ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

A Geographical Study of Temperature and Rainfall Trends in Marathwada region

Dr. M. T. Musande
Head
Department of Geography
Jawahar Arts, Science and Commerce College, Andur, Tq. Tuljapur, Dist. Osmanabad (MS)

ABSTRACT: -

The temperature and rainfall trends are analysed for meteorological data of Marathwada region in Maharashtra State. India over approximately three decades stretching between years 1980-81 to 2010-11.

Climate variability particularly that of the annual air temperature and rainfall, has received a great deal of attention worldwide. The magnitude of the variability or fluctuations of the factors varies according to locations. Hence, examining the spatiotemporal dynamics of meteorological variables in the context of changing climate, particularly in countries where rainfed agriculture is predominant, is vital to assess climate-induced changes and suggest feasible adaptation strategies. To that end, the present study examines long-term changes and short-term fluctuations in monsoonal rainfall and temperature over Marathwada region in the state of Maharashtra. Both rainfall and temperature data for period of 1980–2010 were analyzed in this study. The detailed analysis of the data for 30 years indicate that the annual maximum temperature and annual minimum temperature have shown an increasing trend, whereas the monsoon's maximum and minimum temperatures have shown a decreasing trend.

Keywords: - Global Warming, maximum temperature, rainfall, Intensity of Rainfall, rainy Day

INTRODUCTION

This paper explores annual trends of rainfall in the Marathwada region over the period between 1980-81 and 2010-11. The climatic variability for an area is referred to the long term change in rainfall, temperature, humidity, evaporation, wind speed and other meteorological parameters. According to intergovernmental panel on climate change reports, frequency of droughts as well as extreme events will as extreme events will be increase and rainfall pattern will also change which is a key factor influencing economic growth of regions, especially in the country like India where the 65 percent people are directly or indirectly depend on agriculture.

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

But agriculture is hanging on erratic in nature. It also has great variations in spatio-temporal, those fluctuations extremely damaging agriculture, food security, health and many more. Therefore, the present study has been conducted in order help farmers, researcher, economist and policy makers to make fast decisions for better planning process with variations of rainfall.

The Marathwada region lies in the upper Godavari basin. The absolute location of region is $17^{0}38'53''$ North latitude to $20^{0}40'51''$ North latitude and $74^{0}33'28''$ East longitude to $78^{0}21'12''$ East longitude.

The study region is bounded to the north by Jalgaon, Buldhana, and Washim districts, to the north east by Yavatmal district to the east by Nizamabad and Adilabad districts of Telangana state to the south and south east by Bidar and Gulbarga districts of Karnataka state, to the west by Ahmednagar to the Southwest by Solapur and to the North West by Nasik district. Its shape is roughly triangular. East-West maximum extension of region is 394 Kilometers and North-south extension in of region is 330 Kilometers. Total Geographical area of region is 64434 Square Kilometer which is 20.95 per cent of the state and its population is 1.87 cores which is 16.66 percent of the state as per census of 2011. Administratively study region is divided into eight districts that are further divided into 76 tehasils.

DATA AND METHODOLOGY

The data used in this paper are the monthly averages of total mean rainfall, minimum and maximum atmospheric temperatures during 1980-2010. The yearly averages were calculated from the monthly readings which are provided by the India Meteorological Department, Pune.

Annual rainfall series of all the 8 district of Marathwada region are developed then computed arithmetic mean (X) , Standard Deviation (SD) and rainfall variability for the each district applying coefficient of variation which is expressed as percentage is defined as.

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

$$\text{Co-efficient of Rainfall Variability} = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

OBJECTIVE:-

The main objectives of this paper to review studies pertaining to trends in rainfall, rainy days and temperature over Marathwada Region.

