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Analyses of Rainfall and Temperature of Pune District, Maharashtra

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Abstract:
Analyses of Rainfall and temperature are the most effective and the most powerful components of our natural environment. These components have complex bearing on formation of soil, natural vegetation, different flora and fauna, biodiversity and ultimately various economic activities and occupations of the human being.In this research work, endeavor is made to show how the rainfall and temperature affect the various economic activities of human being. The rainfall and temperature of the region play an integral part of our natural environment. These elements influence the way of the life of the people in particular region. Even the surface of the land is modified mostly by the action of rainfall and temperature. The study undertaken in this project work is analyzes the rainfall, temperature and probability estimates of weekly rainfall of Pune district.

Keywords: Analysis, Rainfall, Temperature, Pune, Trends, Methodology,

I. INTRODUCTION

Climatic changes will influence the severity of environmental stress imposed on vegetable crops. The response of plants to environmental stresses depends on the plant developmental stage and the length and severity of the stress (Bray, 2002). Plants may respond similarly to avoid one or more stresses through morphological or biochemical mechanisms (Capiati et al. 2006).A trend of about 10 to 12 per cent (of the normal) increase in monsoon rains were reported along the west coast, northern Andhra Pradesh, and northwestern India during the last century. A decreasing trend of about 6 to 8 % is observed over the last 100 years over eastern Madhya Pradesh, North-Eastern India and some parts of Gujarat and Kerala (Mall, 2006)
Huge crop losses were noticed in Maharashtra (India) due to unseasonal and poor rain fall distribution during 1997-98. The 1997/1998 El Nino event affected 110 million people and resulted in the loss of global economy nearly US$ 100 billion. Insurance companies showed that natural weather-related catastrophes caused an estimated economic loss of US$960 billion for the period of 1950-1999 (IPCC, 2007). Apple productivity in particulars and stone and other fruit in general has shown declining trend of 40-50 per cent in Himachal Pradesh up to 1500 mm due to warmer climate and lack of chilling required chilling hours during winter and adequate growth during warmer summers (Petri and Leite, 2004). The apple growing area is rapidly shifting from lower elevations to higher elevations, and larger area have been reduced unfit for cultivation (Rana et al., 2008).

The rain and hails during flowering adversely affect the fruit set, whereas, moderate temperature of 20oC with relatively low rains during flowering results in the good fruit set (Randev, 2009). Rana and others (2009)

reported decrease in chill unit hours in the apple growing areas of Himachal Pradesh. Most of the apple varieties require 1000-1600 hours (at or below 7.20C) of chill units depending upon the variety (Singh and Sharma, 2015).Africa is highly susceptible to the potential impacts of climate change and Ethiopia is regularly cited as one of the most exposed and with the least capacity to respond and adapt (Thornton et al. 2006). Ethiopia already suffers from historical climate variability and extreme climatic cases (Mesfin 1984, Pankhurst 1985, McCann 1987, IIRR 2007). Droughts and floods are common phenomena in Ethiopia, occurring every 3 to 5 years (World Bank 2006).

Analysis of historical climate data show an increase in mean annual temperature by 1.3°C between 1960 and 2006, translating into an average rate of 0.28°C per decade. The annual minimum temperature increased by about 0.37°C every decade between 1951 and 2006 (McSweeney et al. 2008). Ethiopia 's National Meteorological Agency (NMA) identifies drought and flood as the major hazards in the future as well, with potential negative impacts on agriculture and food security (FDRE 2011).

Many Indian and global studies using a variety of models (INFOCROP, DSSAT) reported that rising minimum temperatures during maturity period may significantly reduce wheat yields in India including Madhya Pradesh (Naresh Kumar et al., 2014; Bapuji Rao et al., 2015). One of the adaptation measures to mitigate the impact of climate change will be to use more suitable and/or resilient crop varieties (IPCC 2007).The general growing season in Europe and Germany has been extended by 10 days (Chmielewski and Rotzer 2001 and 2002). The flowering dates in cherry blossoms (Prunus yedoensis Matsum.) were analyzed in relation to air temperature in March, or as a function of latitude, longitude, coldness / warmth indices. It was shown that mean flowering dates for cherry in Japan and Korea are 3 to 4 days earlier when the mean air temperature in March increases by 1°C (Yoshino and HyeSook 1996).

