



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

THE ANALYTICAL STUDY FOR EVIDENCES OF CLIMATE CHANGE IN BILASPUR AND IT'S SURROUNDING [CG].

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Abstract

Climate change has been disruptive phenomena across global to local scale along-with variation in dimension and time. It is the result of adverse human impact on the ecosystem of our mother Earth. It is felt through present irregular weather circumstances, than the normal weather conditions occurred during the past thirty years ago and even earlier. Bilaspur and its surrounding [CG] have been selected for analysis of prevailing climate change under present scenario through conventional approach.

The evidences for climate change in the area under study have been classified in-to two categories namely: Natural and Anthropogenic. The natural factors are-Dust, Aerosol and deteriorated hydrological condition, which have their role in increasing respiratory & water-borne diseases to the quality of public health. The anthropogenic factors are –Emission of green house gases [carbon dioxide] through working cement plants, Land degradation due to ongoing civil engineering projects like Construction of Road, Flyover, Sewage and Bio-mass burning, disturbing the regime of air, water, vegetation and land.

The prevailing climate change at local scale has been analyzed through irregular present rainfall pattern, dynamic land-use/land cover, and increase in land surface temperature, diminishing Arpa river and groundwater depletion, with their possible quantification, as observed most common evidences.

Introduction

The climate of a region refers to average weather condition/ atmospheric condition for the period of previously thirty years and more. The weather condition is related to meteorological parameters like: wind, temperature, sunshine, cloud cover and precipitation [rainfall].

The climate of India has been broadly classified into FOUR categories on the basis of month wise occurring season annually and as follows: [8]

- Winter season: Three months, namely- December, January & February.
- Pre-Monsoon season: Three months, namely-March, April & May.
- Summer Monsoon season: Four and half months, namely- June, July, August, September & first half of October. It is also known as South Asia Monsoon.
- Post-Monsoon season: Two months namely- second half of October and November.

Besides these seasons, Indian region has also prone to severe weather events/ climate extremes like- Cyclone, Thunderstorm, Heat wave, Cold wave, Avalanche, Flood, Drought, Lightning and Cloud burst.

The climate change in specific region refers to any change in climate over time-preferably less than thirty or even few on account of either natural variability or result of human activity [12].

The impact of global climate change over Indian region are: Melting of glacier & ice in Himalayan area, Avalanche in Himalayan area, Glacial Lake Outburst Flooding in Himalayan area, Degradation of forest cover, Flood, Drought Crop disease in agricultural area, Increase in Green House Gases, More frequency of powerful cyclone in coastal area, Rising sea level in coastal area, Increase in land surface temperature due to urban growth etc.

The local climate change in central portion of CG state [upper Kharun river basin of District Raipur] has been observed as reducing trend of surface runoff, decreasing evapo-transpiration, Depletion of groundwater table & recharge as adverse impact on prevailing hydrological cycle [10].

Area of Study

It belongs to Bilaspur city, as nucleolus [CG] and it’s periphery with-in the radius of 70 Km. It includes district Bilaspur, Pendra, Gaurela, Baloda Bazar, Janjgiri-Champa, Arpa river basin and adjoin Sheonath river. It is illustrated as Fig.1.

