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CLIMATE CHANGE AND DISASTER RISK REDUCTION

Special Guidance

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CONTENT

Rainfall variability assessment over Bundelkhand region and its impact on rainfed agriculture

Akram Ahmed, Arti Kumari, S K Singh, and Surajit Mondal

Abstract

The present study is carried out over the Bundelkhand region, located in the central part of India which is susceptible to frequent drought and crop failure due to inter-annual rainfall variability. Gridded daily rainfall data resolution 0.25° × 0.25° for the period 1901–2013 has been analyzed to study the spatial variation of annual rainfall over Bundelkhand. A declining trend is observed in annual and monsoonal rainfall in most of this region which will be a challenge in mitigating the water requirements in *Kharif* as well as *Rabi* crops. Hence, arrangement for supplemental irrigation and intensification of water conservation measures is recommended for sustaining crop yield under this variable rainfall scenario.

1. Introduction

Normal rainfall deviation in a region has an enormous effect on the water availability for agriculture (Granados *et al*., 2017). Climatic variability in various parameters like precipitation and temperature etc. affects crop growth stages and thus, influences the crop yield. The frequency of natural hazards, particularly drought and flood events, has been amplified worldwide. Many a time, high-intensity rainfall events that occur in the offseason cause vast crop damage and put surgeon economic status of farmers. According to the Fifth Assessment Report of Intergovernmental Panel on Climate change (2014), there will be a worldwide increase in the number of monsoon break days and extreme rainfall events. A decline in the number of monsoon depressions and monsoon intensity and its frequency over India has been carried out extensively and some of them tried to link these parameters with climate variability (Vishnu *et al*., 2016). Various studies indicated the effect of rainfall variability on crop yield. Break days, spatiotemporal analysis of annual and seasonal rainfall and drought.

In this study, the continual spatial variation of annual and monsoonal rainfall and its trend over the Bundelkhand region has been studied based on fine-resolution gridded rainfall data, as well as its possible implications on rain, fed agriculture, and necessary advisories to mitigate the adverse effect of rainfall variability has been also discussed.

2. Materials and methods

2.1 Study area

Bundelkhand region, part of central India, comprises seven districts of Uttar Pradesh and six districts of Madhya Pradesh (figure 1).

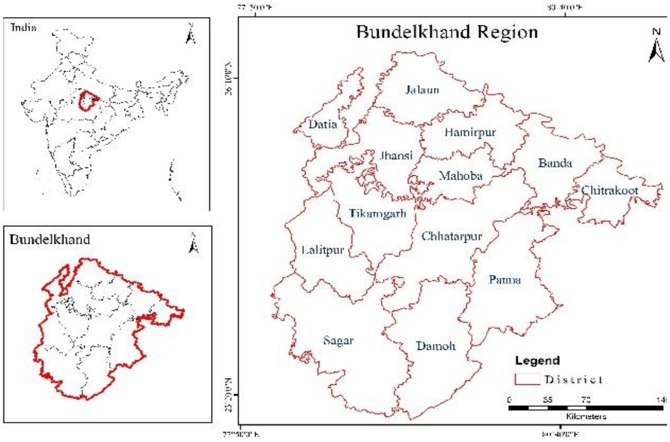

Figure 1: Location map of study area

The districts that belong to the state of Uttar Pradesh are Jhansi, Lalitpur, Mahoba, Chitrakoot, Banda, Hamirpur, and Jalaun while the districts Sagar, Damoh, Chhatarpur, Tikamgarh, Panna, and Datia come under Madhya Pradesh. The total geographical area of Bundelkhand is 7.16 million hectares. It is mostly an agrarian economy as about 82% of its population depends on agriculture.

2.2 Data used

Gridded daily rainfall data of resolution 0.25° × 0.25° for the period 1901–2013 acquired from the India Meteorological Department (IMD) is used in this study. Rainfall data of 156 grids spread evenly over Bundelkhand and its 30 km buffer area is studied.

2.3 Trend analysis

In this study, Modified Mann-Kendall (MMK) test (Hamed and Rao, 1998) along with the Theil-Sen estimator (Theil, H.,1992; Sen, P. K.,1968) is used for trend analysis of seasonal and annual taluk scale (a taluk is a subdivision of a district comprising of several villages) of Bundelkhand. A positive value of the MMK test statistic (Z) signifies a rising suggests a declining trend of the time trend whereas its negative value series variable. If a linear trend exists in

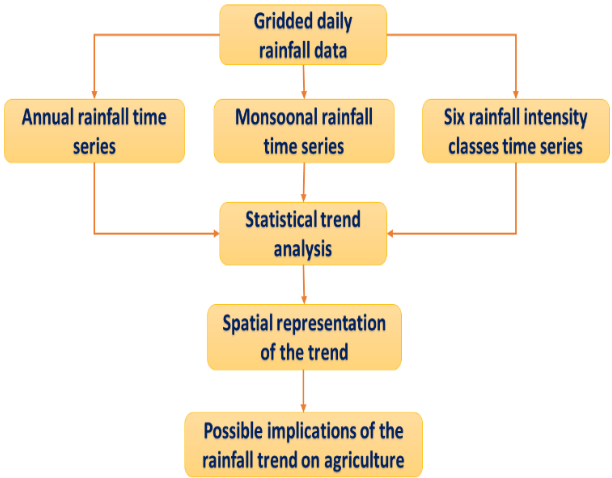

Figure 2 Methodology flowchart

rainfall time series data of 113 years at the time-series data, the magnitude of the positive or negative trend is assessed by a non-parametric test, known as Theil-Sen estimator. Besides, daily rainfall data of each year of each grid has been classified into six rainfall intensity classes based on Alpert *et al*. (2002). Time series consisting of data of annual occurrence of each rainfall class at each grid is also evaluated for trend. The inverse distance weighting interpolation method is used for representing the spatial variation of annual rainfall and its trend (Curtarelli *et al*., 2015). Besides, the spatial variation of the trend of each rainfall class is displayed over the study area. A flowchart describing the methodology used for carrying this study is shown in Figure 2.

