

Study of Rainfall Variability of the Nashik District (MS) India

Rajendra P. Gunjal

KRT Arts, BH Commerce and AM Science (K.T.H.M.) College, Nashik, Maharashtra, India

Abstract

The economy of India still largely depends upon rain-fed agricultural production. (Srivastav et al., 2007). Rainfall is a climate parameter that affects the way and manner man lives. Its regime, amount and variability are dominant natural factors that influence the life and economy of the people (Gadgil, 2002). The principal objective of the present paper is to understand interannual variability of rainfall of the Nashik District. The rainfall data were obtained for rain gauge stations located at taluka headquarters of the district from India Meteorological Department (IMD), Pune. The variability of the annual as well as in the short-period rainfall is the prominent feature of the monsoon rainfall in the district and many times it results into occurrence of droughts or floods.

Key Words: rainfall, monsoon, variability

Introduction

Although monsoon rainfall is a regular phenomenon, there are fluctuation in the intensity and spatial extent on time scales ranging from days to centuries. The short term fluctuations include not only the active and dormant phases in the rainy season, but also the individual disturbances during the active phase of the monsoon. The striking and probably the most immediately felt aspect of rainfall is the inter-annual variability. This characteristic of rainfall has the potential to cause severe droughts and floods over extensive areas. Variability, both over time and space is an important attribute of rainfall in the Nashik District that impinges on its resource value and utilization. Therefore, in the present paper, variability in rainfall with respect to time is portrayed.

Introduction to the study area

Nashik District is located in the north-western part of Maharashtra (Figure 1) and covers an area of 15530 km². It is situated between 19° 35' and 20° 50' N latitudes and between 73° 16' and 74° 55' E longitudes. The elevation of the Nashik District is varying between 300 m to 600 m ASL with some lofty peaks. Large spatial and periodic variations are observed in the rainfall. The average annual rainfall of the district is 1076 mm.

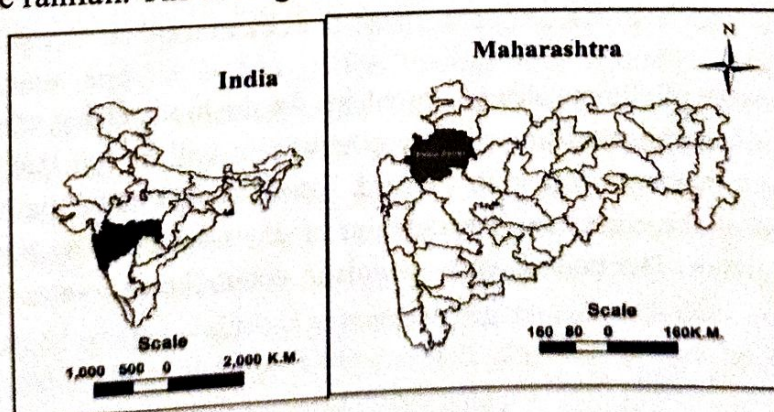


Figure 1: Location map of the Nashik District

Data and methodology

The principal objective of the present paper is to understand variability of the rainfall of the Nashik District. Therefore, rainfall data were obtained for rain gauge stations located at taluka headquarters of the district from India Meteorological Department (IMD), Pune. The district has 15 talukas, however, 11 representative talukas have been selected for the present study. The data for above-mentioned parameters have been obtained since the inception of the stations (i.e. from late 19th century to 2005). Almost all the stations have continuous records for over 120 years. However, the data for Surgana station are available only for 50 years (i.e. from 1955 to 2004). In order to understand the principal regime characteristics of the rainfall, simple statistical parameters such as mean, standard deviation, coefficient of variation, skewness, etc. are obtained to reduce and summarize the rainfall data.

Inter-annual variability of rainfall

Inter annual variability is peculiar characteristics of monsoon rainfall of India. Various aspects of rainfall variability over the country and its region are studied by many researchers (Gadgil et al. (1993), Iyengar and Basak (1994) Sarkar and Subramanian (1995)). The monsoon is a very stable and dependable source of water for the Nashik District. Superimposed on this stable picture, are seemingly small year to year changes. However, these small changes constitute a significant inter-annual variability in the rainfall. The rainfall regime in different parts of the district is not identical. Therefore, in this section, annual rainfall data around 125 years for different rain gauge stations in the district have been analyzed to know the annual rainfall characteristics of the district and the details are given in Table 1. The observations show very high range of annual rainfall in the region. For example, the minimum annual rainfall recorded at the Chandwad station was 104 mm for the year 1972, and the maximum annual rainfall was 1167 mm for the year 1933 (Table 1).