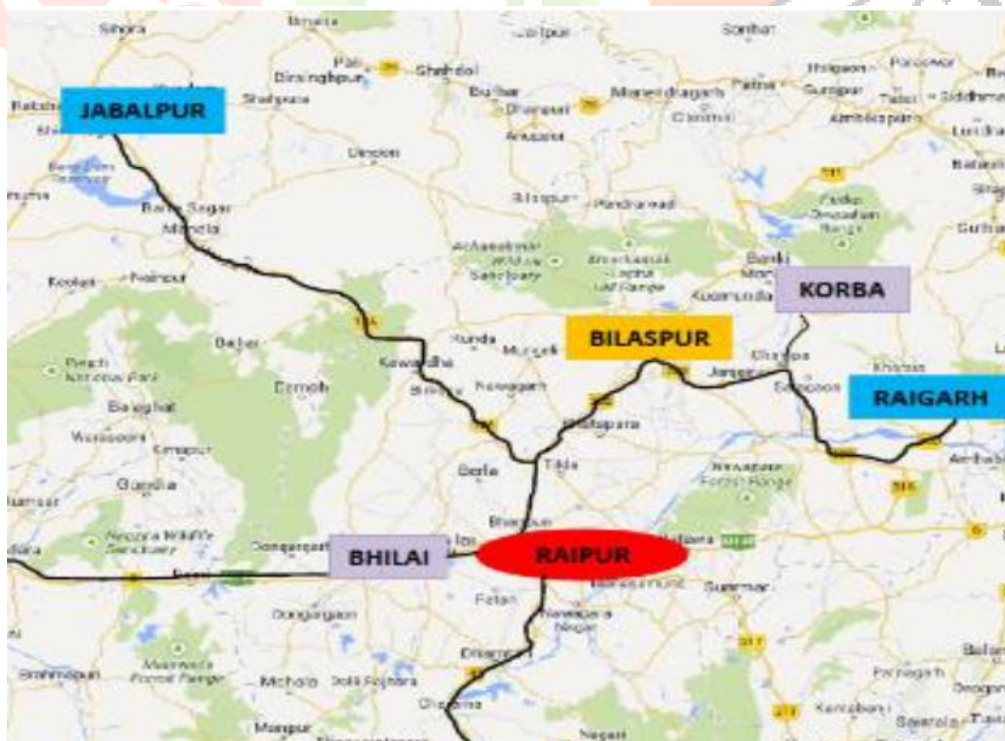


Fig.1 Location Map for area of study

Evolved Methodology & Objectives

The evolved methodology is based upon conventional approach, namely-Relevant Literature Review. Twelve Relevant Literatures have been evaluated. Their findings have been logically documented for achieving the solution to following three objectives:-

- ✓ Status of Climate change.
- ✓ Basic governing evidences for climate change
- ✓ Characteristics of changed rainfall pattern.

Result & Discussion

The northern portion of area under study has reserved forest-Kanhan Pendari, followed with agricultural area-cross drainage with rivers Arpa, Maniyari & Sheonath in the middle portion and urban complex cum industrial Infrastructure in the southern portion respectively.

Bilaspur city is about 400 years old. It is named after local fisherwomen BILASAH. It has been situated along both banks of Arpa river. The Arpa river has been mentioned, even during Mahabharata period [9]. Bilaspur and its surrounding has been enriched with coal washery, thermal power plant, cement plants, rice mills as prominent industrial infrastructure and contributing to climate change. Each objective has been explained as follows:-

- ✓ Status of Climate change :-

The water scarcity has been observed during pre-Monsoon and post-Monsoon season in majority of state on account of adverse impact on various hydrological parameters of local hydrological cycle. CG has 27 districts and out of it, 16 districts including Bilaspur are prone to Drought, as per study conducted by Institute of Human Development, New Delhi [8]. All kinds of drought namely-agricultural, meteorological, hydrological and socio-economic do occur in drought prone area with overlapping also.

CG has eight sectors, where the climate change phenomena have been observed. The suggestive preventative measures to mitigate their impact have been summarized as Table 1.

S N	Name of Sector	Suggested preventative measures to mitigate climate change
1	Agriculture	Reduce use of artificial fertilizer to decrease groundwater pollution and increase rainwater harvesting
2	Water Resource & Sanitation	Encourage implementation of micro-watershed activity, open defecation, effluent treatment
3	Forest & Bio-diversity	Documentation cum monitoring of forest cover, agro forestry
4	Urban Complex	Management of municipal solid/liquid waste disposal, development of oxy-zone, regular cleaning of road & street
5	Transportation	Check noise pollution, road accident, regulation of traffic rules
6	Energy	Promoting use of solar powered light, water pump
7	Industrial infrastructure	Check GHG, Pollution, Zero discharge policy
8	Public Health	Check aerosol, promote sanitizer, quality control on potable water

Table 1: Prominent sectors along-with preventative measures prone to climate change in CG

✓ Basic governing evidences for climate change:-

There are two broad categories of governing evidences for local climate change in the area of study namely: Key Driver and Prominent [7]. The Key Driver has three types as [a] anthropogenic emission of GHG, [b] Aerosol through land degradation & [c] Change in land-use/land cover. Similarly the prominent category has also three type's like-[d] Land surface temperature, [e] Groundwater table fluctuation & [f] decay of Arpa river. The silent aspect of each type has been explained as follows:-

[a] Anthropogenic emission of GHG:

It is associated with the cluster of operational cement plants at Baloda bazaar and Janjiri-Champa. The release of Carbon Dioxide as one of the major component of Green House Gas [GHG] and amount of final cement production has almost same ratio. More-over it has adverse impact on local flora and fauna [4].

The global carbon dioxide concentration has increased from an average of 280 ppm during pre-industrial period to 407 ppm in 2018 [4].

