<b>Winter</b>	<b>4.14-6.31</b>
	<b>Monsoon</b>	<b>2.91-4.62</b>

Source: Lal (2001)

## IMPACT OF CLIMATE CHANGE

- Intensification of hydrologic cycle
- Increase in total rainfall, but a shift towards winter.
- More intense rainfall in fewer months and fewer hours
- More intense floods, more frequently.
- Longer and more intense summer. More demand for water.
- Slight increase in average temperature. Large increase in agricultural requirement.
- Fewer rainfall months water will have to be stored for longer durations.

## RETREAT OF GLACIERS IN UTTARANCHAL

GLACIERS	PERIOD	YEAR	TOTAL RETREAT(in mt.)	AVERAGE RETREAT (mt./ year)
Milam	1849-1957	108	1350	12
Pindari	1845-1966	121	2840	23
Shanklup	1881-1957	76	518	6.8
Poting	1906-1957	51	262	05
Glacier (3) in Arwa valley	1932-1956	24	198	20.8
Gangotri	1962-1991	31	620	20
Tipra Bamak	1960-1987	27	100	3.7
Dokriani Bamak	1991-2000	09	164.6	18.2

Source: Gergan, 2001

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## RETREATING GANGOTRI

➤ The Gangotri Glacier, India;  
Last 200 Years

➤ This composite image from  
the ASTER (Advanced  
Spaceborne

➤ Thermal Emission and  
Reflection Radiometer)  
instrument aboard NASA's  
Terra Satellite shows how the  
Gangotri glacier terminus has  
retracted since 1780.

(ASTER image courtesy of  
NASA EROS Data Center,  
September 9, 2001)





**Moraines in the river valley indicating glacial retreat 8**



**Snout of Gangotri Glacier which has exposed the area for periglacial activities after its retreat**



**Evidence of Avalanches showing glacial retreat**

**Increase in Snow melt**

**LONG TERM CHANGES**

**SHORT TERM CHANGES**

**Decrease in Snow Potential**

**Increase in Run-off**

**Decrease in Run-off and Discharge**

**Flood and Erosion in Highlands**

**Water Scarcity in Future**

**Flooding in Lowlands**

## Flood affected areas and flood damages in India (1953 to 2002)

Item	Unit Average	Flood Damage Average	Maximum Damage (with year)	Year
Area Affected	10 <sup>6</sup> ha.	7.38	17.50	(1978)
Population Affected	10 <sup>6</sup>	32.97	70.45	(1978)
Human Lives Lost	Nos.	1560	11316	(1977)
Cattle Lost	Nos.	91555	618248	(1979)
Cropped Area Affected	10 <sup>6</sup> ha.	3.48	10.15	(1988)
Value of Damage to crops	10 <sup>6</sup> Rs.	5969.65	25109.00	(1988)
Houses Damaged	10 <sup>6</sup>	1.19	3.51	(1978)
Value of Damage to Houses	10 <sup>6</sup> Rs.	1891.02	13078.9	(1988)
Value of Damage to Public Utilities	10 <sup>6</sup> Rs.	5662.36	31714.03	(1998)
Value of Damage to Houses, Crops and Public Utilities	10 <sup>6</sup> Rs.	13760.84	58459.80	(1998)

Source: Central Water Commission



## CONCLUSION

- The Himalayan-Ganga region is fragile and prone to climate changes.
- Disaster processes like Snow melting, soil erosion, slope instability, landslides and floods and risk from natural hazards are increasing.
- There is also a strong correlation between anthropogenic activities in the mountains and hazards in the plains such as floods.
- It is appropriate to apply Community Climate System Model version 3 (CCSM 3) for linking the effects of climate change on El Nino & consequently on Indian monsoon.
- It is important that steps for flood and drought management must go hand in hand.
- It is a well-known fact that floods in this region can be modified to a large extent by creating storage's and water harvesting structure in the upper reaches of the streams of these basins.
- Inter-linking of rivers with pragmatic approach should be promoted.