Table 1: Annual rainfall characteristics of the Nashik District (between 1878 and 2005)

Station	Record length (year)	Rmax (mm) (year)	Rmin (mm) (year)	AAR (mm)	σ	Cv	Cs
Chandwad	127	1167 (1933)	104 (1972)	647	199	0.31	0.49
Dindori	127	1600 (1981)	348 (1986)	775	223	0.29	0.88
Igatpuri	125	6601 (1931)	1645 (1899)	3297	725	0.22	0.75
Malegaon	127	976 (1874)	61 (2001)	534	186	0.35	0.11
Nandgaon	127	1210 (1887)	117 (1972)	605	194	0.32	0.48
Nashik	128	1540 (1883)	47 (2002)	703	233	0.32	0.56
Peth	117	4673 (1931)	451 (1982)	2240	618	0.28	0.58
Satana	110	965 (1980)	93 (1962)	514	173	0.34	0.25
Sinnar	127	1026 (1938)	241 (1918)	599	194	0.32	0.22
Surgana	50	3440 (1981)	705 (1968)	1950	579	0.30	0.58
Yeola	126	1039 (1943)	205 (1952)	555	164	0.30	0.41

The maximum annual rainfall ever recorded in the district is 6601 mm which was recorded at Igatpuri in the year 1931. Such a huge amount of rainfall is six times greater than the average annual rainfall of the district (1076 mm). The low annual rainfall, less than 100 mm are recorded at Nashik, Malegaon and Nandgaon. The least annual rainfall on the record is just 47 mm, which was measured at Nashik for the year 2002. The value appears to be doubtful and needs validity (Table 1). Such extreme observations of the annual rainfall, reemphasizes the high range of daily rainfall in the district. The highest annual rainfalls at

different stations show a linkage with their average annual rainfalls. The magnitude of highest annual rainfall at various stations is nearly double of the average annual rainfall of the respective station (Table 1). For instance, the average annual rainfall of Igatpuri is 3297 mm and the highest annual rainfall recorded for it is 6601 mm. The same can be noticed for Nandgaon and Satana (Table 1).

It is well known that the rainfall of the same region varies from one year to another. A quantitative measure of this variability is the coefficient of variation (Cv). The Cv is useful measure of variability in the annual rainfall. The Cv is the ratio between standard deviation and mean. Inter-annual variability of the annual rainfall in the district is not so high, as the coefficient of variation (Cv) of annual rainfall in most parts of the Nashik District is generally observed about 30%. The distribution with less Cv is said to be more uniform, consistent or less variable (Dutta, 2006). However, in the eastern part of the district, the Cv touching 35% suggesting relatively high inter-annual variability (Table 1).

Igatpuri, the highest rainfall receiving station in the district, has little inter-annual variability as the Cv is just 22% while the eastern low rainfall locations situated in the rain-shadow area like Malegaon and Satana show high inter-annual variability in the district because the Cv is about 35% (Table 1). The variability of annual rainfall is comparatively lower in the western part of the district than in the eastern part. Since the values of the mean annual rainfall are lower in the east than in the west, this implies that the annual rainfall amounts are not only lower in the east but are also less reliable than in the wetter western part of the district.

Skewness is one of the most commonly used moments for the annual rainfall. The values of coefficient of skewness (Cs) are positive for all the stations. They are ranging between 0.11 and 0.88 (Table 1). The positive values propose the occurrence of a few very wet years during the gauged period. All the values of the skewness (Cs) are statistically significant, as they are calculated on the basis of more than 100 years data (Viessman et al., 1989).

Conclusions

The present study brings out some important conclusions of the rainfall over the Nashik district. Inter-annual variability of the annual rainfall in the district is not so high, as the coefficient of variation (Cv) of annual rainfall in most parts of the Nashik District is generally observed about 30%. However, in the eastern part of the district, the Cv touching 35% suggesting high inter-annual variability. Igatpuri, the highest rainfall receiving station in the district, has little inter-annual variability as the Cv is just 22% while the eastern low rainfall locations like Malegaon and Satana situated in the rain-shadow area show high inter-annual variability in the district as the Cv is about 35%. The values of coefficient of skewness (Cs) are positive for all the stations. They are ranging between 0.11 and 0.88. The positive values propose the occurrence of a few very wet years during the gauge period.

References

1. Dutta, D., 2006. Statistics and operation research- A unified approach. Laxmi publications (P) Ltd, New Delhi, pp. 20.

2. Gadgil, A., 2002. Rainfall characteristics of Maharashtra. In: Diddee, J., S.R. Jog, V.S. Kale and V.S. Datye (Editors), Geography of Maharashtra. Rawat Publications. Jaipur, pp. 89-102.
3. Gadgil, S., Yadumani, and Joshi, N.V., 1993. Coherent rainfall zones of the Indian region. International Journal of Climatology, v. 13, pp. 547-566.
4. Iyengar, R.N. and Basak, P., 1994. Regionalization of Indian monsoon rainfall and long-term variability signals. International Journal of Climatology, v.14, pp. 1095-1114.
5. Sarkar, J. and Subramanian, S.K., 1995. Dryspell probability by Markov Chain Model at Madras during the northeast monsoon months. Mausam, v. 46, pp.85-87.
6. Srivastava, A. K., Guhathakurta, P., Rajeevan, M., Dikshit, S.K. and Kshirsagar, S.R., 2007. Did unusual warming over the mid and higher latitudes play some role in causing the unprecedented failure of the south west monsoon during July 2002? Meteorology and Atmospheric Physics, v. 96, No.3-4, pp. 193-201.
7. Viessman, W., Lewis, G.L. and Knapp, J.W., 1989. Introduction to Hydrology. Happer and Row Publishers, Singapore.