1.1 Location of the Study Region

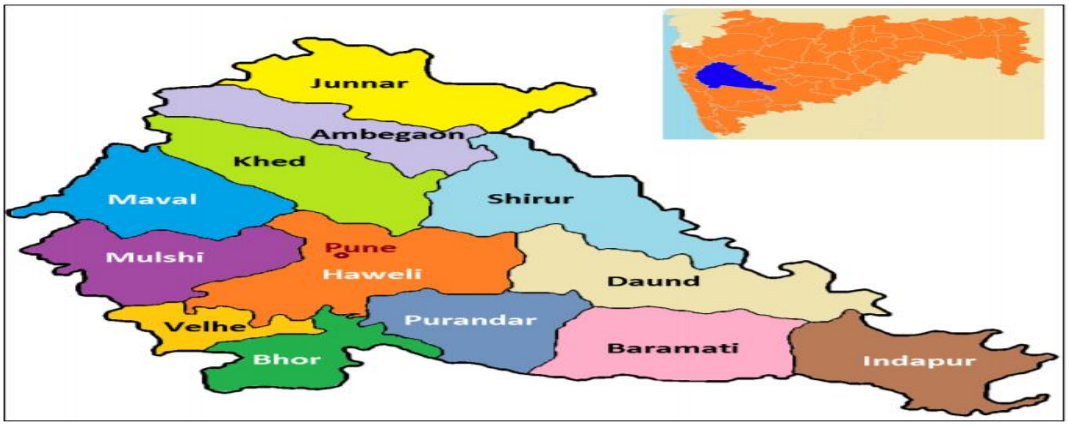

Fig.1.1: Presentation of the investigation area of the location map of Pune

Pune District, known for its diverse topography and agricultural significance, experiences varying climatic conditions. The analysis aims to shed light on long-term trends, anomalies, and potential implications for sectors such as agriculture, water resources, and urban planning. Pune District, located in the Maharashtra, India, is characterized by diverse topography and plays a crucial role in the agrarian landscape of the region. Understanding the climatic conditions, particularly rainfall and temperature patterns, is essential for sustainable development and resource management. The city 'Pune' is in the tropics at more than 550 m. above sea level. Its latitudinal extension is 18 31' north and 7351' east.

The town is 30 miles from the crest line of the Sahyadri and 63 miles from the Arabian Sea. It has a strategic position in the valley of Mula-Mutha, which joins each other a few kilometers east of Pune and forms a part of the Bhima basin and a part of the Krishna basin. Pune is situated on the lee-word side of the western Ghats and the western margin of the Deccan plateau. The general slope of the area is towards the east. Down the valley to the east, the terraces become wider and more extensive.

II. METHODOLOGY

The main objective of the study is to analyze rainfall, temperature and probability estimates of weekly data of Pune district. Temporal variation in rainfall and temperature is very high at Pune. These variations in

rainfall and temperature on annual, monthly, and weekly basis are studied using the rainfall data of Pune station during the 100 years 1901 to 2000.Using the rainfall and temperature data various analysis like mean, mode, median, variability, standard deviation, co-relation, have been drawn. Using the rainfall data, probability estimates have been drawn. Primary data is collected through intensive field work. Some secondary data has been collected from the District Gazetteer, Municipal year book, District statistical abstract and Socio-economic abstract and records of villages, tahsils and Panchayat offices. The analysis is based on meteorological data collected from multiple sources, including local weather stations, satellite observations, and historical records. The data cover an extended period, allowing for a comprehensive assessment of long-term trends.