3. Results and discussion

3.1 Annual rainfall variation and its trend analysis

Mean annual rainfall over Bundelkhand varies from 760 mm (lowest) to 1227 mm (highest) at Datia and Damoh districts, respectively (Figure 3). An increase in annual rainfall amount is observed from north to south of the study area. Trend analysis of annual rainfall time series displays a decreasing trend almost throughout Bundelkhand except in few places of Datia and Sagar districts where an insignificant increasing trend in annual rainfall has been detected (Figure 3).

The highest declining trend of 2.16 mm per year in annual rainfall was shown in Hamirpur taluk of Hamirpur district; Banda, Baberu, Karwi, and Mau taluks of Banda district and Lauri taluk of Chhatarpur district, whereas the lowest decreasing trend of 0.49 mm per year was shown in Jhansi and Mau Ranipur taluks of Jhansi district; Nivari and Jatara taluks of Tikamgarh district; Lalitpur taluk of Sagar district and

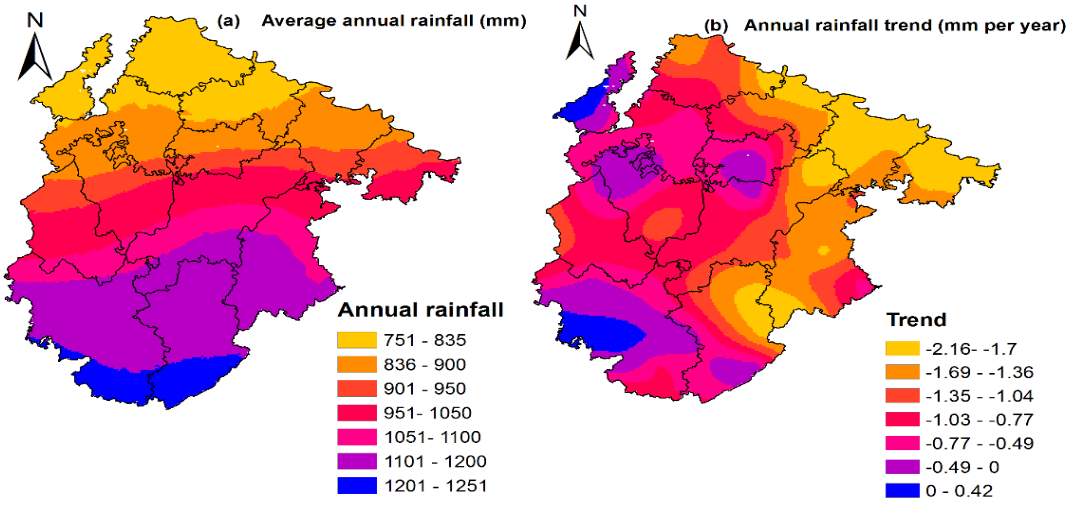

Figure 3 (a) Spatial variation of annual rainfall in mm (b) Annual rainfall trend (mm per year)

Damoh taluk of Damoh district. The monthly rainfall variation of Lalitpur district; Khurai and Rehli taluks and its trend over the Bundelkhand region can be shown in Ahmed *et al.* (2019). They have revealed that like annual rainfall, monsoonal rainfall is also following a decreasing trend in most parts of Bundelkhand.

3.2 Trend analysis of rainfall classes

On an average, the frequency of class 1 (0.1 mm day^{-1} ≤ intensity < 4 mm day^{-1}), was found to be 42 whereas, the frequency of classes 2 to 5 (class 2: intensity < 4 mm day^{-1}, class 3: intensity <32 mm day^{-1}, class 4: intensity <64 mm day^{-1}, class 5: intensity < 128 mm day^{-1}) was found to be 30, 12, 6 and 2 respectively, in a year. The occurrence of class 6 (intensity ≥ 128 mm day^{-1}) rainfall type was rarely found. While analyzing

the trend of time series of rainfall classes, it has been found that frequency of light to moderate rainfall class types, viz. classes 1 to 3 follow a decreasing trend in most places of Bundelkhand (Figure 4). No trend in rainfall class 4 was observed in the vast area of Bundelkhand. Few places located in the central part of Bundelkhand have shown an increasing trend for the rainfall classes 3 and 4, although none of the grids have shown a significant increasing trend for class 3. Almost no trend for rainfall class 5 was found throughout Bundelkhand except at two grids, of which one grid has shown a significant decreasing trend, and the other has shown a nonsignificant increasing trend. It was revealed that the occurrence of rainfall class 6 types is very less for the study period. Hence, no trend was shown for rainfall class 6 in any of the grids.

3.3 Implications of rainfall variability on rain-fed agriculture in Bundelkhand

Cereals (54.6%) are the major agricultural produce followed by pulses (32.4%), oilseeds (8.0%), sugarcane (0.2%), and other crops (4.8%) of this area. Among cereals, Jowar and wheat are mostly cultivated during *Kharif* and R*abi* season, respectively. Among pulses, urad and chickpea are mostly cultivated during *Kharif* and *Rabi* season, respectively. Groundnut is the main oilseed crop grown in this region during the *Kharif* season. *Kharif* crops of this region are mainly rain-fed. Pulses and oilseed crops are grown in this region greatly depends on monsoon residual moisture content. Monsoonal rainfall is the mainstay of *Kharif* agriculture of the study region. Decreasing trends in annual and monsoonal rainfall amounts will be a challenge in mitigating the water requirements in *Kharif* as well as *Rabi* crops and affects the rain-fed agriculture of Bundelkhand.

Several parameters derived from monsoonal rainfall such as monsoonal rainfall amount, cumulative rainfall amount in June-July, monsoonal rainfall onset date, etc. derived for Jhansi district have been correlated with groundnut yield to see their effect on groundnut yield. In this study, groundnut yield has shown the highest correlation with rainfall class 3 (0.46) followed by class 2 (0.31) than class 1 (0.10) and class 4 (0.05). It implies more influence of light to moderate intensity rainfall (classes 1 to 3) on groundnut yield compared to heavy rainfall class 4. Groundnut yield has shown a negative correlation with class 5 type (–0.0006) rainfall events and delays in the onset of monsoon (-0.13).

