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https://doi.org/10.47884/jweam.v1i1pp63-68

Journal of Water Engg. and Management

ISSN 2582 6298
Volume-01
Number- 01

Jr. of Water Engg. and Mgt.
2020,1(1) : 68-73

Journal of Water Engg. and Management, 2020,1(1) : 68-73

Author's personal copy

Journal of Water Engg. and Management, 2020, 1(1) : 68-73
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Research Paper

Study of Decadal Rainfall Variation of Ramgarh District using TRMM Data

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Received: April 13, 2020, Accepted: April 24, 2020

ABSTRACT -

The study has been done to investigate the decadal change observed in the rainfall of Ramgarh district from 1998 to 2018. Due to the lack of adequate rain gauge stations and irrelevant precipitation data, TRMM method has been used for the study. The approved accuracy of TRMM data through NASA has been frequently used to study the rainfall data of those locations where the rain gauge stations are unavailable or the data are not relevant for the study. TRMM 3B43 data of 7 Raster location points of Ramgarh district has been processed and the precipitation maps were prepared accordingly under Arc GIS. The precipitation values of 1998, 2008 and 2018 of all 7 points were obtained through raster to vector methodology in Arc GIS which was studied and compared through the retrieved GIS precipitation maps. The decadal precipitation of all 7 raster locations has shown a gradual decrement in its value when compared thoroughly. The gradual increase in mining and industrial development has possibly decreased the forest cover as well as the agricultural activities. A sharp overall reduction in the decadal precipitation values is somewhere indicating a serious concern towards fulfilling the future water demand of this growing city.

Keywords: TRMM 3B43; Arc GIS; Raster to vector methodology.

INTRODUCTION

Mining activity imbalances the ecological system, which ultimately affect the hydrological cycle and precipitation. The Reduction of moisture in air and soil, deforestation, variation of drainage system etc. will be responsible for change in the hydrological cycle and fluctuating rainfall trends (Karmakar et al., 2012). Due to mining activity, forest declines which play a important role in the hydrological cycle through the process of evapotranspiration and hence contribute greatly to the atmospheric water which is responsible for the precipitation (Dubey et al., 2011; Frelich, 2014).

The climate change has become one of the most critical and challenging problem around the world. Rigorous use of natural resources and the anthropogenic activities has increased the global warming drastically. The gradual increase in the population has played a major role on the variation of climatic change. The change has been observed continuously in the topographical features due to urbanisations. Out of some anthropogenic activities, Mining is one of the chief factors that have widely contributed toward the vital change in the geographical, environmental and the hydrological condition in past centuries. Mining activity has drastically been expanded in this region over last 100 years and as the result a great geographical change has been observed in this area. Hence to study the impact of change in the

topographical aspect and the variation occurred in the hydrological properties due to mining, Ramgarh district has been chosen as the study area for the analysis.

MATERIALS AND METHODS

Study Area

Ramgarh district is carved out of Hazaribagh district on 12th September 2007. The district is situated between 23˚ 25' 30" North to 23˚ 58' 00" North latitude and 85˚ 12' 00" East to 85˚ 53' 00" East longitude, having an area of 1360.08 km². Fig. 1 shows the detailed description of the block of Ramgarh District. The mineral assets of Ramgarh have assumed an extraordinary job in industrialization, social and financial advancement of the area. Ramgarh is wealthy in minerals, for example:-

- Coal
- Coal – Bed
- Methane
- Limestone
- Fire Clay
- Granite-Gneiss

As in different areas of Chotanagpur, the Ramgarh region is also invested with mineral assets. In the locale, minerals, for example, Coal, Limestone, Fire Clay, China Clay, what's more, Quartz are found. These can be named as Major Minerals. Minor minerals, for example, Granite, sand, and so on are additionally accessible in the District (District Survey Report of Stone District- Ramgarh, 2018).

