



CLIMATE CHANGE INVESTIGATION USING RAINFALL DEPARTURE INDEX: “A CASE STUDY OF AHMEDNAGAR DISTRICT, MAHARASHTRA”

Sandip Baban Sasane

Ph.D. Research Fellow, Department of Geography, Shivaji University, Kolhapur

ABSTRACT:

Last few years climate is changing in Maharashtra, mainly in rainshadow zones. Where the amount of rainfall is low resulting drought condition, agricultural sector collapsed and entire rural economy is disturb due to drought. Thus in present study the tehsil wise drought intensity has been carried out through rainfall departure Index of 14 rain gauge stations during 2012 to 2015 for better future agricultural planning. The result show that the entire district had under drought but Karjat, Jamkhed and Shevgaon tehsils were more affected by severe drought whereas Parner, Nagar, Shrigonda, Pathardi and Kopargaon were affected by moderate drought. While only Akole tehsil in district had normal rainfall. Therefore to tackle drought conditions in future, better irrigation facilities should be provide in severe drought prone areas and also cropping pattern should be change with adopting low water requirement crops.

Key words: *Rainfall, Departure Index, Meteorological drought, Severe Drought*

INTRODUCTION:

Agriculture is one of the key sectors in India, providing about 54 per cent employment with contributing about 17 per cent of GDP. Indian rural economy entirely depends on agriculture while agriculture hung on monsoon. Rainfall is playing a vital role in planning and strategies of any agricultural activity in rural areas of country. The nature of rainfall is highly erratic and intra seasonal variability is also very high varying with place to place. Last few years in Maharashtra rainfall was very scanty with highly variable specially, in Ahmednagar district rainfall variability increased from 25.08 % in 1971 to 43.43 % in 2011 (Sandip Sasane, 2016) hence, district is highly vulnerable to drought. A year is considered as drought year as per IMD criteria, if the total amount of annual rainfall over an area is deficient by more than 25% of its LTM value. Deficiency in the range of 25 to 50 % represents moderate and more than 50 % severe drought (IMD Report, 1971). Drought is one of the serious hazards and frequently occucreasing natural hazards that related to

deficiency of rainfall over extened period of time. This rainfall deficiency resulting in a water scarcity for agriculture and allied sectors therefore these drought prone areas are lagging behind not only agricultural but also in economic growth. Many indices of drought are in extensively using today, such as the decile approach (Gibbs and Maher 1967, Lee 1979, Coughlan 1987) used in Australia and the Palmer Drought Severity Index and Crop Moisture Index (Palmer 1965 and 1968, Alley 1984) in the United States. A relatively new index that has gained considerable popularity worldwide is the Standardized Precipitation Index (SPI), developed by McKee et al. (1993 and 1995). Therefore the present study attempt has been made to assess meteorological drought areas in Ahmednagar district applying rainfall departure index.

STUDY AREA:

Ahmednagar is the largest district of Maharashtra State with geographical area of 17, 418 sq. km. (17. 41 lakh ha.) which is 5.66% of area of Maharashtra State. It lies between 18° 2' to 19° 9' N latitude and 73° 9'

o 75° 5' E longitude with covering 14 tehsils. It is an agrarian economy. The population of district is 45, 43,083 (Provisional Census, 2011) and Out of total workers 75. 42% are engaged in agriculture. The district has 12, 56,500 ha Net Cropped Area (NCA) out of 3, 30,000 ha area (26.27 %) is under canal and well irrigation but remaining about 9, 26,500 ha. (73.73 %) area is rain fed. Therefore agricultural operations are mainly depends on SW Monsoon, but rainfall in district is highly erratic. The average annual rainfall in the district is 568.7 mm.

MATERIAL AND METHODS:

The tehsil wise rainfall data was obtained from the Indian Meteorological Department, Pune. The data consisted of year wise annual rainfall for the period of 2012 to 2015 recorded at 14 rain gauge stations of Ahmednagar district. The drought classified on the basis of annual rainfall deficiency criteria as per Indian Meteorological Department and National Commission on Agriculture (Table 1). The criterion is based upon the percentage of rainfall departure from its long term mean and is computed as;

Where,

$$DI = \left[\frac{RF - MRF}{MRF} \right] * 100$$

Departure Index (Percentage of departure from Long Term Mean)

RF = Annual rainfall in mm

MRF = Long Term Mean of annual rainfall in mm.

Rainfall departure index was calculated using ExcelSAT software, on the basis of the percentage of departure from LTM rainfall (Table 1) the year wise drought maps were prepared through ArcGIS 10.2 software (Fig.3) and corresponding drought in Ahmednagar district was presented in table 2.

RESULTS AND DISCUSSIONS:

The annual percentage departures of rainfall from long term mean (LTM) has been calculated for identification of drought intensity as per IMD criteria, if the total amount of annual rainfall over an area is deficient by more than 25% of its LTM value (Table 1).

(Source: Computed by Researcher)

The percentage annual rainfall departures (Departure Index) in all tehsils of Ahmednagar district were calculated and presented in table 2. From the annual rainfall departure analysis, the intensity of drought has been carried out and represented by charts for 2012 to 2015 period (Fig.2). The highest severe drought tehsils were found in 2012 followed by 2015 year.

SPATIO-TEMPORAL DISTRIBUTION OF DROUGHT INTENSITY

The calculation of rainfall departure was carried out using annual rainfall data of 14 tehsils. It has been observed that Nagar, Parner, Shrigonda, Karjat, Jamkhed, Shevgaon and Pathardi tehsils were severely affected by droughts during 2012 followed by Karjat Jamkhed and Shevgaon in 2015. However maximum numbers of years were lying in the range of mild to moderate drought (Table 3).