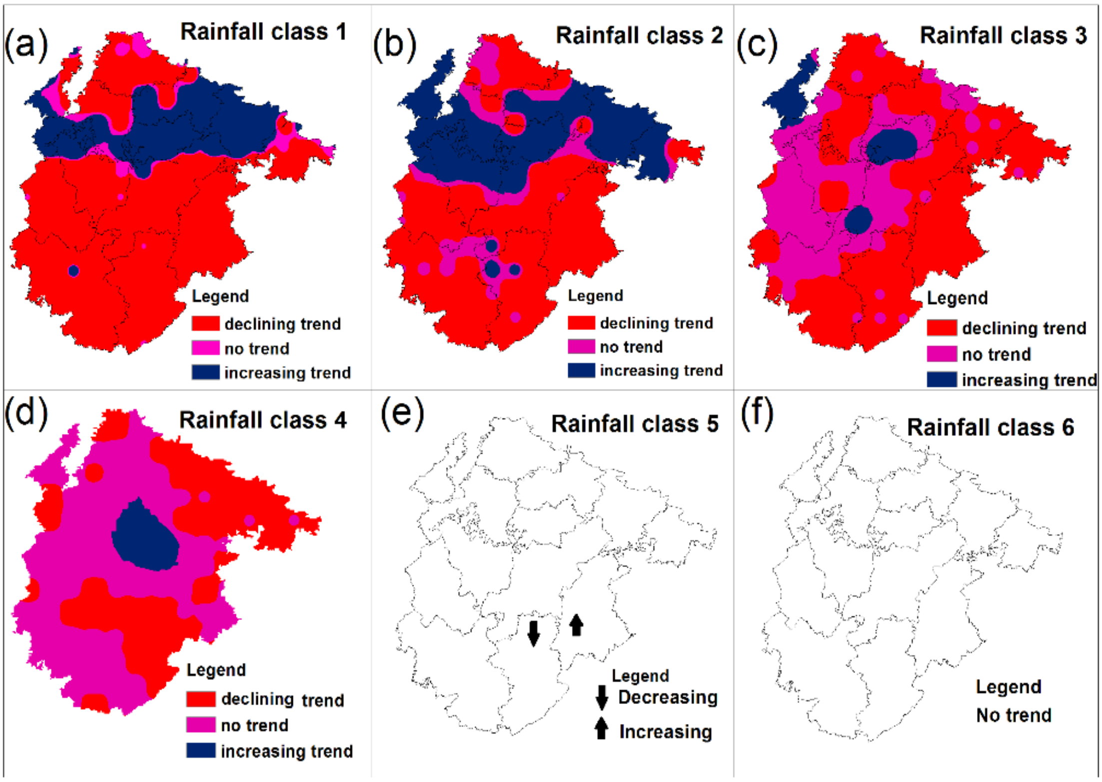

Figure 4: Spatial variation of trend of rainfall: (a) Class 1 (b) Class 2 (c) Class 3 (d) Class 4 (e) Class 5 (f) Class 6

3.4 Advisories for risk reduction in crop yield due to rainfall variability

The few advisories which are essential for risk reduction in crop yield are listed below:

- Promotion of improved drought-tolerant varieties of linseed, chickpeas, sesamum, lentil, dual-purpose Bundela Sorghum and pearl millet in areas where the more declining trend of rainfall is observed.

- There is also a need to promote agroforestry systems like agri-silviculture and silvopasture, particularly in degraded land to compensate for the crop yield loss by additional income in form of fuel-wood and fodder.
- Similarly, to deal with water stress, the soil and water conservation measures like mulching, raising bunds, gully plugs, check dams, ponds, etc. should be promoted.
- Promotion of fertigation system through drip and sprinkler as these modern irrigation systems has high water and nutrient use efficiency.
- Early forecasting of rainfall to farmers may be helping in scheduling application agricultural inputs such as irrigation water, fertilizers, pesticides, etc.
- Imparting knowledge to the farming community for sustainable management of natural resources.

4. Conclusions

This study shows that annual rainfall as well as light to moderate intensity rainfall events in most of the places in the Bundelkhand region is following a declining trend. It indicates a gradual drying up of the Bundelkhand region due to the declining trend of rainfall. A positive correlation between groundnut yield and frequency of light to moderate intensity rainfall events in a year and in addition, a declining trend in annual rainfall amount and light to moderate intensity rainfall events indicates a challenge to sustain rainfed crop yield in coming days.

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Issues and Impact of Climate Change with special reference to Coastal Population

Dr. Babita Kumari

1. Introduction

Our earth is very dynamic which continuously going through a continuous process of change because of various natural and anthropogenic factors, global warming (GW) and climate change (CC) are one of them. After the industrial revolution in the world, human has contributed as a most active agent to CC through the emission of greenhouse gases (GHGs) and aerosols, and through changes in various other anthropogenic activities like land use/land cover (LULC) changes, increasing global temperature (World Meteorological Organization, 2005). Climate model simulations of the effect of GHGs emissions are compared against the observed climatic variation in the past and their possible outcomes on natural phenomena are done by Climatologists. According to them, "there is strong evidence that the anthropogenic activities are mainly responsible for warming over the last 50 years and since mid-19th century average land and sea surface temperature has increased by 0.6±0.2˚C globally where most of the change had occurred since 1976 (Fig. 1), Intergovernmental Panel on Climate Change (IPCC, 2001).

There is variation in the rise in temperature on a regional basis, it may be greater or lesser than the global average of the rise in temperature (IPCC, 2001). For instance, warming in the United States is anticipated to be more than the global average, and the highest warming is expected over the Arctic (Georgi et al., 2001). The ten warmest years occurred between 1995 and 2005 since thermometer records became available in 1860 and after 1998, 2005 was the second hottest year on record, because of the influence of El Nino in the Pacific Ocean which contributes into a rise in temperature above than the average temperatures of the world (WMO, 2005). As per the Intergovernmental Panel on Climate Change (IPCC), the average global temperature is expected to increase by 2½ to 10 °F in the next century.