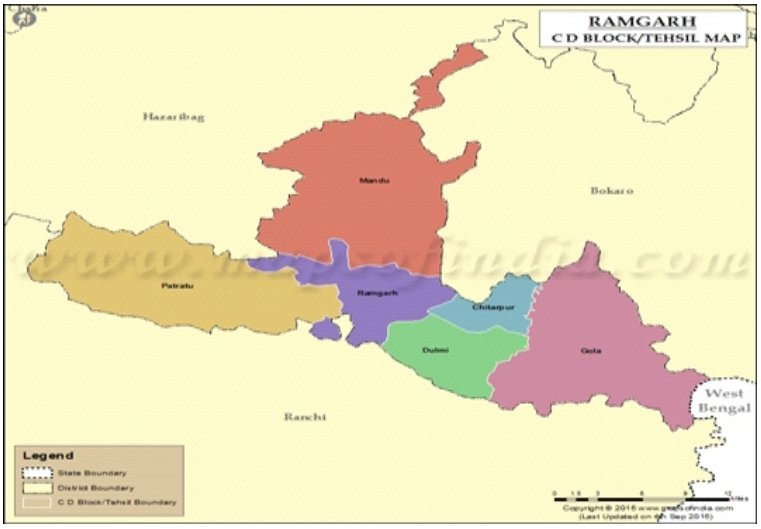

Fig. 1 Block map of Ramgarh district (Source: www.mapsofindia.com)

TRMM (Tropical Rainfall Measuring Mission)

This program was started in the year 1997 with the joint venture of JAXA and NASA. The convenient evaluation of active and passive microwave instruments and the use of low inclination orbit (35°) have made TRMM data, the world's foremost reliable data for the study of rainfall trends related storms and tropical climatological process as well.

The accuracy of the above data has been checked many times and it has been found much suitable for the study. The comparison of two monthly precipitation data values of Australia from January 1998 and December 2010 has been

studied. The Tropical Rainfall Measuring Mission (TRMM) of rainfall product (3B43) and the rain gauge data having monthly gridded values obtained from the Australian Bureau of Meteorology (BoM) have been taken. The Histograms obtained has shown almost the similar probability distribution. Hence it can be concluded that the TRMM 3B43 monthly product would be suitable to be used in the climate studies (Fleming et al. 2011). This process is very much useful for areas with very abrupt variable conditions (Hunink et al., 2014).

Data collection

For the decadal analysis of rainfall trend in the Ramgarh district the TRMM 3B43 data set has been used which was downloaded from the website https://giovanni.gsfc.nasa.gov. This product is created using TRMM-adjusted merged microwave-infrared precipitation rate (mm/h) and Root-Mean-Square (RMS) precipitation-error estimates. It provides a "best" precipitation estimate in a latitude band covering 50^0 N to 50^0 S, an expansion of the TRMM region, from all global data sources, namely high-quality microwave data, infrared data, and analyses of rain gauges. The granule size is one month (Tropical Rainfall Measuring Mission Senior Review Proposal 2011).

Evaluation of Rainfall trend analysis through TRMM

The rainfall trend analysis of Ramgarh district for 20 years (1998-2018) has been done using TRMM 3B43 annual accumulated rainfall data set which was downloaded from the website of https://giovanni.gsfc.nasa.gov .The downloaded data set was processed under Arc-GIS software of version 10.3 to evaluate and compare the rainfall values. The 7 raster location points of the district has been used for the investigation.The location of these points has been tabulated in the Table 1.The precipitation map obtained individually through the TRMM_3B43 data, processed under Arc GIS has shown the detailed description of the rainfall distribution over 7 specified locations of the district.