[b] Aerosol through land degradation:

Aerosol is the mixture of very small size [6-12 μm] solid/liquid particles spread in air. It is responsible for respiratory disease, when inhaled by human beings. The urban and rural area of Bilaspur has witness the execution of major civil engineering schemes namely-Sewage, Turkadih bridge, Fly-over at Tifra, Uslapur and Road widening along Sakri-Kota, Sarkanda-Koni, Bhaisajhar barrage and drastic cutting green trees during the past ten years with causing several fold land degradation through their construction cum implementation. The successful of each scheme has generated huge quantity of aerosol into local atmosphere and inhaled by residents.

[c] Change in land-use/land cover:

The land-use/land cover is the human imposed function on land resource by living society. The dynamic change in land-use/land cover for urban portion of Bilaspur [30.50 sq. km.] has been observed during the 17 years in between 2002-2017 [6]. The loss of land has been quantified for agriculture, open land, tree clad area and surface water body in hectare as-94.89, 121.71, 1.61 and 23.83 respectively. Similarly, the gain of land has been quantified for built-up, mixed built up, riverine and industrial area in hectare as-172.40, 56.60, 6.06 and 0.23 respectively. The quantification has been made through temporal analysis of satellite data, utilizing supervised classification & GIS, as illustrated Fig.2. The cause of dynamic change in land-use/land cover seems to be anthropogenic developmental activities.

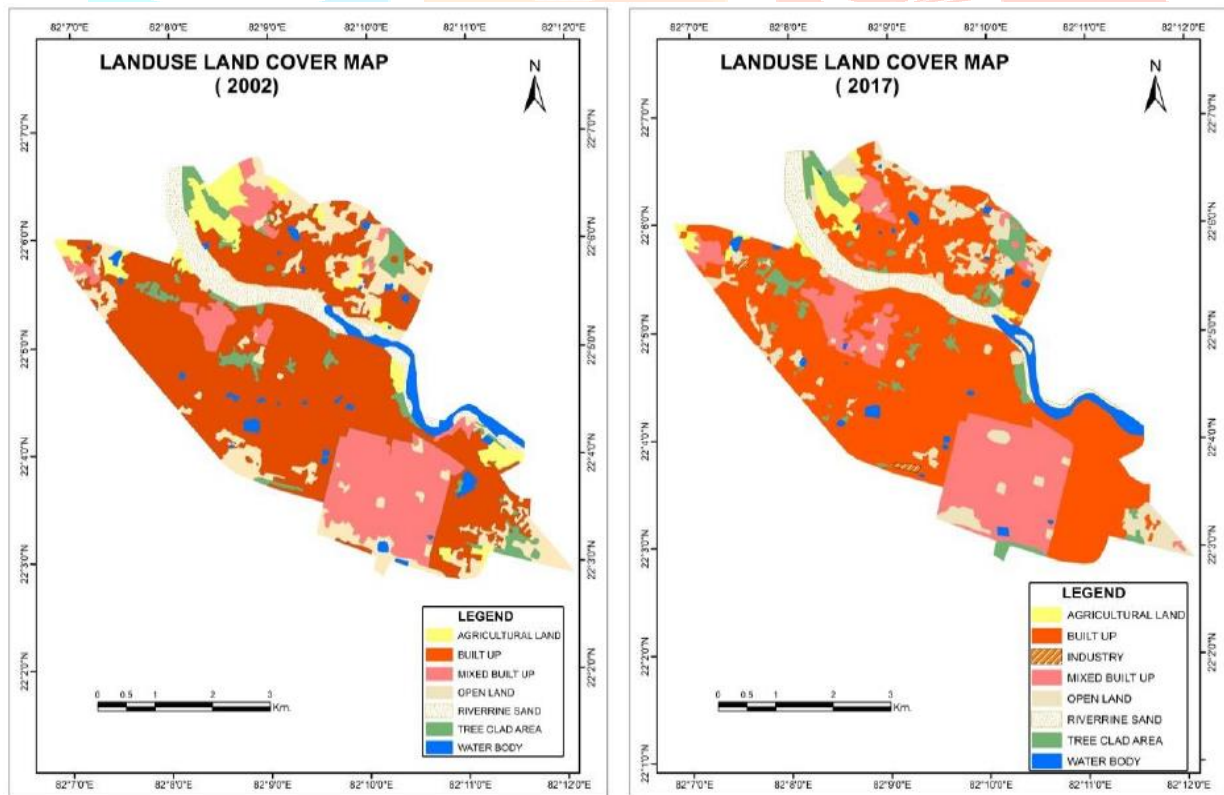


Fig.2 Dynamic land-use/land cover observation in Bilaspur urban area during 2002-2017

[d] Land surface temperature:-

It has been observed up-to 2 m height pertaining to eight land-use/land cover, belonging urban area of Bilaspur. The change in land surface temperature has been identified through the Remote Sensing analysis, with using Landsat-7 ETM and Lansat-8 thermal infra red data. The enhancement in land surface temperature during 2002-2017 has been quantified in the range of 23.85 -40.09°C and 30.7 -45.00°C respectively. It is illustrated as Fig.3. The reason for enhancing land surface temperature seems to growth of concrete jungle, development of new residential colonies and coal washery activity.