All seven continents and five ocean are affected by warming but mid and high latitude areas of the continent are most affected because of CC. Precipitation becomes more erratic, arid, and semi-arid areas are becoming drier, whereas other regions are becoming wetter and the frequency of the heaviest precipitation events have increased (Karl and Knight 1998; Mason et al., 1999). The little glimpse of CC that has occurred so far has already had comprehensible effects on an extensive diversity of natural ecosystems (Walther et al., 2002). The earth's climate is changing very fast and differently, these CC affect our lives socially, economically, and physically and the outcome of CC is more than a GW. The increase in average temperature in the single factor for massive changes which translates into extreme temperatures, flooding, storms, sea-level rise expected 0.11 to 0.77 meters by 2100 (IPCC, 2001), drought, the impact of agriculture or food production, and impact on health conditions, etc. The atmospheric temperature of the earth has increased due to a rise in GHGs emission, with the exact change differs regionally. The rate of emission of GHGs is responsible to increase the average surface temperature of the Earth which is about 0.2°C per decade.

Climate change can have an impact on the formation of a storm by regulating the difference in temperature between the poles and the equator. There will be a high risk of flood, droughts, and storms like tropical cyclones with devastating wind speeds, a wetter and erratic Asian monsoon, and, stronger mid-latitude storms (Pounds and Puschendorf, 2004). This difference in temperature provides the energy to mid-latitude storms which affect the most populated area over the Earth's surface. The Equator is already hot and humid so a slight change in temperature does not matter very much as on the poles, because at the poles the air is cold and dry and a little additional heat and water vapour can increase temperatures substantially. As per George Tselioudis, a research scientist at NASA Goddard Institute for Space Studies (GISS) and Columbia University due to this there is less temperature difference between the poles and the equator and because of a decrease in temperature difference the count of storms decrease. The pattern of CC can be observed worldwide and seen in the latest natural disaster in Haiti by hurricane Mathew. It is the strongest storm that hit Haiti since hurricane Cleo in 1964. About 1.125 million people were affected and around 546 people were died according to Haitian government figures (Stewart, 2017). This can also be equated with global climate change.

2. Impact of climate change on sea level

Rising sea level is the most severe catastrophic effects of climate change. The most important reason behind the rise in sea level is because of the melting of glacier and if sea level rising at the same rate then by the end of the century it maybe three feet higher than today (Levitus et al., 2005). Communities living in the low-lying coastal area are the major victims of the rising sea level. For instance, in Bangladesh, 17 percent area of the country would be flooded or even submerged by just a one-meter rise in sea level (Anthoff et. al., 2010). South-east and mid-Atlantic coasts of the united states are the most vulnerable area from rising sea level and not only this, but about 54 percent of its population lives close to the ocean are also lives at risk of inundation. Some other areas like North Carolina's Outer Banks, the Florida Coast, and much of southern California and Maldives are in risk (National Centre for Atmospheric Research, 2005). It is projected that the Maldives will face a rise in the level of 1.5 feet (half a meter) and about 77 percent of its land will be submerged by the 21st century

(Woodworth, 2005 & Tol, 2007) and If sea level rise by 3 feet (1 meter) then by about 2085 whole the Maldives could be submerged in the ocean (Anthoff et. al., 2010).