DISCUSSION:

In a large measure climate determines where man may live and thrive, what crops he may raise? What type of home he may appropriately build? What sort of clothing he may wear? And what pests and diseases he must combat? (*Whitback R. H*. 1932). The potential crop producing ability of a given area is depend primarily upon the existing climatic and soil conditions. Since, Climatic factors exert mainly a regional influence on plant life, the differences in the behavior of a crop or a group of crops over extensive areas, as in a given state or a group of states, may be considered as due primarily to differences in climatic rather than soil conditions (*Klages K. H.W*. 1958). It is obvious that climate dictates the range of crops which a country can economically produce. This in turn sets the range of commodities which that country must import if it wishes its people to live a full life in the modem sense (*Stamp L.D*., 1963). The success or failure of the cropping season is determined by the intensity of the climatic factors. The three most important factors of climate from the stand point of plant response are temperature, water supply and light and they may be treated as primary determine of crop growth (*Hildreth A. C*. etal., 1941).

Climate plays an important role in characteristics of agricultural economy in a region. It can influence the choice of farming system either indirectly through its impact on soil formation or directly through such as the length of the growing season, the occurrence of frost and the availability of water for crop Growth (Shirlaw D.W., 1971).

The climate of the Marathwada region is generally dry except during the south-west Monsoon season. The year may be divided into four seasons. The cold season from December to February followed by the hot season from March to May, the south-west Monsoon from June to September and the post monsoon season from October to November.

I) TEMPERATURE

Temperature conditions have been less erratic from year to year than rainfall conditions in each agricultural region. However, great annual ranges may be highly significant in different

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

zones giving rise two or more cropping seasons. For this reason, especially in Marathwada different crops are raised in different seasons.

Without suitable temperature conditions, germination of seeds and growth of plants are retarded. Temperature regulates all the chemical and physical processes of plant metabolism. The Metabolic processes begin at a certain minimum temperature and increase with rise of temperature until they reach at maximum temperature called the optimum. Further with rise in temperature above the optimum level the metabolic activity is slowed down until it ceases at a temperature called the maximum. Each species has its own minimum and maximum beyond which its life activity ceases (*Kochhar P. L.*, 1967). Each crop plant needs a certain number of effective heat units for germination, growth, stalking, maturing and ripening. This is called the thermal constant and varies from crop to crop. Temperature above the minimum is therefore, effective in furthering the growth of a plant forwards maturity and ripening. The crucial air temperature is 6°C at and above which plants grow (*Schimper A. F. & Wilhem,* 1903). It is also known as the crucial limit. Ideal temperature conditions for crop production are between l8.3°C and 23.9°C.

For the agricultural geographer, two of the best indicators of regional differences in temperature currently available or derived are i) Length of the growing season and ii) accumulated temperature above the maximum for plant growth (*Singh Jasbir and Dhillon S.S.*, 1995).

During the hot season the heat is often intense and the day temperature on individual days the day temperature may be as high as 46^{o}C in Aurangabad, Jalna, Beed, Osmanabad, Latur, Parbhani and Hingoli district.

There is relief from the heat on some day when thundershowers occur during the afternoons. With the advance of the southwest monsoon into the region by the first or second week of June the temperatures fall appreciably and the weather is pleasant throughout the southwest monsoon season. By the first week of October the South-west monsoon withdraws and the day temperatures increase slightly and a secondary maximum is reached in October. There after the temperature begins to decrease gradually. Generally, the temperature is moderate except, the hot months in March, April and May. The maximum temperature is experienced in April and May while minimum in December and January.

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

The table 1 indicates that during the period of investigation, mean monthly maximum and minimum temperature is 40.60^0c and 14^0c respectively in study region.

