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A FOCUS ON M.K TESTS, THE EFFECTS OF FLUCTUATING RAINFALL ON DURG DISTRICT WATER RESOURCES.

Dr. Bhawana Mahule

(Assistant Professor), Department of Geography, Dr. Manrakhan Lal Sahu Government College Jamul, Durg, Chhattisgarh, India.

Correspondent Author Email Id: - bhawanamahule123@gmail.com.

Abstract

Severe flooding and extensive droughts might be on the horizon in India due to changes in monsoon precipitation brought about by regional climate oscillations. Animals, crops, people's well-being, and forests are all places that might feel the effects of changes to water resources. According to what is put out in the article. The M.K. test and trend of depletion were used to conduct the analysis. Notably, throughout the last fifteen years, surface water has been drained at the quickest pace of 1375 m3/ha, while groundwater in the Drug district has been reduced at the fastest rate of 3421 m3/ha. There is a very significant (á=1%) tendency towards decreasing water resources in the Drug district, according to the statistical analysis of the M.K. test. Water supplies are dwindling because to desertification, uncertain rainfall, and inconsistent rainfall patterns. Thus, in this age of climate change, it would have been prudent to discuss improving the consumptive use of water resources for both plants and people by conducting an inventory study and implementing suitable strategic plans.

Key words: Rainfall, Water Resources , M.K Test, Rainfall Variability.

Introduction

Climate change is making extreme events in the hydrological cycle more often, which might have serious implications for the world's water supply. This includes both surface and groundwater, as well as water used for irrigation and stream ecosystems. Overall variations in precipitation amount, frequency, and intensity have a direct influence on runoff size and timing, as well as flood and drought severity (IPCC, 2007). With 17.5% of the global population and 4% of the fresh water resources, India is a very populous country. Rainfall nourishes the great majority of rivers, which stream seasonally, although a handful flow continuously. Groundwater supplies provide water for irrigation to at least 60% of the irrigated land. The widespread depletion of groundwater resources has led to an increase in the practise of burying oneself for water. This will lead to a decrease in the availability of potable water and an improvement in its quality. The fifth assessment report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2013) states that atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have increased substantially since 1750 as a result of human activity and have now exceeded pre-industrial values found in ice cores dating back thousands of years. The atmospheric concentrations of CO_2, methane, and nitrous oxide in 2011 were 391 ppm, 1803 ppb, and 324 ppb, respectively. The majority of the increase in nitrous oxide and methane levels is due to agricultural practises, whereas the majority of the increase in carbon dioxide levels is due to changes in land use and the burning of fossil fuels. Water resources are presently undergoing tremendous fluctuation as a result of drought, uncertain rainfall occurrences, unpredictable rainfall patterns, and unpredictable rainfall itself. All sorts of things are affected, including the sustainability and output of farming, human livelihoods, animals, and so on. Reduced precipitation over the long run may change the local climate, which would have consequences for agriculture, plants, and animals. Accurate and transparent data collection and analysis are crucial for the evaluation of water resources, which are a part of every ecosystem. Considering these factors, the research aims to examine how climate change is influencing the water resources of Durg district and how rainfall variability varies in this districts.

Materials and Methods

Geographically located in eastern India, Chhattisgarh is delineated by the latitudes 17°41′N and 17°30′E and the longitudes 84°15′E and 79°30′E. Orissa and Jharkhand, a recently formed state that separated from Bihar, are situated to the east and west, respectively. Telangana and Madhya Pradesh occupy the southern and northern regions. The regional water resources analysis employed precipitation data from 1912 to 2022 for the Durg region. Over the course of the last century, precipitation availability in the Durg region has been critical for the recharge of both surface and groundwater. As an illustration, consider the accounting procedure proposed by Thorn Thwaite and Mather (1955) for surface and ground water: a) It is considered that 90% of precipitation is efficacious. b) Runoff contributes only 20% of this surplus, while percolation contributes 80%. Twenty percent of the surplus is allocated to surface water recharge, ten percent to ineffective rainfall, and eighty percent to ground water recharge. Water resources have been subjected to time trend analysis on surface and subterranean water data gathered over the last century. A regression analysis was performed in accordance with the equation. The investigations that ascertained the drift of the water availability scale in the previous century included Singh, V. et al. (2012), Bianchi et al. (1999), and Sarsti et al. (1997). Using the slope of the trend equation, the groundwater recharge and surface water recharge for a 1 ha land plot and a 1 ha reservoir were calculated, respectively. The non-parametric M.K test is frequently applied to the analysis of hydrologic data. While the M.K. test does not imply normality, it does disclose the direction of the trend rather than its magnitude (McBean and Motiee, 2008).

Result and discussion

Rainfall analysis

An analysis of precipitation The following are the results of a statistical analysis of district-specific precipitation for the database spanning the years 1912 to 2022. Kharif crops experience water duress during their growth and development stages. Additionally, researchers hailing from diverse disciplines undertook these types of investigations. Wadood and Pragyan examined rainfall data from Chhattisgarh spanning four decades. While annual precipitation averages have increased, variability has also increased, as uncertainty levels have grown and the likelihood of intermittent extended drought periods has risen from 13% during 1961–1970 to 20% during 1991–2000. According to Rajegowda et al. (2009), the state of Karnataka experienced a decline in annual precipitation from 1,204 millimetres during the first half of the twentieth century (1901–1950) to an average of 1,140 millimetres between 1951 and 2000. After analysing precipitation data for the Saharanpur region of Uttar Pradesh state from 1959 to 2008, Singh et al. (2012) identified a future and historical downward trend. A number of regions within the state of Chhattisgarh have experienced a reduction in annual precipitation, according to Baghel and Sastri (1992). Each year, according to Choudhary and Sastri (1999), the quantity of precipitation in the Durg district has been declining. Both the amount of precipitation and the frequency of wet days exhibit a distinct decline throughout the agricultural season. Sastri (2010), who corroborated prior research, determined that the state experienced a reduction of 35–0% in precipitation from 1951 to 2000, relative to the mean values recorded during the period 1901–1951.