2.1 Cause behind sea-level rise

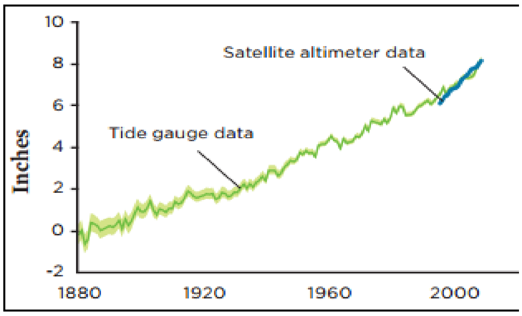

Figure 5 Average global sea level rise

Source : NRC, 2012; Church et al., 2011, Cazenave and Llovel, 2010

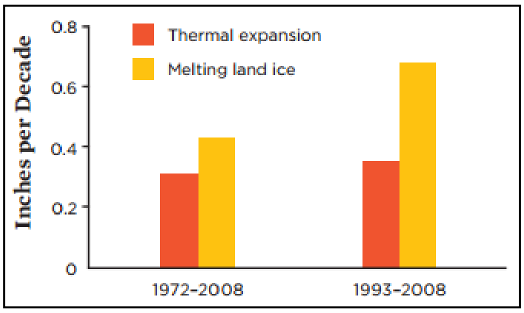

Figure 6 Contribution of climatic phenomena in sea level rise

Source : NRC, 2012; Church et al., 2011, Cazenave and Llovel, 2010

Since the industrial revolution global warming is the main cause behind the sea level rise. Anthropogenic processes like burning coal and oil and deforestation of tropical forests increase the concentration of greenhouse gases in the atmosphere which leads to the warming of the earth by 1.4°F since 1880 (Hansen et al. 2010). Ocean waters also get warm because of rising atmospheric temperature and 85 percent of the excess heat of the atmosphere have absorbed by the since 1880 (Levitus et al., 2001; Levitus et al., 2005; Levitus et al., 2009; Cazenave & Llovel, 2010). Ocean water expands when gets heated so the main cause of rising sea level for about 100 years after the beginning of the Industrial Revolution. Nonetheless, the contribution of thermal expansion in rising sea levels has reduced in the past few decades because of the acceleration of the melting of land ice (Lombard et al., 2005; Cazenave & Llovel, 2010). Two-thirds of the world's freshwater is stored in the form of Land ice glaciers, ice caps, and ice sheets and they are shrinking because of the rise in atmospheric temperatures (Trenberth et al., 2007). Indeed additional water causes a rise in sea level (Kaser et al., 2006; Meier et al., 2007; Cogley, 2009; EPA, 2012). About one inch of water added into the sea from 1993 to 2008 from the melting of glaciers, ice caps, and ice sheets which accounts for more than half of the increase during the said period (Church et al., 2011). Change in regional Ocean current because of submergence of land is another cause for seal level rise. These types of phenomena have effects on "hot spots" that are experiencing local sea-level rise more than the average, for example, the East and Gulf coasts of the United States (Sallenger et al., 2012; Milne, 2008). Global warming and climate change are the main culprits of the rise in sea level. Since 1880 there is about eight inches rise in sea level. Long term rise in sea level is recorded by tide gauges since 1870 and these trends are also confirmed by satellite observations since 1993 (blue line) fig.5. Melting of land ice glaciers, ice caps, and ice sheets contribute about 52 percent of sea-level rise between 1972 and 2008, whereas the thermal expansion of oceans accounts for about 38 percent, and the remaining 10 percent rise in sea level is because of the withdrawal of groundwater and other factors. Between 1880 to 2009 global sea-level rise approximately eight inches from and the decadal rise is about 0.8 inches from 1972 to 2008 (Church et al., 2011). The coastal region between Nova Scotia to the Gulf of Mexico experienced one of the rapid sea-level rise in the twentieth century from 0.01 inch yearly in Boston to 0.38 inch yearly in Louisiana (NOAA, 2012) fig. 6.

The global average absolute sea level (GMSL) change between 1880 to 2014 is shown in table 1. Average absolute sea-level change refers to the height of the surface of the ocean without taking into account the rise and fall of the nearby land surface. GMSL data are collected from CSIRO (Commonwealth Scientist and Industrial Research Organisation, 2015) and NOAA (National Oceanic and Atmospheric Administration, 2015). These data are showing a cumulative change in global sea level since 1880. Long terms tide gauge measurement and data measured from satellite imageries are used in the calculation of the GMSL data. Between 1880 to 2014 GMSL value increase from -62.48 to 28.07 inches. The average decadal growth rate of GMSL is about 17.4 percent and the highest GMSL change is 21.84 between 1990 to 2000.

Table 1 : Global mean sea-level change (GMSL) between 1880 – 2014

S. No	Year	Global Mean Sea Level (inches)	Decadal change rate (%)
1	1880	-62.48	19.29
2	1890	-58.07	18.82
3	1900	-51.22	19.72
4	1910	-49.76	18.73
5	1920	-43.43	19.64
6	1930	-41.85	18.67
7	1940	-36.30	17.30
8	1950	-26.50	16.58
9	1960	-17.44	19.01
10	1970	-15.71	14.14
11	1980	-6.50	10.00
12	1990	0.00	10.00
13	2000	9.84	21.84
23	2010	21.61	19.95
24	2011	21.50	-
25	2012	25.75	-
26	2013	26.73	-
27	2014	28.07	10.00

Source : EPA (the United States Environmental Protection Agency) CSIRO (Commonwealth Scientific and Industrial Research Organisation), 2015

2.1 Regional sea-level change

Changing the wind field and the associated change in ocean circulation are responsible for variation in regional sea-level change (Kohl & Stammer, 2008). There is spatial variation in sea level rise in the ocean. For example, there is a higher rate of rising in sea level in the western tropical Pacific and a decline in sea level in the eastern Pacific between 1993 to 2010 and also about 5.4 ± 0.3 mm/ year rise in the region between Japan and Korea, which is about two times higher than the GMSL trend (Kang et al., 2005). Tide gauge measurement is used to show the observed and projected relative change in sea level for nine coastal regions since 1970. The yellow color is showing the observed in situ relative sea-level values and the purple line is showing the satellite record. The shaded region is showing the projected range for 2006 to 2021.

In situ relative sea-level, value, and satellite records are almost similar in all region range between -0 to 0.2 m. Projected change in sea level is highest in New York between 0.3 to 0.9 m followed by Ijmuidin (a port city in North Holland) 0.2 to 0.8 m. At San Francisco, the projected value is about 0.3 to 0.8 m and in the Bay of Bengal, it is 0.3 to 0.7m. In Kinmen, China the projected range is also very high i.e. 0.3 to 0.8m. In Brest (France) and Mar de Plata (Argentina) the projected range is 0.3 to 0.7m and in Fremantle (Australia) and Pago Pago (the main island of American Samoa) the projected range is between 0.3 to 0.8m. fig. 3.