Table No. 1: District wise Monthly Temperature in Marathwada Region

District / Region	Maxim/ Minim	Months												Annual
		January	February	March	April	May	June	July	August	September	October	November	December	
Auran-gabd	Max	29.7	32.4	36.1	39.2	40	35.1	30.6	29.3	30.6	32.9	29.1	33	33
	Min	14	16	20	23.4	24.2	22.9	21.8	21.1	20.8	19.6	13.9	19.5	19.5
	Aver	21.9	24.2	28.1	31.3	32.1	29	26.2	25.2	25.7	26.3	21.5	23.3	26.2
Jalna	Max	29.9	32.6	36.3	39.4	40.2	35.4	31.1	29.5	31.0	32.8	30.3	29.2	33.1
	Min	13.2	15.1	19.1	23.1	24.4	23.5	22.4	21.7	21.2	19.5	15.7	13.1	19.3
	Aver	21.5	23.8	27.7	31.2	32.3	29.4	26	25.6	26.1	26.1	23	21.1	26.2
Beed	Max	30.2	32.8	36.5	39.6	40.3	35.8	31.6	30.6	31.4	32.6	30.5	29	33.4
	Min	12.5	14.3	18.2	22.7	24.7	24	23.1	22.4	21.7	19.4	15	12.3	19.2
	Aver	21.3	23.5	27.3	31.1	32.5	29.9	27.3	26.5	26.5	26	22.7	20.6	26.3
Osmanabad	Max	28.9	31.7	35.7	37.9	39	33.7	30	29.1	29.2	29.9	28.9	28.6	31.9
	Min	15.3	17.1	20.5	23.2	24.7	22.5	21.1	20.7	20.7	19	15.3	14.7	19.6
	Aver	22.1	24.4	28.1	30.5	31.8	28.1	25.5	24.9	24.9	24.4	22.1	21.6	25.7
Latur	Max	29.9	32.8	36.6	39.4	40.4	35.5	31.4	30.3	30.8	31.9	30.2	29.2	33.2
	Min	13.7	14.3	19.3	23	25	23.4	22.2	21.7	21.4	19.3	15.1	13.2	19.4
	Aver	21.8	23.5	27.9	31.2	32.7	29.4	26.8	26	26.1	25.6	22.6	21.2	26.3
Nanded	Max	30.7	33.9	37.7	40.7	41.8	37.1	32.5	31.2	31.9	33.1	31.1	30	34.3
	Min	13.4	15.7	19.1	23	25.6	23.8	22.8	21.9	21.8	19.4	15	12.5	19.5
	Aver	22.1	24.8	28.4	31.8	33.7	30.4	27.6	26.5	26.8	26.2	23	21.2	26.9
Parbha-ni	Max	29.9	33.2	37.3	40.4	41.6	36.5	32	30.7	31.5	32.6	30.6	29.1	33.8
	Min	14.2	16.6	20.5	24.2	26.3	24.4	23.1	22.5	22.2	20.2	16.3	13.9	20.4
	Aver	22.1	24.9	28.9	32.3	33.9	30.4	27.5	26.6	26.8	26.4	23.4	21.5	27.1
Hingoli	Max	30.3	33.5	37.5	40.5	41.7	36.8	32.3	30.9	31.7	32.8	30.8	29.5	34.1
	Min	13.8	16.2	19.8	23.6	25.9	24.2	22.8	22.2	22	19.8	15.6	13.2	19.9
	Aver	22.1	24.8	28.6	32	33.8	30.5	27.5	26.5	26.8	26.3	23.2	21.3	27.0
Maratha-wada	Max	29.9	32.8	36.7	39.6	40.6	35.7	31.4	30.2	31	32.3	30.1	29.7	33.3
	Min	13.7	15.6	19.5	23.2	25.1	23.5	22.4	21.7	21.4	19.5	15.2	14	19.6
	Aver	21.8	24.2	28.1	31.4	32.8	29.6	26.9	25.9	26.2	25.9	22.7	21.8	26.4

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

Source: Computed by the Researcher, based on socio-economic reviews and district statistical abstract of district of Marathwada 91981-82 to 2010-11)

In rainy season monthly maximum temperature for July and August is 31.40^0c and 30.20^0c respectively which is useful for plant growth. In the October maximum temperature increased up to 32.3^0c due to October heat.

In winter season mean monthly maximum and minimum temperature is recorded 29.9^0c and 13.7^0c respectively in study region. This low temperature is useful for Rabbi Crop such as Wheat and Gram.