III. RESULTAND DISCUSSION

The entire study is based on secondary data pertaining to the rainfall and temperature of the Pune city. The hundred year's data of rainfall and temperature of Pune city (Since 1901 to 2000) is collected from the Indian Meteorological Department, which is in the central part of the city. The temporal analysis reveals seasonal variations in rainfall patterns. Monsoon seasons are crucial, and the distribution of rainfall during these periods is examined to identify any shifts or irregularities. The study also includes a spatial analysis to understand how rainfall is distributed across different regions within Pune District. Variations in precipitation levels can impact agricultural productivity and water availability.

Identification of extreme weather events, such as heavy rainfall or droughts, provides insights into the vulnerability of the region to climate-related risks. Examining mean temperature trends over the years helps identify any long-term warming or cooling patterns. Understanding how temperatures vary across seasons is crucial, especially considering the impact on agricultural cycles and the overall environment.

Data for this analysis was sourced from local weather stations, satellite observations, and historical records spanning several decades. This comprehensive dataset allows for a thorough examination of climatic patterns and trends. The study reveals temporal variations in rainfall patterns, emphasizing seasonal shifts and trends over the years. Monsoon seasons are of particular interest due to their critical role in the regional climate. An assessment of the spatial distribution of rainfall across different regions within Pune District helps identify areas susceptible to variations in precipitation levels. Identification and analysis of extreme weather events, such as intense rainfall or prolonged droughts, provide insights into the district's vulnerability to climate-related risks.

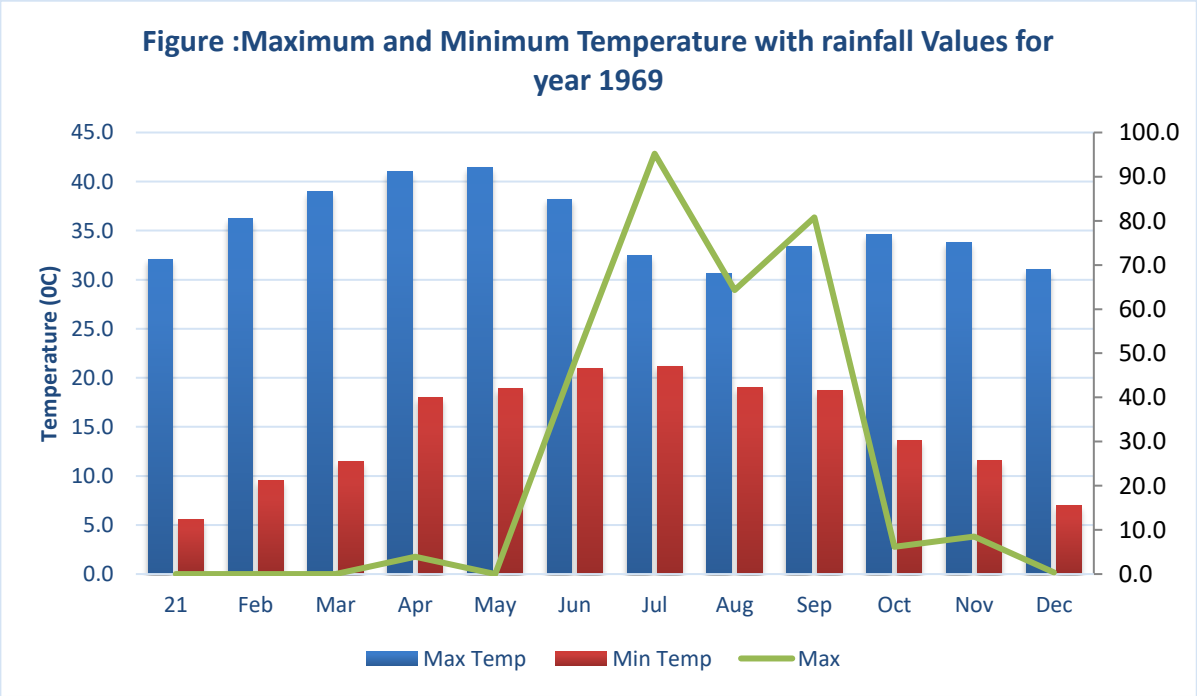

Fig.3.1: Exposition of the maximum and minimum values of Temperature and Rainfall during the year 1969

