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### 33. Study of Rainfall Variability on Pune District

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#### Abstract

The growing population and their needs, there is increasing emphasis on natural resources. Water is an important factor in this resource. The use and availability of water we need micro level study on rainfall. Every year due to rainfall vagaries, one or the other part of the country experiences floods or drought conditions which affects human wealth and properties and so also the physical and socio-economic conditions of a country. The main purpose of this research paper is to describe the variability of precipitation and the scientific technique used to create the merged analysis of rainfall over Pune.

#### Introduction

All the people, animals, plants and other living things in India are depends upon the rainfall received during the southwest monsoon months of June to September. Rainfall is the dominant single weather element influencing the all needs of people such as intensity and location of farming system and the choice of enterprise. "Climatic variability particularly rainfall variability is a major factor influencing the agricultural productivity and sustainability in the tropics." (Virmani 1994).

For the last 9 to 10 consecutive years, Pune district of Maharashtra is experiencing deficient monsoon rainfall and which leads to severe drought conditions in many parts with high amount of water scarcity for agricultural and irrigation purposes but for drinking water and all things. And last 2 years it received the high rainfall with extra rainy days. In view of this, the present study attempts to study rainfall at micro level viz. Taluka/village level in the Pune district.

#### Study Region

##### About Pune

Pune is the second largest district of Maharashtra State in respect of its geographical area 15642 sq.km, which is about 5% of the total area of State. It comes under Krishna valley. It presents western part of the Maharashtra and geo co-ordinates of the study region is 17°54' N

and  $19^{\circ}24'$  N and  $73^{\circ}29'$  E and  $75^{\circ}10'$  E. It is bounded by Ahmadnagar district in north and north east direction, Satara and Solapur districts in south and south east respectively; in the northwest and west Thane and Raigad districts respectively For administrative convenience the entire district has been divided into 14 talukas namely Pune City, Haveli, Khed, Ambegaon, Junnar, Shirur, Daund, Indapur, Baramati, Purandhar, Bhore, Velhe, Mulshi and Maval. Pune city is located at 559 m above m.s.l. It is located in the Deccan Plateau and is about 100 kms east from Konkan coast, at a distance of about 160 kms from Mumbai.

### **Objectives**

1. To study mean monthly, seasonal and annual rainfall variation over different talukas and the district as a whole.
2. To study of rainfall amount, onset and withdrawal monsoon over Pune district.
3. To study the rainfall variability trend by using statistical methods.

### **Significant terms used**

1. **Rain Intensity:** The intensity of rainfall is a measure of the amount of rain that falls in a particular duration (days). It forms an essential tool while designing any storm water system over a basin or in a region which can withstand extreme rainfall.
2. **Rainy Days:** Rainfall amount realized in a day is 2.5 mm or more.

### **Data Used**

The present study is based on secondary sources of time series data obtained for 30 years from 1971-72 to 2011-12. Daily rainfall data of all the stations inside the district have been procured from 1971 to 2004 for the stations located in the Talukas of the Pune district from the National Data Centre (NDC), India Meteorological Department (IMD), Pune.

### **Methodology**

On the basis of all the available daily rainfall data, a homogeneous set of rainfall data was prepared excluding all the outliers. This data formed the data base for further analysis. Using this data, mean monthly, seasonal and annual rainfall for all the talukas of the Pune district were calculated. Similarly wet and dry days during the twelve year period were also worked out.

### **Statistical method**

For statistical data analysis Mean, Coefficient of Variation (CV), Correlation of Coefficient (R<sup>2</sup>) and Trend Analysis to given important scenario of change pattern of time series data were used.

1. Coefficient of Variation: "A statistical measure of the dispersion of data points in a data series around the mean." It is calculated as follows:  
Coefficient of Variation = S.D / Mean. The coefficient of variation represents the ratio of the standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from each other.
2. Rain Intensity: Ratio of rainfall during the monsoon months to the number of rainy days during the monsoon months.
3. Correlation coefficient means statistic that is calculated from sample data and is used to estimate the corresponding population correlation coefficient. Correlation coefficients generally take values between -1 and +1. A positive value implies a positive association between variables (i.e., high values of one variable are associated with high values of the other), while a negative value implies a negative association between variables (i.e., high values of one variable are associated with low values of the other). Thus, a coefficient of -1 means the variables are perfectly negatively related; while +1 means a perfect positive relation. A coefficient of 0 means the variables is not related.

