Analysis of Rainfall Charactristics in the Drought Region of Nashik District

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ABSTRACT

The climate of the district is monsoonal in character. However it is marked with large variations in weather conditions at different locations. Against this backdrop, the rainfall characteristics were analyzed in terms of annual average amounts, distribution, intensity, variability. The rainfall data for the period of two decades (1985 to 2005) was procured from Indian Meteorological Department (IMD), Pune and analyzed by using above said statistical techniques that helped to understand the rainfall distribution in the study region. In brief, an overall analysis of rainfall parameter indicated considerable regional spatio-temporal variability. Average annual rainfall of the district is 1190.30 mm. The relief of study area significantly impacts on annual rainfall amounts, as a result four hyetal zones were identified. Firstly, The Wet Zone in the western hilly regions of Sahyndris, Secondly, in the Intermediate zone Kalwan, Dindori, Nashik and Igatpuri tehsils. And thirdly, Semi-arid and Arid Zone is spread over larger portion; partially or fully cover 11 tehsils of the study region. An overall analysis of rainfall parameter proved that the magnitude of rainfall is a fundamental weather element, which determines the location of the particular crops in different parts of the study area.

Keywords: rainfall variability, hyetal zones, cropping patterns.

INTRODUCTION:

The climate of the district is monsoonal with 'hot', 'rainy' and 'cold' weather seasons and characterized by dryness except in southwest monsoon season. However it is marked with large variations in weather conditions at different locations. By and large, it leads to form three types of micro-climates in the study area.

a) Western part is characterized by high rainfall, moist or humid weather condition.
b) The central part record moderate temperature and rainfall.
c) Eastern part of the district receives low rainfall and marked with extreme heat in the month of March, April and May and cold in Nov and Dec. This is a semi-arid belt, where cool winter and hot summer prevails.

The most important factors of climate from the standpoint of plant response are temperature and rainfall. They may be treated as primary determinants of crop growth (Singh and Dhillon 1998). The ultimate success of this enterprise depends largely on favorability of micro-climate at a specific location (Tawade 1981). Against this backdrop, it was essential to identify the water scarcity regions with respect to rainfall distribution. Since rainfall is the single most dominant weather element that determines the cropping pattern at the particular locality. In context to this, the rainfall characteristics were analyzed in terms of annual average amounts, distribution, intensity, variability and its correlation with agriculture.

Location of the Study area:

The Nashik district is located in the northwest part of Maharashtra. It has the following latitudinal and longitudinal extent (Fig 1).

i) Latitude - 19°35' N to 20°35' N
ii) Longitude - 73°16' E to74°55' E.

Origin of research problem:
Nashik district is located over the 'Western Deccan Plateau' of the state that is in rain shadow area of Sahyandri mountain ranges. It is a chronically drought prone region despite that it is has been already famous for grape farming that is mainly concentrated only in the canal irrigated southern potion (Godavari river area). On the other hand, northeastern part covering namely Kalwan, Satana, Malegaon, Deola, Nandgaon and Chandwad tehsils of study region is located in rain shadow area. It receives an uncertain and low amount of rainfall that leads to form it drought prone region. Moreover, seasonal river flows and existing water reservoirs do not possess an inadequate water to meet the demands of agriculture. Consequently, availability of water for irrigation is a major limitation in agricultural practices.

DATA BASE & METHODOLOGY:

The rainfall data for the period of two decades (1985 to 2005) was procured from Indian Meteorological Department (IMD), Pune. Then it was analyzed by using statistical techniques viz. Arithmetic average, Intensity of rainfall and Coefficient of Variability that helped to understand the rainfall distribution in the study region.

Hypothesis:
At the micro level, spatio-temporal rainfall distribution indicates considerable regional variability.

Objective:
To investigate spatio-temporal distribution and phenomenal changes in rainfall amounts of study area.

Scope of study:
Present micro-level study would be significant in two ways. Firstly, it would provide base for implementation of irrigation and water shed projects. Secondly, due to continuous water shortages experienced in the study region, the farmers could shift to cropping patterns that could be cultivated with minimum irritation potentials.

RESULTS AND DISCUSSION:

A) Spatial Distribution of Rainfall:
The averages of annual rainfall, rainy days and intensity of rainfall are calculated for the two decades (1985 - 2005) data period and presented in table 1.