Combining all drought years, entire district was affected due to continues drought but Karjat Jamkhed and Shevgaon tehsil were more affected so that agriculture sector totally collapsed and people migrated to cities like Pune, Mumbai and Ahmednagar for employment form these tehsils.

CONCLUSION

The result shows that entire district except Akole tehsil experienced continues drought during last four years. In 2012, except Akole tehsil entire district faced drought, Nagar,

Parner, Shrigonda, Karjat, Jamkhed, Shevgaon and Pathardi tehsils experienced severe drought (Deficiency –50.0 or above per cent rainfall from normal). Next year in 2013, Akole, Rahata and Shrigonda tehsils received normal rainfall while remaining all 11 tehsils experienced mild drought (Deficiency 0. to -25 per cent rainfall from normal). In 2014, except Akole, 6 tehsils had mild drought whereas 7 tehsils showed moderate drought conditions but in 2015, except Akole had no drought but 11 tehsils experienced moderate (Deficiency - 25 to -50 per cent rainfall from normal) and Karjat Jamkhed and Shevgaon tehsils faced severe drought. The overall drought proneness is high in entire district but terms of severe drought concerned Karjat, Jamkhed and Shevgaon and in terms of moderate droughts Parner, Nagar, Shrigonda, Pathardi, Shevgaon and Kopargaon were more affected. Therefore to tackle drought conditions better irrigation facilities should be provide in severe drought prone areas and also cropping pattern should be change with adopting low water requirement crops to tackle drought.

REFERENCES

1. Das, Kore, and Jadhav (2003): An Effective Method of Identification of Drought in Kharif Season, *Mausam*, Vol. 54, No. 4, pp 909-916.
2. Gibbs WJ, Maher JV (1967) Rainfall deciles as drought indicators. Bureau of Meteorology Bulletin 48, commonwealth of Australia, Melbourn.
3. Indian Meteorological Department (1971): Rainfall and Drought in India, Indian Meteorological Department, Government of India, Poona, India
4. Rajpoot Pushpendra Singh & Kumar Ajay, (2013): Assessment of Meteorological Drought in Satna District, M.P., India, *Universal Journal of Environmental Research and Technology*, 3(5).
5. Sasane S. B., (2016a): Rainfall Spatial Distribution in Ahmednagar District (Maharashtra), *Proceeding of National Seminar on Conservation & Management of Natural Resources in India*, Shrirampur, pp- 207-209.
6. Sasane S. B., (2016b): Detection of Changes in Rainfall for Identifying Climate Change using Mann-Kendall Test, *International Journal of Researchers in Biosciences, Agriculture and Technology*, Vol.2, No. 2, pp

Table 1: Intensity of Meteorological Drought based on Departure Index

Departure Index	Intensity of Drought
0.0 or above	No Drought
00.0 to – 25.0	Mild drought
- 25.0 to – 50.0	Moderate drought
-50.0 or above	Severe drought

(Source: Indian Meteorological Department (IMD), Pune)

Table 2: Departure of Rainfall from Long Term Mean in Ahmednagar District

Sr. No.	Tehsil	Departure Index			
		2012	2013	2014	2015
1	Nagar	-63.61	-10.98	-23.80	-48.88
2	Parner	-55.07	-2.46	-45.90	-27.38
3	Shrigonda	-50.60	20.20	-30.81	-32.46
4	Karjat	-58.23	-9.19	-20.82	-77.24
5	Jamkhed	-50.92	-19.60	-28.16	-61.71
6	Shevgaon	-56.33	-15.82	-39.29	-55.36
7	Pathardi	-60.53	-14.98	-32.07	-43.56
8	Newasa	-16.36	-11.17	-14.68	-31.47
9	Rahuri	-6.16	-8.14	-22.06	-43.49
10	Sangamner	2.54	-3.31	-14.94	-25.53
11	Akola	15.55	56.10	47.09	33.84
12	Kopergaon	-20.16	-22.40	-48.26	-34.63
13	Shrirampur	-26.42	-11.73	-20.38	-44.58
14	Rahata	8.84	8.72	-27.71	-36.90

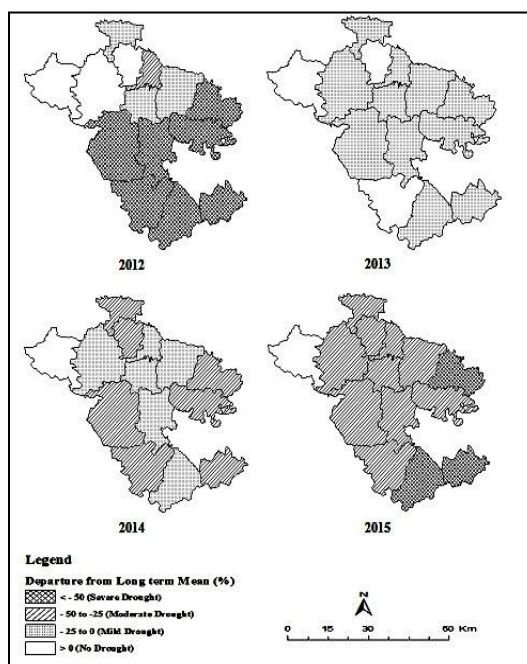


Fig. 1: Spatio-Temporal Distribution of Drought Intensity in Ahmednagar District