Temperature is probably the most important environmental variable to consider when selecting tropical fruit cultivars for sites. Literature reviews of climatic parameters for major tropical fruits are very basic and drawn from field experiences. The mean temperatures range for optimum growth of most tropical fruits are about 24-30°C (Mukherjee 1953; Whiley et al. 1989). mango trees can tolerate temperatures up to 48°C for short periods (Mukherjee, 1953) and have limited tolerance to cold. Lychee and longan require a warm sub-tropical to tropical climate that is cool but also frost-free or with only very slight winter frosts not below -4°C, and with high summer heat, rainfall, and humidity. Mangosteen requires high rainfall, high humidity and high temperature. It does not tolerate low temperature at all and therefore is limited to humid tropics.
Temperatures below 20°C reportedly slow the overall growth of the mangosteen tree whereas high temperatures above 35°C cause some stresses on the trees (Rejab et al. 2008). The impact of temperature change can be clearly seen from the fact that the northern parts of India are warmer than the southern parts, with a general increase of 3-6°C cover the base-period average (Lal et al. 1995; Lonergan et al. 1998). Cool temperatures during inflorescence development reduce the number of perfect flowers (Naik and Mohan Rao 1943). The photosynthesis rate was highest in the temperature range of 20-30°C and the evapotranspiration rate increased with temperature and was highest at 30-35°C (Shiraishi et al. 1996).