Table 1 indicates that the average temperature is 32.8^0c in of May, in study region, but varied from district to district. The low average temperature is observed in Aurangabad, Jalna and Nanded district i.e. below 32.5^0c. It is moderate in Beed and Latur district i.e. 32.5^0c to 33.2^0c, whereas it is high in Nanded, Parbhani and Hingoli district.

During the period of investigation, the average temperature of October is 25.9^0C in study region, but spatial distribution is variation from district to district in study region. The average temperature is low in Osmanabad district i.e. below 25.06^0C. It is moderate in Latur district, whereas it is high in Aurangabad, Jalna, Nanded, Parbhani, Hingoli and Beed district i.e. above 25.72^0C.

Table 1 also indicates that the average temperature of December is 21.8^0C respectively in study region, but spatial distribution varies from district to district in study region. The average temperature is low in Jalna, Beed, Latur, Hingoli and Nanded district i.e. below 21.5^0C. It is moderate in Osmanabad and Parbhani district, whereas it is high in Aurangabad district i.e. above 22.4^0C.

II) RAINFALL

Rainfall as the primary ecological parameter has created variety of farming enterprises, types or systems in the world. It is the dominant single weather element influencing the intensity and location of farming systems and the farmer's choice of enterprises. It also becomes a climatic hazard to farming when it is characterized with scantiness, concentration, intensity, variability, and unreliability, it is more important in the minimal regions, where average or normal rain fall is generally necessary for successful crop production. In such area the system of crop production must be correlated more or less to the moisture factor (***Klages K.H.W,.*** 1958). About more than 84 percent of the annual rainfall in the region is received during the south-west monsoon season,

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

the rainiest month being June, July gets the heaviest rainfall in the North east, while during the retreating Monsoon, rainfall in September becomes more important in the East. The South-West monsoon is the pivot around which almost the entire farm life and economy swings.

The details of the mean annual rainfall and co-efficient of rainfall variability from 1980-81 to 2010-11 are given in the table No. 1.

The region as whole receives 792.40 MM. annual average rainfall .The mean annual rainfall in the region varies from 710.80 MM. in Aurangabad district to 935.17 MM. in Nanded district. Generally rainfall decreases from East to West in the study region (*Map 2*).

Table No. 2: Mean Annual Rainfall, Intensity of Rainfall and Co-efficient of Rainfall Variability in Marathwada 1980-81 to 2010-11

Name of the District	Mean annual rainfall in MM.	Rainy Day	Intensity of Rainfall	Co-efficient of rainfall variability in percent
Aurangabad	710.80	44.2	16.08	28.84
Jalna	725.00	42.5	17.06	28.93
Beed	734.20	50.4	14.95	29.25
Parbhani	839.53	47.3	17.96	27.94
Nanded	935.17	51.4	20.86	21.30
Latur	788.00	51.3	15.56	27.26
Osmanabad	772.60	47.5	16.25	31.46
Hingoli	873.07	50.4	19.88	21.69
Marathwada	792.40	46.2	17.16	25.92

Source: Computed by the Researcher

The spatial distribution of rainfall varies from district to district; the high rainfall is found in the eastern part of the study region particularly in Hingoli and Nanded district i.e. above 850. It is moderate in Osmanabad, Parbhani and Latur district i. e. 750 MM. to 850 MM. Whereas it is low in North-western part particularly in Aurangabad, Jalna and Beed district i.e. below 750 MM.

INTENSITY OF RAINFALL

The term intensity used in the context of rainfall received during 24 hours period. It is important as it determines the intensity of soil erosion by rain and the usefulness of rain. More ever the intensity of rainfall determines the water regime there by irrigation potentials of the region. In other world higher the intensity of rainfall higher is the degree of erosion, lower is the water regime and irrigation potentials, and vice versa.