### **Rainfall Properties of the Pune District**

#### **Monsoon onset, withdrawal and duration**

The analysis of rainfall for agricultural purposes must include information concerning the trends or changes of precipitation, the start end and length of the rainy season, the distribution of rainfall amounts through the year, and the risk of dry and wet spells.

The southwest or the summer monsoon (Jun-Sept) is the main source of rainfall over the Pune district. Onset and withdrawal dates of monsoon rainfall were collected for the period of 1981 to 2012 in order to know the long term variation in the rainfall pattern over the district. During the last 30 years or so, onset date over the district was as early as 31 May in 1990 and as late as 21 Jun in 1981 and 2009 (a severe drought year) against the normal onset date of 10 June. Similarly, the withdrawal date was as early as 19 Sept in 1985 to as late as 26 Oct in 2010. Therefore, total duration of monsoon over the entire district varied from 103 days in 1985 to 137 days in 2010 against the normal duration of 114 monsoon rain days.

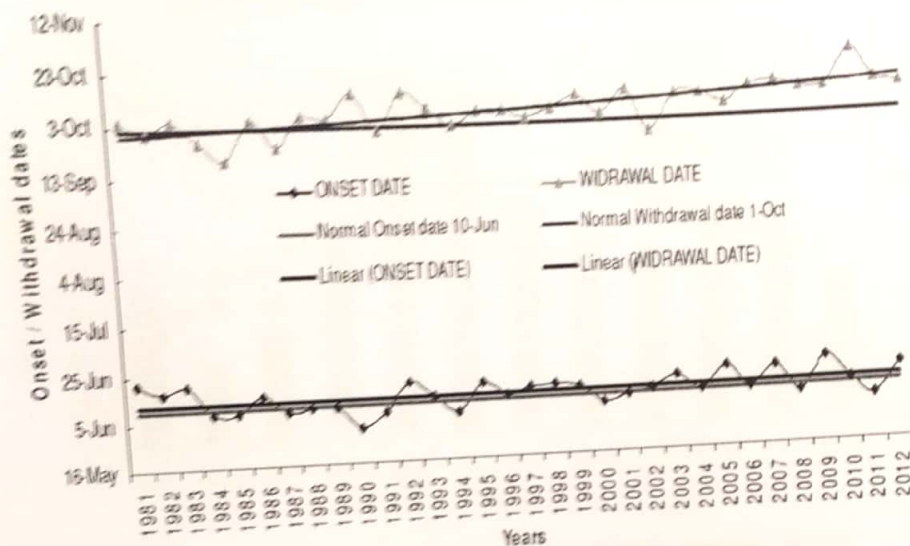


Fig: Time series of onset and withdrawal dates over the Pune district

In the present study monsoon onset and withdrawal was considered for the period of 2001 to 2010. During this period, the monsoon duration over the district was minimum (107 days) in 2002 – a severe drought year and maximum (137 days) in 2010 – a good monsoon year against the normal duration of 114 monsoon rain days.

Table: Early and Late Onset/Withdrawal dates over the Pune district.

Monsoon onset /withdrawal	Early Date	Late Date
Onset	4 June 2011	21 June 2009
Withdrawal	26 Sept 2002	26 Oct 2010

The average rainfall over the district shows a decreasing trend ( $R^2 = 40\%$ ) especially during the period of 2007 to 2012 however, duration of monsoon was near normal or above normal. During this period there were two severe drought years 2002 (58 rain days) and 2009 and two excess rainfall years 2005 and 2006 with 65 and 73 rain days respectively.