Table 1. Average annual rainfall, Rainy days and Intensity of rainfall

Sr. No.	Tehsil	Annual Average Rainfall (in mm)	Rainy Days	Intensity of Rainfall (mm) (Ave. rainfall / rainy days)
1	Yeola	536.64	47	11.19
2	Deola	606.43	33	18.54
3	Satana	621.56	38	16.63
4	Malegaon	623.54	44	14.76
5	Nandgaon	649.52	43	15.40
6	Chandwad	657.74	55	13.06
7	Sinnar	680.75	51	13.70
8	Kalwan	698.13	54	12.76
9	Dindori	700.39	70	11.29
10	Niphad	755.45	47	16.71

Sr. No.	Tehsil	Annual Average Rainfall (in mm)	Rainy Days	Intensity of Rainfall (mm) (Ave. rainfall / rainy days)
11	Nashik	758.22	67	11.78
12	Peth	2278.92	94	24.50
13	Surgana	2417.30	87	28.09
14	Trambak	2679.57	87	30.87
15	Igatpuri	3189.70	111	31.70
District Average		**1190.3**	**62**	**18.1**

Source: Indian Meteorological Department, Pune

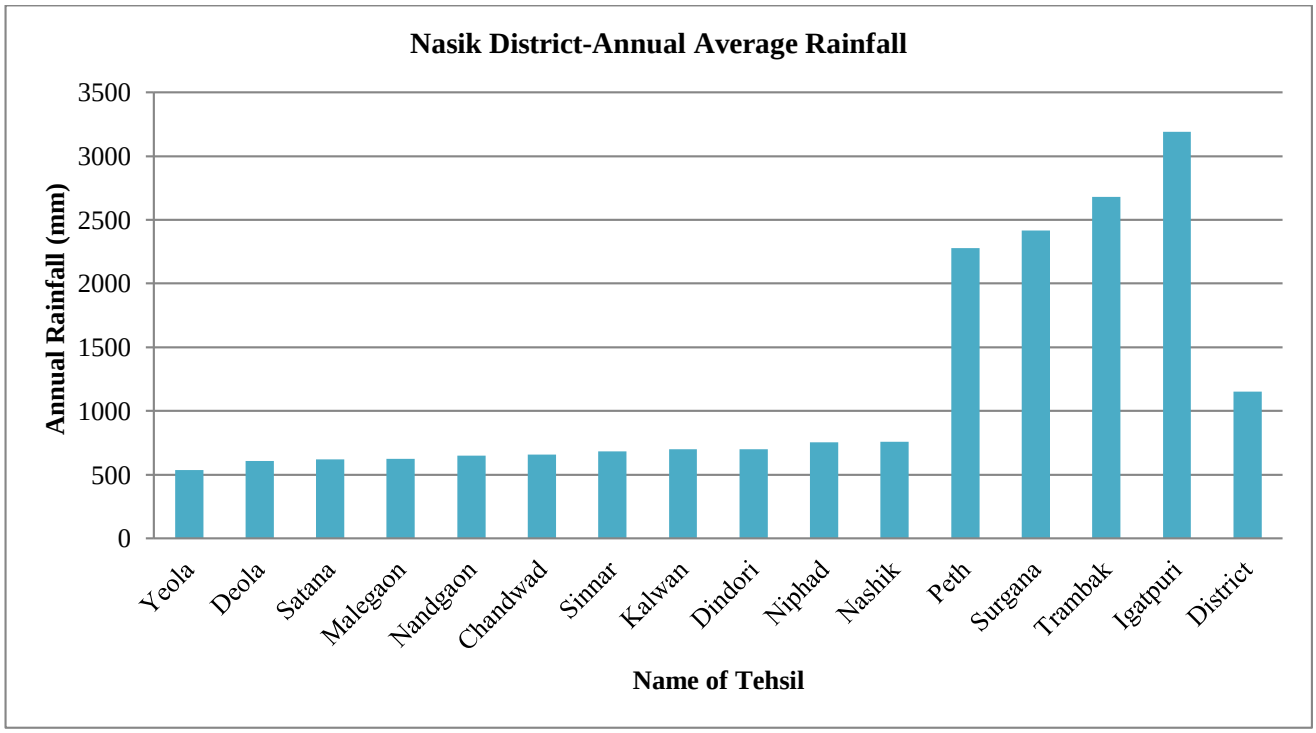

Figure 1: Annual Average Rainfall

Average annual rainfall of the district is 1190.30 mm. However, observation of table 1 and figure 1 indicates significant variations in spatial distribution of rainfall in the study region. As stated earlier, the relief of study area significantly impacts on annual rainfall amounts, as a result four hyetal zones can be identified.