The intensity of rainfall is calculated by the following formula (Monkhouse and

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

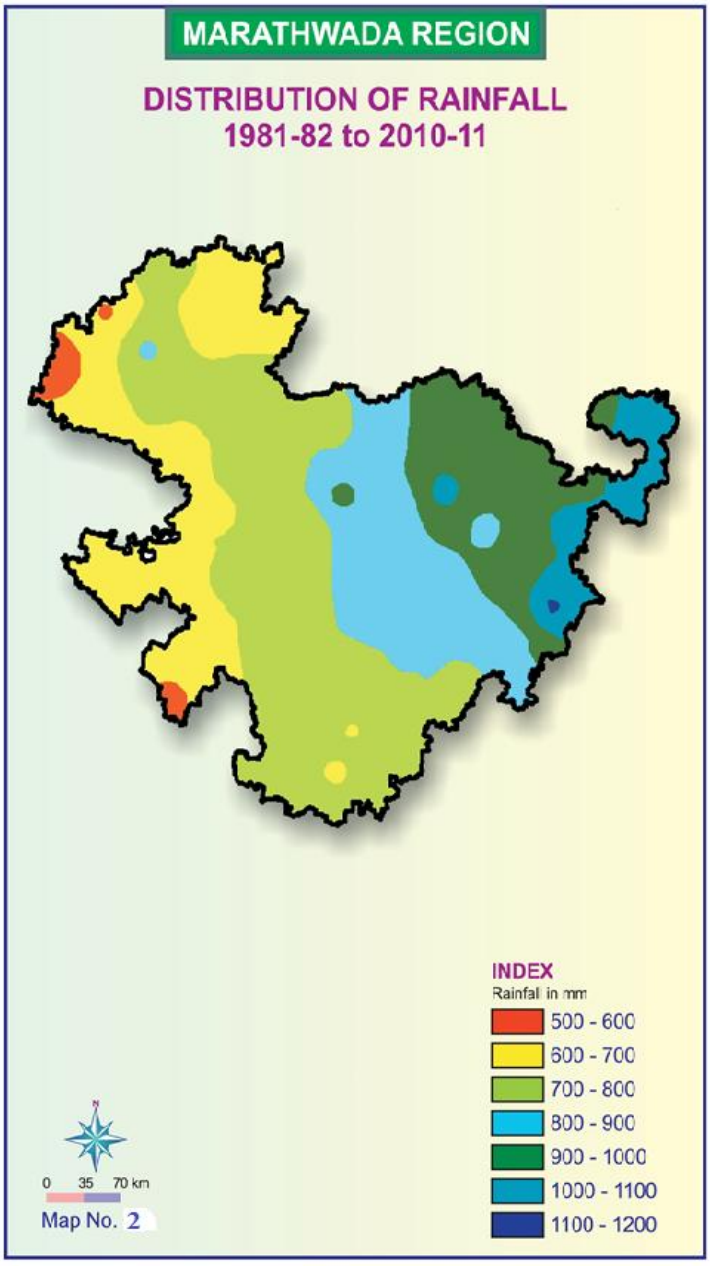
Wilkinson: 1971)

$$I = \frac{A}{X}$$

I = Intensity of Rainfall.

A = Annual Rainfall.

X = Number of Rainy days.



The table 2 reveals that Marathwada region as a whole has 17.11 mm intensity of rainfall, but spatial distribution varies from district to district. The high intensity of rainfall is recorded only in Nanded district i.e. above 18.23 MM. It is moderate in Hingoli, Parbhani, Osmanabad and Jalna districts ranging from 17 MM. to 18 MM., while it is low in Aurangabad, Beed and Latur district i.e. less than 17 MM.

RAINFALL VARIABILITY

To understand the spatial organization of agricultural landscape, the study of rainfall variability is very important. The intensity of irrigation, cropping pattern and productivity all are related to variability of rainfall.

Variability of rainfall increases

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

with decrease mean annual rainfall. Variability if excess of 20 percent implies great risk to farming (*Williamson,* 1925). In this situation, it is essential additional water supplies for successful cropping.

The co-efficient of rainfall variability is calculated by the following formula.

$$\text{Co-efficient of Rainfall Variability} = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

Where SD = the standard deviation.

Mean = the Arithmetic mean of rainfall during the 30 years.