Table 1 Location details of the different sub study area of Ramgarh District

Location	Latitude	Longitude
Upper mandu region	23˚ 48’ 04” N	85˚ 28’15”E
Lower mandu region	23˚ 44’ 56” N	85˚ 28’15” E
Ramgarh	23˚ 36’ 51” N	85˚ 31’23” E
Bhurkunda	23˚ 39’ 08” N	85˚ 21’36” E
Chitarpur	23˚ 34’ 28” N	85˚ 39’04” E
Dulmi	23˚ 32’ 11” N	85˚ 36’31” E
Gola	23˚ 31’ 55” N	85˚ 43’13” E

RESULTS AND DISCUSSIONS

The precipitation trend of the study area was evaluated by processing the 3B43 TRMM data set into the Arc-GIS 10.3. The raster to point conversion of the image were used to obtain the annual rainfall value of total 7 location points under the six main blocks of the district. The rainfall value was evaluated and compared graphically. The processed precipitation map of year 1998, 2008 and 2018 respectively under the Fig. 2, 3 and 4 has been thoroughly studied and compared. Under the yearly analysis it can be seen that there has been a drastic decrement of rainfall between the year 1998 to 2008 which was the peak time of mining and industrial development of this area. Gradually from 2008 to 2018 the rainfall has been decreased throughout the district. The TRMM 3B43 data of all 7 raster points has been obtained and processed in Arc GIS. The detailed variation of average annual rainfall value of all 7 location points has been tabulated under the Table 2.

Table 2 Rainfall data observed by raster to vector calculation through the TRMM 3B43 Image data

Raster Point Location	Average Annual Precipitation (mm)		
	Year		
	1998	2008	2018
Mandu (upper region)	1644.146	1447.005	1090.700
Mandu (lower region)	1548.887	1350.916	1049.464
Bhurkunda	1658.926	1383.103	1177.505
Ramgarh	1721.853	1375.270	1218.140
Chitarpur	1781.594	1329.247	1285.080
Dulmi	1747.989	1410.727	1336.172
Gola	1748.001	1409.683	1396.659

After the detailed analysis of the above data it can be seen that in year 1998 then minimum average annual rainfall was of Mandu block (lower region) which is one of the dense mining region of the district, but the value was 1548.887 mm which is quite satisfactory but for this particular region the rainfall value in 2008 has drastically been reduced to 1350.916 and similarly in year 2018 the value reduced to reach at 1049.464 mm. The maximum rainfall variation has been seen in Ramgarh, Chitarpur, Dulmi and Gola between 1998-2008, but in between 2008-2018 the maximum rainfall variations can be seen in the Mandu (upper and lower region) and Bhurkunda. This variation can possibly be related to the gradual reduction in forest as well as the agricultural activities and hence the excessive industrial, mining and urban growth.