i) The Wet Zone:

In the western hilly regions of Sahyndris, the moisture laden southwest monsoon winds are obstructed. That leads to yield the orographic or relief type of precipitation.Consequently, the highest rainfall < 2000 mm is often recorded on the narrow strip at the extreme western part close to Sahyandri hills. It covers Igatpuri, Trambak, Peth and Surgana tehsils.

ii) The Intermediate zone:

There is a rapid decrease in the amount of rainfall in the east of crest Sahyandris. The annual rainfall is between 2000 to 1050 mm in parts of Kalwan, Dindori, Nashik and Igatpuri tehsils. Hence, it forms transition or intermediate zone between wet and dry rainfall zones of the district.

iii) The Semi-arid and Arid Zone:

The south west monsoon moisture-laden winds get empty while crossing the 'Sahyandri Mountains' and they reach in eastern region with decreased capacity to shed moisture in the form of rains. So that leads to the formation of rain-shadow area in eastern portion. This area is spread over larger portion; partially or fully cover 11 tehsils of the study region.

"The region having less than 700mm annual average rainfall can be considered as drought prone area" (Phule 2002). With reference to this, it can be stated that the eastern half of districtcan be considered as drought prone area of the Nashik district. The stations namely Yeola, Deola, Satana, Malegaon, Nandgaon, Chandwad, Sinnar tehsils record < 700 mm annual rainfall.

Rainfall variability:

Normally it is seen that rainfall is a highly variable phenomenon from season to season and one year to another. And its variability increases with decreasing mean annual rainfall. In this view, the coefficient of rainfall variability was obtained with help of the formula given by Hammond and McCullagh (1998). Simply, it is converting a standard deviation to a percentage of the mean.

$$\text{Coefficient of Variability} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Table No. 2.3 Coefficient of Annual Rainfall Variability (1985-2006)

Sr. No.	Tehsil	Coefficient of Rainfall Variability (in %)		Sr. No.	Tehsil	Coefficient of Rainfall Variability (in %)
1	Yeola	38.77		9	Dindori	28.04
2	Deola	36.82		10	Niphad	33.64
3	Satana	37.00		11	Nashik	27.44
4	Malegaon	40.03		12	Peth	29.88
5	Nandgaon	38.14		13	Surgana	21.59
6	Chandwad	38.56		14	Trambak	22.66
7	Sinnar	42.02		15	Igatpuri	22.55
8	Kalwan	34.33		District Average		32.76

Source: Compiled by researcher

It can be observed from table 1 that variability is usually minimum over areas of high rainfall (Nashik, Peth, Surgana, Trambak and Igatpuri) but greatest over rest parts having low rainfall. Variability in excess of 20% implies a great risk to farming (Singh and Dhillon 1998). It indicates that in the absence of irrigation facilities, agriculture occupation could be a risky job in the study area. The dry farming practices are expected to face the climatic hazard like famines and droughts any time.

FINDINGS:

Overall analysis accepts the hypothesis of study that at the micro level there is considerable regional contrast in rainfall variability. Over the Sinnar plateau in the south and in the easternmost parts (Deola, Chandwad, Yeola, Nandgaon, Malegaon and Satana tehsils) the rainfall is highly variable (> 35%), in other words, it is uneven phenomenon. Moreover, due to intense solar radiation the potential evapo-transpiration is high in major parts of the year. Under such conditions of moisture deficiency, only drought resistant crops like bajara, jowar in food grains are cultivated. And the fruits crops can be cultivated with the help of arid horticultural techniques such as drip irrigation and organic soil mulching.

In brief, an overall analysis of rainfall parameter proved that the magnitude of rainfall is a fundamental weather element, which determines the location of the particular crops in different parts of the study area.

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