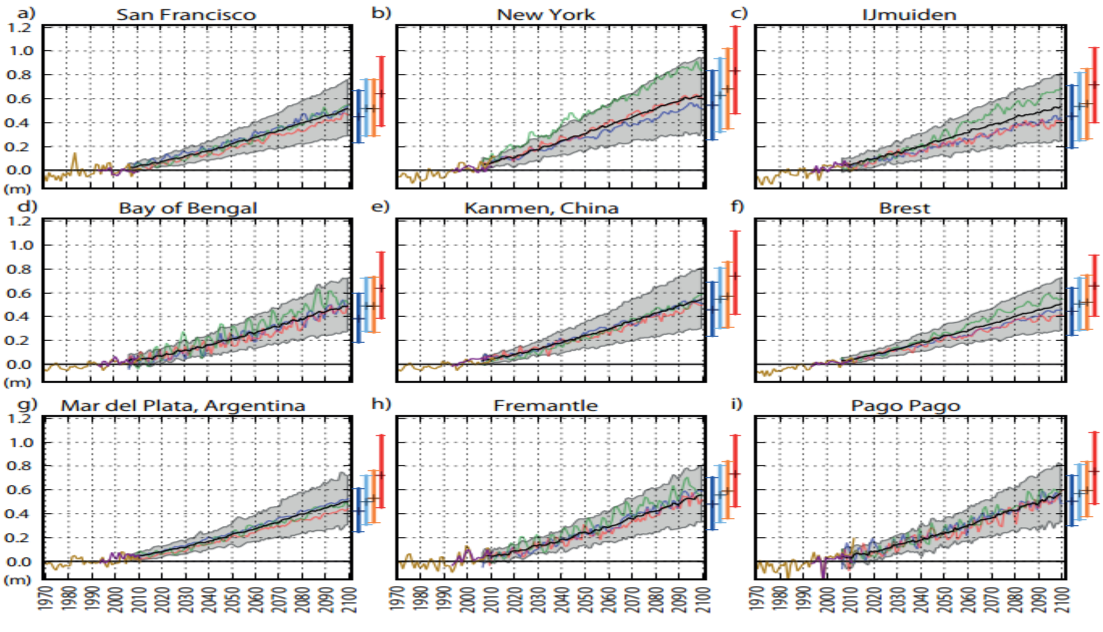

Figure 5 Regional sea level change, Source: IPCC report, 2013

3. Impacts on Coastal cities

According to the UN Atlas of oceans (2016), within 150 km of the coast around 44 % of the population of the world lives. The accelerated rate of population growth in coastal cities and increasing tourism add pressure on the coastal environment. In this regard, climate change makes the situation more vulnerable to coastal cities. Continuous coastlines lying in the low elevation coastal zone constitute only 2% of the world's geographical area but sustain 10% of the total population and 13% of the urban population of the (McGranahan et al. 2007). In low elevation, the coastal zone around 3351 cities is situated and amongst them, 64% are of developing region (CIESIN 2005). It is reported that around 90% of all coastal areas will be affected by varying degrees. In cities like Jakarta (capital of Indonesia) the ground has submerged 2.5 meters in the sea in less than a decade (Global Risk Report, 2019). In East and Southeast Asia, four out of five people will be affected by sea-level rise by 2050. More than 340 million people are living in "delta cities" like Dhaka, Guangzhou, Ho Chi Minh City, Hong Kong, Manila, Melbourne, Miami, New Orleans, New York, Rotterdam, Tokyo, and Venice are already facing the impacts of sea-level rise. Around 59.40 percent of the world's urban population is living in a low elevation coastal zone and prone to the risk of disasters caused due to climate change (Table 1).

In the case of India in 2019 only in India over thirteen states in late July and early August affected by flood leads to the death of 200 people and displacement of about a million people. The most badly affected state in 2019 by the flood was Karnataka and Maharashtra (NDTV, 2019). Besides flood global warming also causes an increase in the frequency of category 4 & 5 types of very intense cyclone over the 21st century (IPCC AR5). There has been about a 32% rise in the last 5 years and an 11% rise in the last decade in the occurrence of cyclone in the Arabian Sea and Bay of Bengal (Indian Metrological Department). According to the study of Scott A. Kulp and Benjamin H. Strauss of Climate Central, around 51 million people of India living in the low lying coastal zone will be affected by 2100 if global warming takes place at the same pace and portion of coastal cities like Mumbai, Surat, Chennai, and Kolkata will be submerged due to recurring floods by 2050.

Table 2 : Urban Population at risk of sea-level rise

Region	Urban Population (000s)	LECZ Population (000s)	Urban population in LECZ (000s)	% of LECZ urban to total urban	% of urban in LECZ
Africa	2,82,143	55,633	32,390	11.50%	58.20%
Asia	14,30,917	4,49,845	2,35,258	16.40%	52.30%
Oceania	2017	852	442	21.90%	51.90%
Developing Total	**20,34,706**	**5,39,908**	**2,92,738**	**14.40%**	**54.20%**
Europe	500943	50200	39709	7.90%	79.10%
N. America	2,55,745	24,217	21,489	8.40%	88.70%
Japan	1,01,936	29,347	27,521	27.00%	93.80%
Australia & New Zealand	18,002	2,845	2,421	13.50%	85.10%
Developed Total	**8,76,627**	**1,06,611**	**91,140**	**10.40%**	**85.50%**
World Total	**29,11,333**	**6,46,519**	**3,83,878**	**13.20%**	**59.40%**

LECZ = Low Elevation Coastal Zone
LECZ : the land area that is contiguous with the coast and 10 meters or less in elevation.

Source : Coastal Analysis Data Set utilizing GRUMP beta population and land area grids (CIESIN, 2005), Low Elevation Coastal Zone created from SRTM elevation grid (CIESIN, 2006)

4. Conclusion

The study shows with the current speed of greenhouse gas emission and global warming, 300 million people of the world will be at risk of coastal flooding by 2050, and China, Bangladesh, India, Vietnam, Indonesia, and Thailand will be most affected where around 237 million people live in the coastal area. Extreme sea-level events like the surge from the tropical cyclone which is rarely in the current scenario become common by 2100. The impact becomes worse in developing and underdeveloped countries where people are already facing other problems. A large number of planning and summits are organized at the world level to tackle the problem. But besides this, there is no sign of a decrease in the emission of greenhouse gas. So in this scenario disaster preparedness is the only issue to minimize the risk to the population, livestock, and property. The approach of government related to disaster preparedness should be aggressive and set clear and actionable agenda. Then only it is possible to minimize the risk of impacts of disaster-related to climate change.

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About author

Dr. Babita is currently working as an Information Officer in the CEECC, ADRI, Patna. Before this, she was working in The INCLEN Trust International as Assistant Research Officer. She has done a Doctor of Philosophy in Geography from Jamia Millia Islamia, New Delhi. She has published five research papers in different national and international journals. Her work and research are focused on Urban Geography and the Urban Environment. She did her post-graduate diploma in Remote Sensing and GIS from Jamia Millia Islamia.

Most Devastating Natural Disasters of 2019: Cases in India

CEECC Team

1. **Bandipur Forest Fire:** In between February 23-25, 2019, a massive forest fire broke out in the Bandipur National Pak. The Sentinel-2 satellite data of the Indian Space Research Organisation (ISRO) estimates say that around 15,443.27 acres of forest land were found but due to the fire blaze in the National Park.

Photo credit: The News Minute

2. **Cyclone Fani :** In between April 26-May 6, 2019, an extremely severe cyclone (speed of around 175 kmph) named 'Fani', means hood of snake in Bangla hits the coastal region of Odisha. Reportedly, it affected more than 1 million people and caused infrastructure damage of around Rs. 596 billion. Including eastern India and Bangladesh, around 89 people lost their lives in this severe storm.