The table 2 reveals that Marathwada region as a whole has 22.19 percent of rainfall variability, but spatial distribution decrease from West to East high rainfall variability is found in Western part of region in Aurangabad, Jalna, Beed and Osmanabad district i. e. above 28 percent, indicates great risk in farming. Moderate rainfall variability is recorded in central part particularly in Parbhani and Latur district ranging from 25 to 28 percent while it is low in Eastern part. The low rainfall variability is registered in Nanded and Hingoli district i.e. less than 25 percent. The rainfall variability is more than 20 percent throughout Marathwada region indicates that irrigation is very important from the view point of better productivity.

(III) OTHER WEATHER PHENOMENA

(A) HUMIDITY

The relative humidity is high during the south-west monsoon season ranging in between 60 percent and 80 percent. This is useful for growth of kharif crops. After September the humidity decreases gradually and in the cold season and summer season the air is generally dry. The summer season is the driest part of the year, the relative humidity, especially in the afternoons relative humidity is less than 30 percent throughout the Marathwada region, indicates artificial watering for better productivity.

(B) CLOUDINESS

In the south-west monsoon season the sky is generally heavily clouded or overcast. The cloud amount decreases rapidly in the post monsoon months. During the rest of the year mostly sky is clear or lightly clouded.

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

(C) WINDS

Winds are generally moderate in force in the latter half of the summer and in the south-west monsoon period. In the rest of the year winds are light throughout Marathwada region. During the south-west monsoon season the direction of the winds is predominantly from the south west to North East.

(D) SPECIAL WEATHER PHENOMENA

The thunder storm occurs in the summer and monsoon months, their frequency being higher in June and September. Dust raising winds are common in the summer afternoons in all districts of Marathwada region, which adversely affects on plant growth. Rainfall due to the storms and depressions from Bay of Bengal in winter season are useful for Rabbi Crops i.e. Jowar, Wheat and Gram in Marathwada region.

(IV) CLIMATIC DIVISIONS OF MARATHWADA REGION

Taking into consideration the factors like, soil, crops, altitude, rainfall, temperature etc. the state of Maharashtra has been divided into nine broad climatic zones (Vaidya and Sahasrabudhe, 1990). (*Figure-3*)

The area of Marathwada region falls under three zones they are as flowing:-

(i) Scarcity zone.

(ii) Assured rainfall zone.

(iii) Moderate to highly rainfall zone.