Consequences for water resources

In pursuit of this objective, our endeavour has been to calculate water balance so that we may determine the respective impacts of discharge and percolation losses on surface water and groundwater. A revision was made to the Thornthwaite model (1955) to account for the assumptions that were previously alluded to. In order to incorporate percolation losses, which contribute to groundwater to the extent of 80%, the water balance is modified. Runoff occurs when 10% of precipitation is ineffective and 20% is in excess; this precipitation ultimately enters surface water. The time trend equations pertaining to surfacewater and groundwater have been resolved, and water balance estimates have been computed for seventeen districts.

Ground water recharge

From 1912 to 2022, we determined that ground water recharge in the Durg regions decreased. Additionally, the annualised rate of decline and the total decline in millimetres were ascertained. Furthermore, the data also provides the cumulative groundwater loss per hectare of land, expressed in cubic metres.A volume reduction of 2046 m3 and 2002 m3, respectively, signifies a significant and swift depletion of groundwater. An examination of the significance of the decreasing pattern of groundwater depletion across different regions has been conducted through statistical analysis of the data. The trend attains statistical significance at the 10% level. No additional districts are impacted.

Surface water recharge

The calculation of groundwater recharge followed a similar approach to that of surface water recharge, employing the time trend equation. Consistent with the pattern observed in drug districts between 1912 and 2022, surface water recharge has exhibited a gradual decrease throughout the past century. The following describes the total surface water loss in numerous districts over the past century: The concept of "artificial recharge" pertains to the deliberate augmentation of groundwater levels. By increasing the rate at which surface fluids percolate into aquifers and enhancing their natural replenishment capacity, it is possible to augment the quantity of groundwater that can be extracted from them. Structures such as constructed wetlands and wastewater stabilisation ponds discharge either untreated or treated stormwater or effluent into aquifers. This is especially beneficial in regions experiencing rapid depletion of surface and subterranean water resources, such as those experiencing severe watershed decline, soil salinization, saline intrusion along coastlines, or general water shortages. The concept of artificial surface groundwater recharge pertains to the methodology of replenishing the groundwater table via soil percolation, wherein surface runoff is discharged into the underlying aquifer. There are numerous technologies available to achieve this objective.

Table 1. M.K test of significance of ground water trends for the period 1912- 2022 in Drug district.

S.N.	District	Test statistics value (Z-Value)
1	Durg	-1.643

(*** - 1 per cent level of significance, ** - 5 per cent level of significance,

* - 10 per cent level of significance)

The overall volume loss in a cistern with a surface area of 1 hectare after 110 years is also computed. With values ranging from 319 to 1078 m3, the data shows that the Drug district had the largest volume reduction of 2167 m3.Table 2 displays the results of the M.K test, which was used to determine if the decreasing trend in surface water depletion across different districts was statistically significant. While there is a noticeable trend of surface water depletion in Durg, it is of great significance elsewhere. The research of Wegehenkel and Kersebaum (2008) indicates that if the Ucker River in Germany experienced more low-flow days, ground water recharge would be drastically reduced, especially in wooded areas, by 44–94 percent. The water balance in the Bhilwara district of Rajasthan state was investigated by Kothari et al. (2008) at the tehsil level. The researchers found that the monsoon season could last anywhere from 10.7 to 12.3 weeks, and that at the tehsil level, there were water surpluses of 43.2 to 241.3 mm and water deficits of 61.4 to 124.7 mm. Aggarwal et al. (2010) found that in Shaheed Bhagat Singh Nagar, Punjab state, the average yearly water demand was 29285 ha-m more than the average annual evapotranspiration needs. A total of 15262 ha-m (or 52% of the total) and 14023 ha-mm (or 48% of the total) of this variation occurred during the kharif and rabi seasons, respectively. According to the study, the Saroa Block had the smallest yearly water deficit of 92 mm, while the Nawanshahar Block had the largest loss of 386 mm. The Sirhind Canal in Punjab state saw an average yearly loss in ground water of 0.55 mm, with a variance ranging from 0.11 to 1.42 mm, as reported by Miglani et al. (2011). Over the course of the investigation, the researchers also found 256,167.64 hectares (ha) of ground potential that had been overexploited.

Table 2. M.K test of significance of surface wa- ter trends for the period 1912- 2022in different districts of Chhattisgarh

S.N.	District	Test statistics value (Z-Value)
1	**Durg**	-2.162**

(*** - 1 per cent level of significance, ** - 5 per cent level of significance,

* - 10 per cent level of significance).

Conclusion

Surface water recharge and groundwater recharge are two examples of the steep loss in water resources that has occurred over the course of the last century when compared to the previous century. Every single resume was singular. Agricultural yields that are difficult to anticipate are a sign of precipitation that is very erratic. The unpredictability and variability of precipitation patterns are factors that have an impact on the replenishment and recharging mechanisms of water supplies. Consequently, both surface and underground water resources are depleted as a result of subsequent droughts and lower precipitation. An very precipitous fall is taking place in the Durg areas. Under these circumstances, there would be a significant disruption in the water requirements of crops, which would necessitate a reevaluation of the cultivation patterns and cultivars that are now in use, in addition to planning at the district level..

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