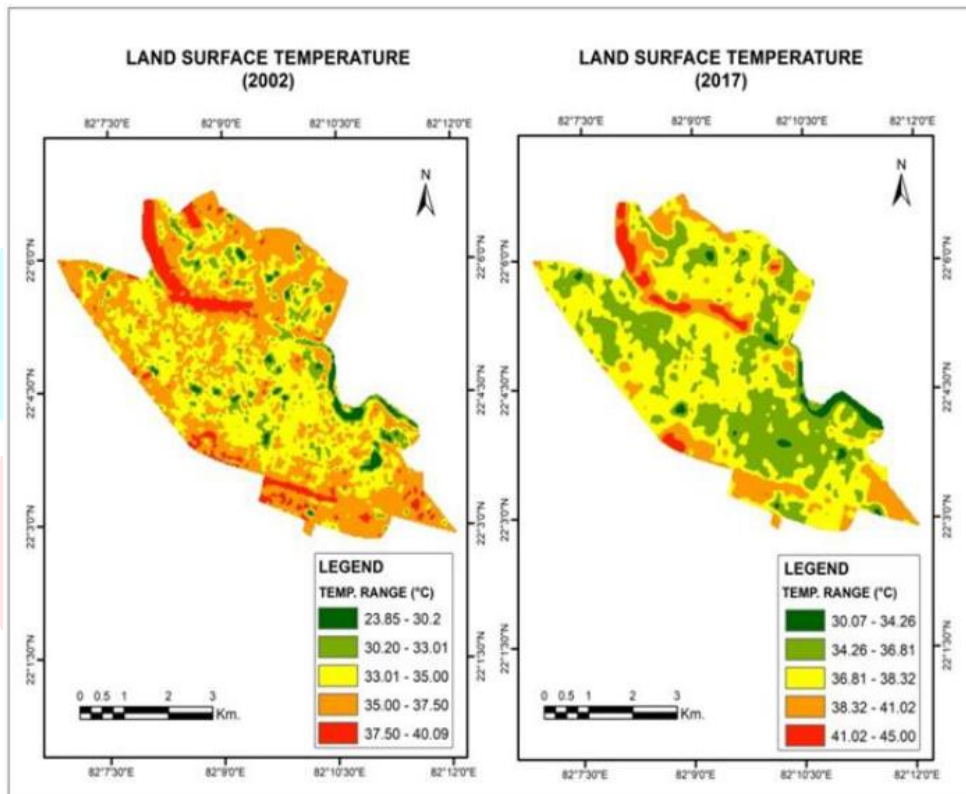


Fig.3 Dynamic land-surface temperature observation in Bilaspur urban area during 2002-2017

[e] Groundwater table fluctuation:-

The higher rate of groundwater with-drawl is due to alarming rate of groundwater fluctuation and expressed as groundwater stage development [%]. Takhatpur block of District Bilaspur has been declared as semi-critical since 2015, as per NCCR, CGWB having groundwater development stage in the range of 70-90% [5]. The reasons behind it are- poor recharge characteristic, excessive successful wells, extensively water supply for agriculture, commercial and domestic to residential colonies.

The groundwater table has been monitored during the period may 2018 to January 2020 at Neora, Ganiyari by NCCR CGWB in the range of 6.65 m to 8.68 m, belonging to pheratic aquifer up to depth range of 5- 15 m from the average ground surface [1].

[f] Decay of Arpa river:-

Arpa river once was life line of Bilaspur city has been virtually dead river presently. The length, average width and average water depth [in winter, pre & post summer season] has been 147 km, 400m and 1-1.5m respectively. It originates from Khondari-Khongsara in Pendra in dry condition- covered with domestic waste disposal, as illustrated through Fig.4. It has several check dams, anicut, barrage, bridges in between Belgahana-Masturi disrupting the river flow. It joins Shivnath river at Thakur deva, nearly Bartoi, that also in dry condition [2]. The river bed has been excavated at several places for extraction of sand, deteriorating further the original river regime.