Photo credit: Quartz

3. **Bihar Flood :** In between August-September 2019, severe flood affected around 8.8 million people in 13 districts of Bihar. Around 130 people died in the flood and caused damage of around Rs. 8.85 million.

Photo credit: Gulf News

4. **Karnataka Flood :** In August 2019, the southern Indian state of Karnataka was greatly affected by a monsoonal flood. Reportedly, around 61 people lost their lives and 15 were found missing across 22 districts of the state. More than 40,000 houses were affected and caused infrastructure damage of around Rs. 495 billion.

Photo credit: The Economic Times

5. **Kerala Flood:** In August 2019, heavy rainfall caused a severe flood and affected 14 districts of Kerela. Series of landslides worsen the situation and declared Red Alert 9 districts of northern and central Kerela, Orange Alert in 3 districts of central Kerala, and Yellow Alert in 2 districts of southern Kerala. Around 121 people lost their lives and affected over 2 lakh people.

Photo credit : The Financial Express

6. **Assam Flood :** In July 2019, the eastern Indian state of Assam was extremely affected by a monsoonal flood. Reportedly, around 52.6 lakh people, 1.64 lakh hectares of crop area of 30 districts were severely affected. Around 91 people lost their lives and 2400 Indian Rhinoceros, some of the other endangered species, in Kaziranga National Park were badly affected.

Photo credit : NDTV.com

7. **Bihar Encephalitis Outbreak :** In June 2019, around 150 children lost their lives due to a serious outbreak of Acute Encephalitis Syndrome (AES) in the Muzaffarpur district of Bihar. In subsequent months, more cases and deaths were reported mainly due to Hypoglycemia. The cause of the outbreak is still unclear but malnutrition, poor hygiene, inadequate health facilities, lack of awareness are considered as major contributing factors. The famous Lychee fruit toxins are also cited as a plausible cause of AES.

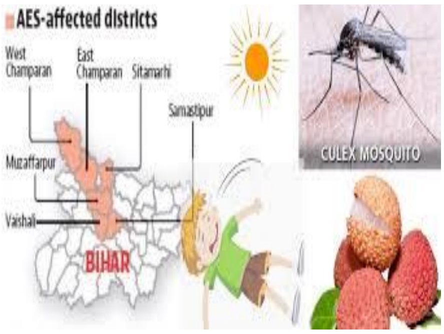


Photo credit : Examrace

Disaster Highlights

PM will Promote Disaster Resilient Infrastructure in India

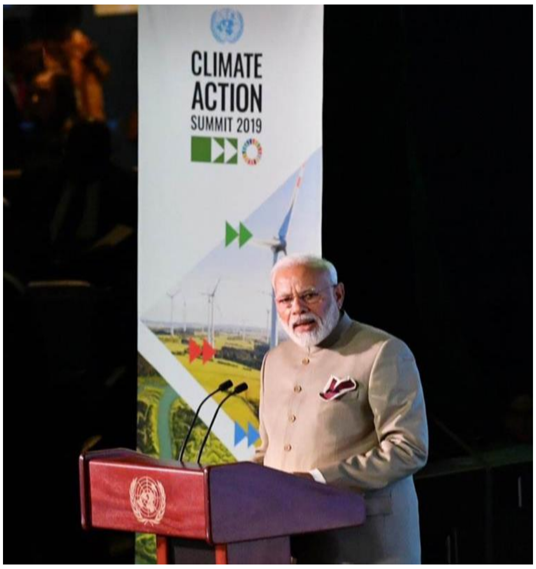


Photo credit: UN.org

At the United Nations (UN) Climate Action Summit 2019, held in New York City, on September 23, 2019, Prime Minister Shri Narendra Modi announced a global Coalition for Disaster Resilient Infrastructure (CDRI). The partnership of the national governments, UN agencies, multilateral development banks, financing mechanisms, private sector, and knowledge institutions will promote the resilience of new and existing infrastructure systems to climate and disaster risks, thereby ensuring sustainable development. CDRI envisions enabling a measurable reduction in infrastructure losses from disasters, including extreme climate events that are developed in consultation with more than 35 countries. CDRI thus aims to promote the objectives of the Sustainable Development Goals, while also working at the intersection of the Sendai Framework for Disaster Risk Reduction and the Paris Climate Agreement.

Source : https://www.un.org/en/climatechange/un-climate-summit-2019.shtml

The Decade of Exceptional Climate and Weather Events: 2010-2019

According to World Metrological Organisation (WMO), 2010-2019 is the warmest decade, and the global average temperature recorded in 2019 (January- October) was about 1.1 degrees Celsius above the pre-industrial period i.e. (1850-1900). With the highest global average temperature, this decade also experienced the highest rate of sea-level rise i.e. 5mm/year between 2014 to 2019. According to the World Glacier Monitoring Service (WGMS), between 2015 to 2018, the average specific mass change of glacier is around 908 mm water equivalent per year.

Source : https://public.wmo.int/en/media/press-release/2019-concludes-decade-of-exceptional-global-heat-and-high-impact-weather

RISAT-2BR1 : Launch of the most Capable Surveillance Satellite of India

Photo Credit : ISRO

RISAT-2BR1 is a synthetic-aperture radar imaging earth observation satellite, provides services in the field of Agriculture, Forestry, and Disaster Management. The spatial resolution of the satellite is 0.35 meters, which means it can identify an object on the ground which is separated by just 35 cm. The RISAT-2BR1 is the first all-weather earth observation satellites launched by ISRO of its series. Before the RISAT series, all the observation satellite of India primarily relied on optical and spectral sensors which were vulnerable to cloud cover.

Source : https://www.isro.gov.in/Spacecraft/risat-2br1

COVID-19 Lockdown Causes Air Purification

Photo Credit : Awar Nazir/Sajjad Hussain/AFP via Getty Images

According to The Weather Channel, a 21-day lockdown in India helped in improving the air quality status of many most polluted cites. Drastic reduction in vehicular emission, dust from industries, and transportation were found major contributors to it. The Central Pollution Control Board (CPCB) reported a 71 percent decline in the nitrogen dioxide in metro cities like Mumbai, Chennai, Kolkata, and Bangalore. The lockdown certainly played an important role, but other factors too influenced the air quality level. Heavy rains in the western and northern regions of India have played an important role in the dropping of air pollution levels.