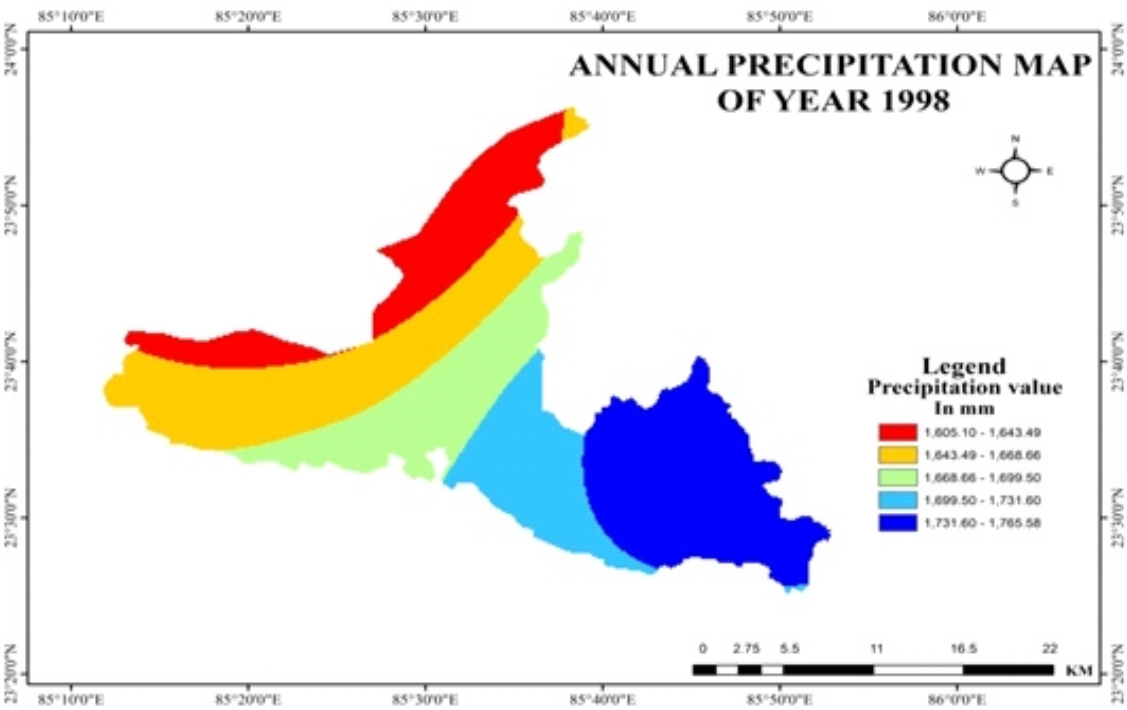

Fig. 2 Annual precipitation map of year 1998 processed through TRMM data in Arc GIS

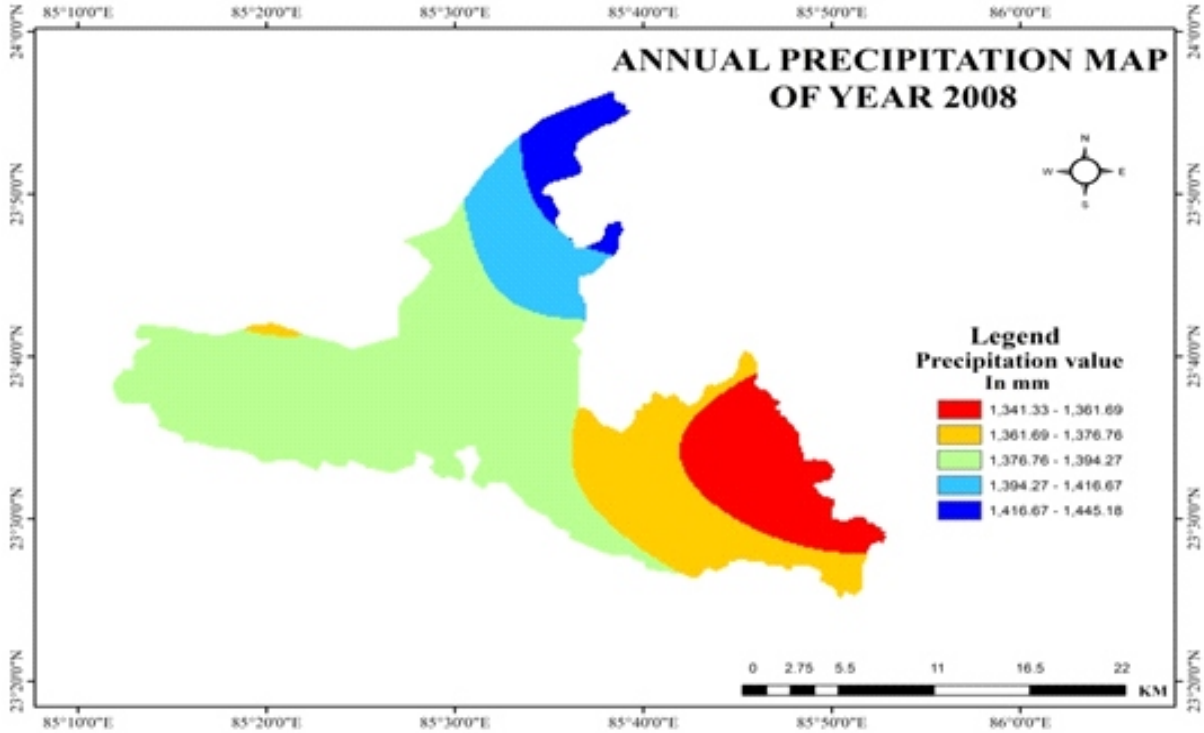

Fig. 3 Annual precipitation map of year 2008 processed through TRMM data in Arc GIS