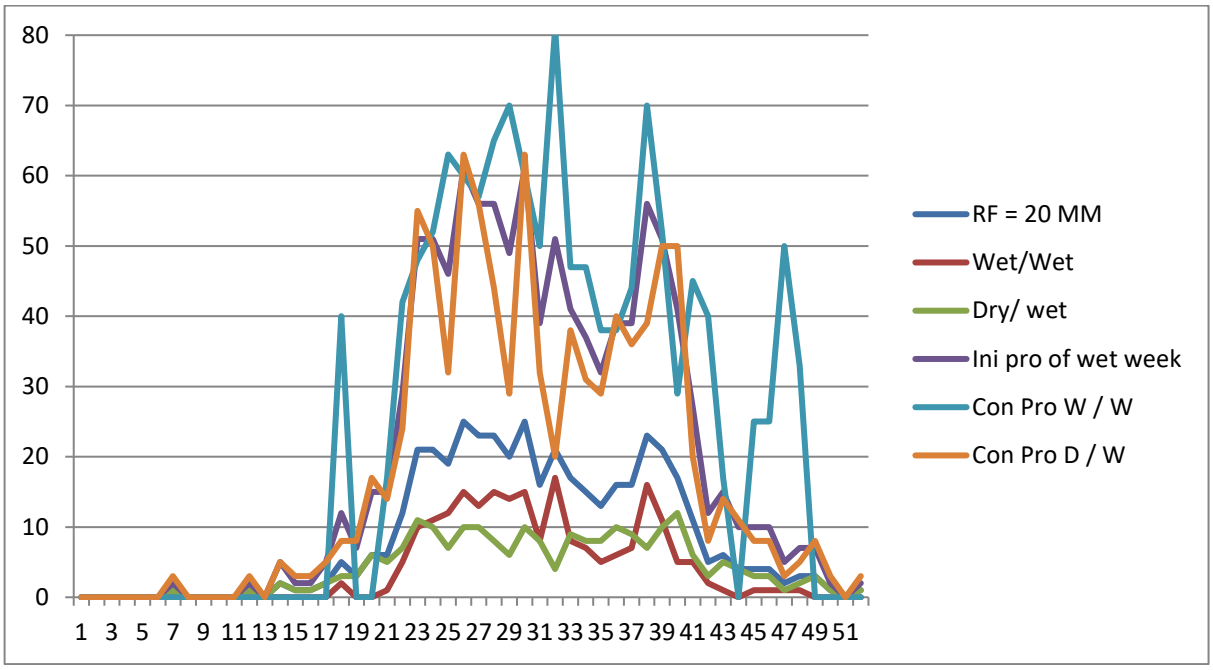

Fig.3.2: Explanation of the Different values of previous years

Climate change is predicted to cause an increase in average air temperature of between 1.40C and 5.80C, increases in atmospheric CO2 concentration, and significant changes in rainfall pattern (Houghton et al. 2001). High temperature and moisture stress also increase sunburn and cracking in apples, apricot and cherries and increase in temperature at maturity will lead to fruit cracking and burning in litchi (Kumar and Kumar 2007). The production of apple has gradually increased but the productivity has fallen from 10.8 to 5.8 t/ha (Awasthi et al., 2001).
Growing concerned now-a-day, is that if the earth warms due to increase of greenhouse effect of carbon monoxide along with other trace gases present in the atmosphere (global warming), then the patterns of the rainfall will change and effect on agricultural productivity and availability of fresh water also. One way of assessment is to the study what might happen is to look at the relationship pattern between rainfall and temperature in the past. Due to the rapid globalization, large-scale influences to tolerate the patterns of human health. Various worldwide changes which include economic, social, demographic, and environment particularly climate is linked, for example, to the increased prevalence of obesity, changes in regional food yields, the emergence of infectious diseases, the spread of cigarette smoking, and the persistence of health disparities (Anthony J. McMichael, 2013).
Climate change is emerging as one of the most and important challenging problems facing the world in the 21st century (Karen L. O'Brien, 2000). Climate change poses serious threats to urban infrastructure, quality

of life, and entire urban systems. Not only poor countries, but also rich countries also will be affected by irregular climate events and trends (World Bank, 2010). Urbanization is among the most obvious aspects of human impact on the earth globe (DeFries, 2008). It is familiar that urban sectors having higher temperatures than surrounding suburban and rural sectors, and thus phenomenon known as the urban heat island effect (Oke, 1988; Kalnay and Cai, 2003; Zhou et al., 2004; Fujibe, 2009, Stone, 2007). As urbanization is increasing across the globe (Grimm et al., 2008), especially in developing countries such as India and China (Grimm et al., 2008; NBS, 2008; DeFries and Pandey, 2010), this urban heat island effect has gained in importance (Kalnay and Cai, 2003; Zhou et al., 2004).

Climate change and globalization, both are considered as important areas for current research, particularly from the perspective of impacts assessment. Much more attention has been focused on the implications of globalization, and particularly trade liberalization, for the environment (Bredahl et al., 1996; Esty, 1995; Krissoff et al., 1996; OECD, 1997a, b; Rauscher, 1997). Climate change is inextricably linked with urbanization. Urbanization, as well as the increased connectivity and economic growth it brings, is the world's most important phenomenon. Generally, more people live in urban areas than in rural areas (UN, 2014).
Examination of mean temperature trends over the years allows for the identification of any long-term warming or cooling patterns.The study explores how temperatures fluctuate across seasons, with a focus on potential impacts on agriculture and the environment.For urban areas within Pune District, the analysis considers the urban heat island effect and its implications on local climate patterns.If applicable, the analysis considers the urban heat island effect, particularly in urban areas of Pune District, and its implications for local climate patterns.