Source : sciencedirect.com/science/article/pii/S0048969720325699

Important Events

Community Awareness: "No Plastic Bags"

To inculcate the attitude of community participation or community awareness in the GSDP trainees, the trainees went out to spread awareness about the serious issue of single-use plastic bags. As a solution to the problem, they also distributed handmade cloth bags to encourage behavioral change among people. This drive has remarkable success in terms of building confidence among trainees.

Trainees during awareness drive on Beat Plastic

Report Launch: Patna Clean Air Action Plan (PCAAP)

The PCAAP Report was launched by Hon'ble Deputy Chief Minister of Bihar Shri Sushil Kumar Modi on November 23, 2019. The report has highlighted the sources of emission and based on the techno-feasibility analysis, a set of sectorial control measures has been proposed.

Launch of the PCAAP Report November 23, 2019

GSDP Inauguration

Inaugral Session of GSDP Course on ETP O&M at Tarumitra

Inaugral Session of GSDP Course on PM at Bihar Pollution Control Board

Inaugral Session of GSDP Course on WBA at ADRI

Updates

Green Skill Development Programme

The Asian Development Research Institute (ADRI) Patna being an ENVIS Resource Partner on Water Management and Climate Change has to lead the GSDP course on Water Budgeting and Auditing (WBA).

However, along with WBA, the center has also conducted other programmes on-Pollution Monitors: Air & Water Pollution (PM), which aims to cater to skilled human resources need for research and implementation process of air quality management. The trainees were also engaged in various emission inventorisation survey exercise; ETP, STP & CETP: Operations & Maintenance (ETP O&M), which aims to cater to the skilled workforce deficit in the fields of wastewater treatment, plant operations, and maintenance; and Biodiversity, Dolphin Conservation & Aquaculture Management, which aims to cater the skilled workforce deficit in the fields of riverine floral and faunal biodiversity with special reference to the biological, taxonomical, ecological and conservational aspects of the endangered Ganges River Dolphins.

So far, under GSDP out of 76 enrolled candidates, a total of 67 candidates has completed the training programme and awarded a GSDP certificate by the Ministry of Environment, Forest and Climate Change, Government of India.

Ongoing GSDP Courses :

With some new additions to the courses, the ongoing training programmes are:

a. WBA: it is the second batch of the training programme, with the addition of new collaboration to The Energy Resources Institute (TERI) on water auditing for the industrial sector. We have also invited our previous batch master trainers to conduct a few of the field training sessions. This time 14 candidates (1 female and 13 male) have shown their interest in the programme. All are from different districts of Bihar state.

b. PM: it is the second batch of the training programme. This time a total of 20 candidates (7 females and 13 males) have shown interest in the programme. This batch has candidates from Bihar, Jharkhand, and West Bengal.

c. ETP O&M: it is the second batch of the training programme. This time a total of 15 candidates (6 females and 9 males) have shown interest in the programme. This batch has candidates from Bihar and Punjab.

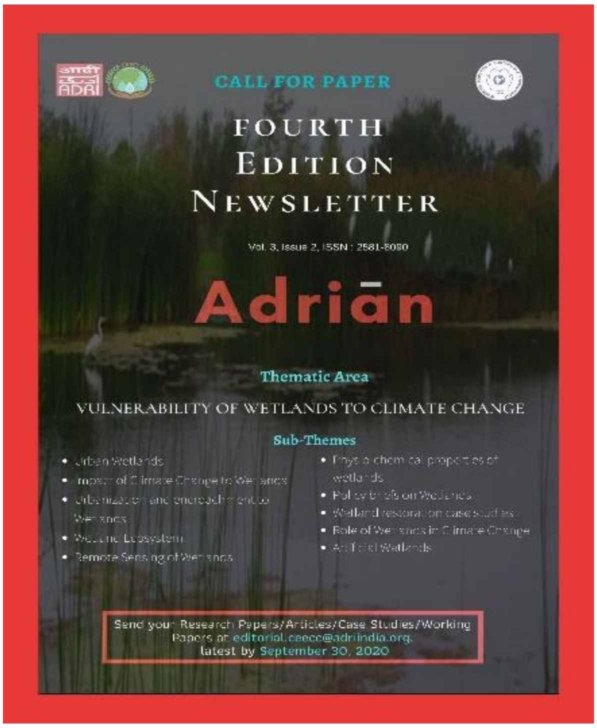
Upcoming GSDPs Courses :

a) Water Budgeting & Auditing (NSQF level 6, 200 hours)
b) Emission Inventory (NSQF level 6, 130 hours)
c) Value addition and Marketing of NTFPs: Bamboo Crafts (NSQF level 5, 400 hours)
d) Bird Identification and basic ornithology (NSQF level 5, 160 hours)
e) Sustain and Enhance Technical Knowledge in Solar Energy Systems (NSQF level 5, 260 hours)
f) Value Addition & Marketing of NTFPs- Bee Keeping (NSQF level 4, 200 hours)
g) Waste Management (NSQF level 6, 300 hours)

For more information on our upcoming courses, please visit: http://www.gsdp-envis.gov.in/Index.aspx

Upcoming newsletter

The center will be now publishing our third volume of the newsletter 'Adrian'. The broad theme of the upcoming issue is "Vulnerability of Wetlands to the Climate Change". In this regard, we are inviting research papers/ articles/ case studies/ working papers, etc. in around 1000-1500 words (excluding references).



Upcoming webinar

The center is going to organize a webinar to discuss the prevailing issues around wetlands, with special reference to urban wetlands. The theme of the webinar is "Vulnerabilities of wetlands and its impact on climate change".

The webinar is scheduled to be held in October 2020.

Newsletter Subscription Form

Please fill in the form and send it back to us by post or email.

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