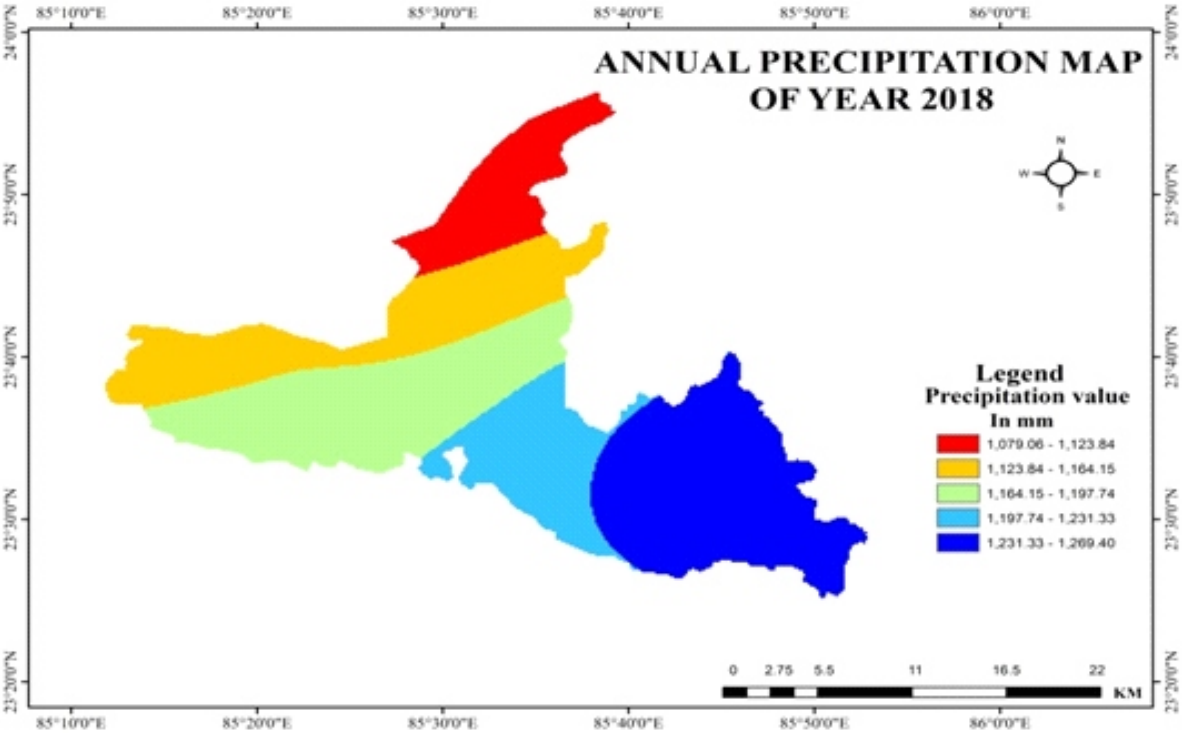

Fig. 4 Annual precipitation map of year 2018 processed through TRMM data in Arc GIS

CONCLUSIONS

After analysing the decadal variation in precipitation value of Ramgarh district through TRMM data it can be inferred that the sharp reduction in the average annual precipitation value is a matter of big concern. The increasing urbanisation has increased the population of these area and hence has also increased the daily water demand. The reduction in rainfall has increased the consumption load over the ground water resource. The sharp decadal decrease in precipitation can become a big challenge towards fulfilling the water demand of the increasing population of the district. Hence proper steps must be taken towards the conservation of forest cover and innovative management techniques must be encouraged towards increasing the ground water recharge of these areas to meet the future water demand.

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