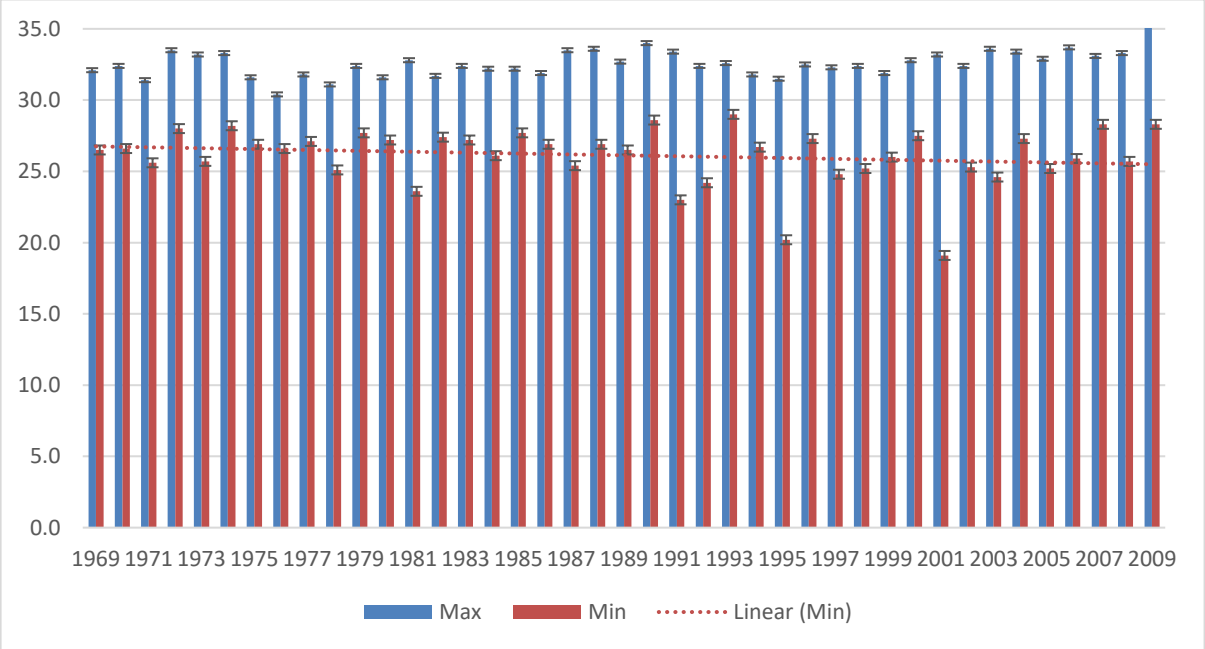

Fig.3.3: Clarification of the minimum to maximum Temperature values of

Their inference was that the probability of rainy-day occurrence was not independent of immediate pass condition indicating they're by persistence phenomenon in rainfall. Many research workers later fitted different models to the runs of wet and dry spells. To explain the observed spells of rainy days, Concharan (1938) proposed a probability model based on the theory of rains and later William (1952), Langlay (1953) and Cook (1962) use the Morkov Chain probability model to fit the daily rainfall observations. Similar outcomes were noticed by several workers in India Raman and Krishnan (1960), Rambhadran (1954), Shrinivasan (1954-59-64), Basoo (1971) have studied the runs of dry and wet spells for selected stations for rainfall persistence.

IV. CONCLUSION

This research shows detailed analysis of rainfall and temperature patterns in Pune District serves as a foundation for evidence-based decision-making. Stakeholders can utilize these insights to develop adaptive strategies, ensuring the sustainable development of the region in the face of climate variability. This research shows a detailed analysis of rainfall and temperature patterns in Pune District, aiming to provide valuable insights into climate variations that can impact various sectors, including agriculture, water resources, and urban planning. The study encompasses historical data spanning several years, examining trends, anomalies, and potential implications for the region. This comprehensive analysis of rainfall and temperature patterns in Pune District provides a foundation for informed decision-making in various sectors. The findings offer valuable insights into climate variations, enabling stakeholders to develop adaptive strategies for sustainable development in the region.

Declaration: The authors of this manuscript do not oppose the interest.

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