Fig.4 The status of Arpa river at it's origin

✓ Characteristics of changed rainfall pattern:-

The rainfall pattern in CG during earlier period [more than thirty years ago] was used to be having more number of rainy days with long duration and less intensity. Such rainfall pattern was beneficial for crops- as rainwater was used to get absorbed in soil, which helps in maintaining soil moisture and replenishing groundwater depletion [11].

The changed rainfall characteristic during the past ten years has been- less magnitude and prolonged duration. The rain shower occurs in May month as pre-monsoon shower. The excess rainfall occurs during start of rainy season [June, July months], followed with middle dry spell [August, September months] and low magnitude in diminishing manner at the end [first half October month [6]. The middle phase of dry spell of long duration encourages low soil moisture condition and less evapo-transpiration-which leads to water scarcity for Kharif crop.

The average rainfall distribution during the period-2009-2017 for district Bilaspur has been illustrated as Fig.5 [8].

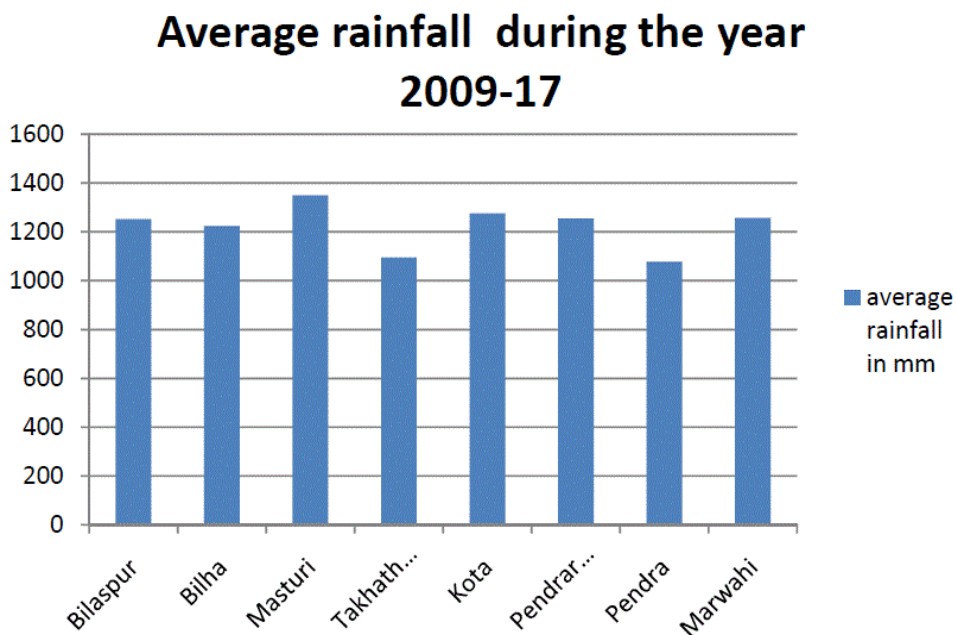


Fig.5 Average Rainfall distribution during the period 2009-2017 in District Bilaspur

The pre-monsoon rain shower occurred in May month at district Bilaspur has been observed during the past twelve years, for period 2010-2021 and summarized as Table 2 [3].

S N	Year	Rainfall in mm	Remark	S N	Year	Rainfall in mm	Remark
1	2010	36.8		7	2016	21.8	
2	2011	7.9		8	2017	16.0	
3	2012	0.4	Negligible	9	2018	34.0	
4	2013	13.1		10	2019	0.8	Negligible
5	2014	32.2		11	2020	20.0	
6	2015	0.2	Negligible	12	2021	26.2	Till 11/05/21

Table 2 Pre-monsoon rain shower in the month of May at Bilaspur during 2010-2021 period.

Conclusion

Climate change in the specific geographic region presents challenges to the human health, food security, quality of life and economy. The worth considering governing evidences for climate change in Bilaspur city and its surrounding are: Rainfall, Forest cover, Dynamic Land-use/ Land cover with land surface temperature, land degradation and emission of GHG.

The mitigation of climate change through “Building Capacity” for the area of study concludes the followings:-

- Encouraging the green cover through green mission by each bonafide resident.
- Promoting solar power based renewable solar energy for water pump and electricity to each household, agricultural field.
- Executing micro-watershed management scheme for conservation of water resource.

- Drastic fluctuation in groundwater posing threat to agriculture, food security & domestic water supply.
- The shifting nature of onset monsoon pattern has put multifold stress on rural livelihood and renewable resources as Land, Water, Soil & Vegetation.

Acknowledgement

The authors would like to express their gratitude to the authorities of Dr. C V Raman University, Kota, Bilaspur [CG] for rendering necessary assistance. The views expressed in the paper are the views of the authors and do not of the organization to which they belong.

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