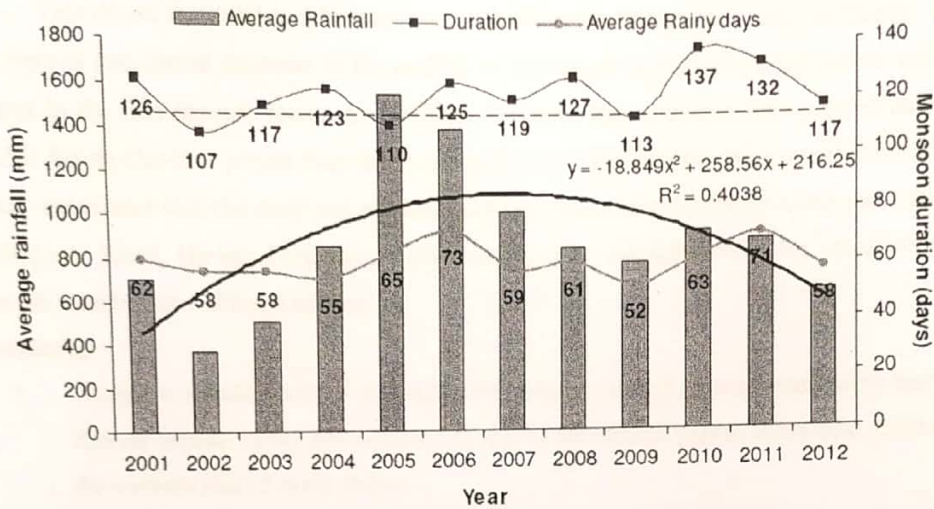


Fig. Yearly variation of monsoon duration, average rainy days and rainfall

**Mean Monthly, Seasonal and Annual Variation of Rainfall**

Pune district experiences heavy rainfall during the four monsoon months of June to September. The daily rainfall data for the period of 2001 to 2010 was analyzed to know mean monthly, seasonal and annual rainfall variation of rainfall over the different talukas of the Pune district. The analysis showed that the mean annual rainfall is highest in the Velhe taluka. Next to it, Maval, Mulshi and Bhore talukas recorded maximum mean annual rainfall during the 10 year period.

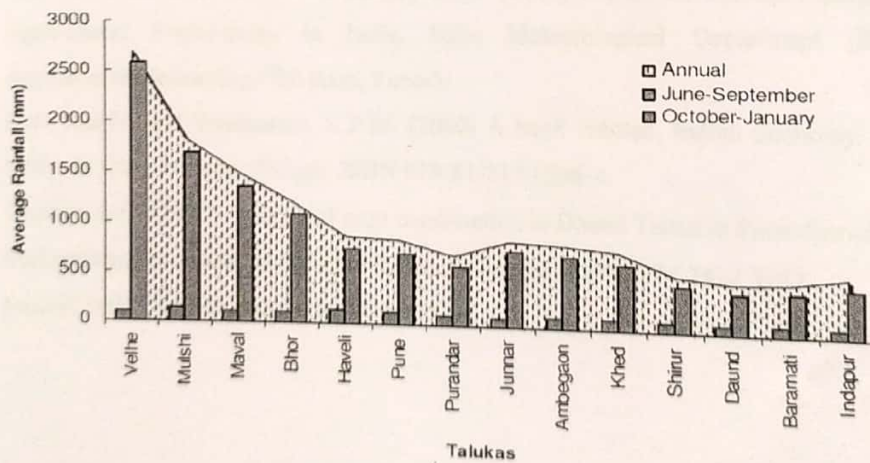


Fig.: Mean Annual and seasonal rainfall distribution in different Talukas

This shows that talukas which are nearer the Western Ghat region received heavy rainfall and there is substantial decrease in the rainfall of talukas away from the Ghat and/or which are located in the rain shadow region of the Ghat. However these talukas receive good amount of rainfall during Oct-Dec period than the four districts of Velhe, Mulshi, Maval and Bhore which is mostly associated with the northeast monsoon activity. It is observed that Western part of Junnar, Ambegaon, Khed, Haveli, Purandar talukas receive good rainfall during the monsoon season than the eastern parts of these talukas.

### **Conclusion**

1. There are significant intra-regional differences in rainfall amount, variability and trend. Annual rainfall varies from about 500 mm in the eastern part to more than 1200 mm in the western part of study region.
2. Rainfall amount is higher and its variability is lower in the western part of the region than in the eastern.
3. Rainfall has shown decreasing trend in annual and seasonal rainfall. During the two drought years of 2002 and 2009 the district experienced very less rainfall activity.

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