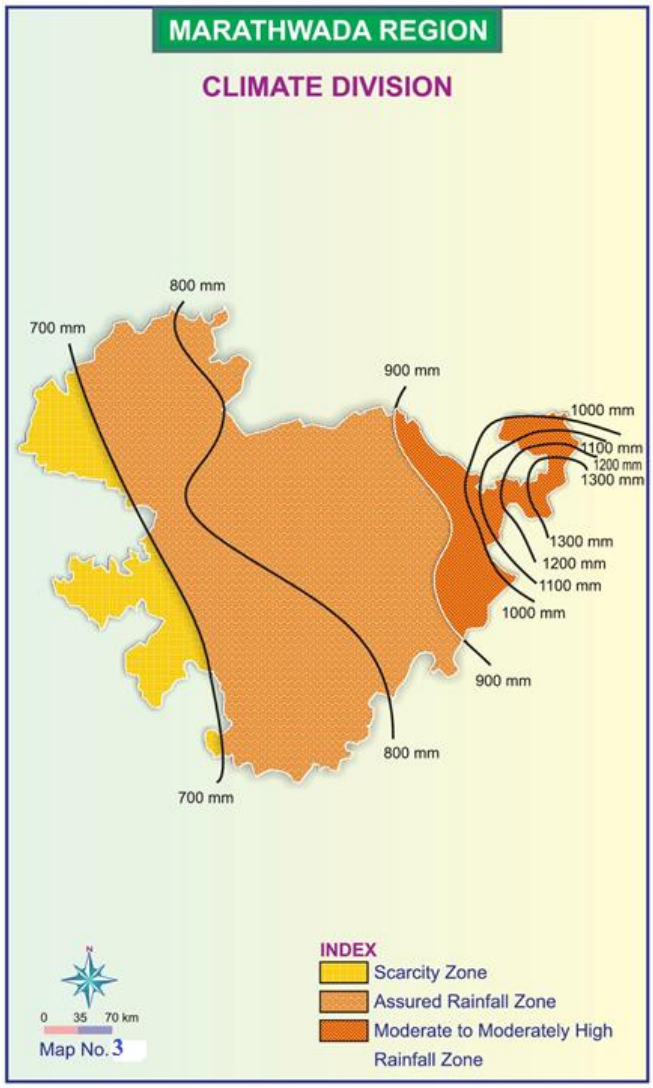
(i) SCARCITY ZONE

The scarcity zone lies west of the isohyetal line of 700 MM. and includes western strip of Beed, Aurangabad districts and Tuljapur, Kallam, Bhoom and Paranda tehasils of Osmanabad district. Particularly this zone is known as drought prone area. Vaijapur, Gangapur, Kannad, Khultabad, aurangabad, Paithan, Ambad, Geli, Ashti, Patoda, Beed, Kaij, Paranda, Bhoom, Kallam, Osmanabad and Tuljapur tahsils comes under the jurisdiction of drought prone area. But due to the Jayakwadi project, Galhati (Ambad) Kohli project (Vaijapur), Purna Anicut (Kannad) and Manjara projects the intensity of drought has reduced to some extent. The soil is medium black calcareous formed from trap with varying depth and texture. Both the Kharif and Rabbi crops are grown in this zone. This zone covers 16 percent of the total area of region.

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

(ii) ASSURED RAINFALL ZONE

The assured rainfalls zone 'extends between 700 to 900 MM. Isohyetal lines covering the Parbhani district, southern Nanded and remaining parts of Aurangabad, Jalna, Beed and Osmanabad districts. The soil of tin this zone is medium black calcareous and suitable for both Kharif, Rabbi and Fruit crops.



(iii) MODERATELY HIGH RAINFALL ZONE

The area east of the isohyetal lines of 900 MM. comes under moderately high rainfall zone which extends over eastern part of the Hingoli district and northern portion of the Nanded district. This zone is favorable for seasonal or yearly crop cultivation. The soil in this zone ranges from brown to dark calcareous with varying, depth from moderate to deep suitable for all Kharif crops. The Rabi crops are grown, on deep soil, while fruit crops in shallow soils.

CONCLUSION:-

The climate is hot and dry throughout the year barring the brief South West monsoon season on which relative humidity is moderate to high. The warmth and bright sunshine throughout the year is useful to ripening of crops. The Marathwada region depends on South East monsoon for rainfall, which is concentrated in brief period of 46 days. The rainfall is uneven and uncertain throughout the region. The average annual rainfall is 792 MM. The annual coefficient of variability of rainfall is more than 21 percent in the region, indicates great need of irrigation in all season for better agricultural productivity. The intensity of cropping and agricultural productivity of the study region is related to rainfall variability. The region is

ISSN: 2278-4632
Vol-10 Issue-6 No. 2 June 2020

divided three agro-climate zones in which rainfall decreased from east to west. The central and western parts receive scanty rainfall and are often affected by draught.

REFRENCES

1. White back R. H.(1932): The Geographic Factor, New York century Co. P.87

2. Klages, K.H.W. (1958): Ecological crop Geography, New York, MacMillan PP. 44,111,189,211 and 335.

3. Stamp L.D. (1963): Applied Geography, Suffolk Penguin P. 15.

4. Hildreth A.C. etal (1941): Effects of climatic factors on sowing plants, water, the United States, Department of Agriculture, New York, Washington. PP292-307

5. Shirlaw ·D.W. (1971): Agricultural Geography of Great Britain, Pergamon Press Oxford P.20.

6. Kochhar P. L. (1967): Plant Ecology, Genetics and Evolution, New Delhi, Atma Ram and sons P. 10.

7. Schimper A.F. Wilhem (1903): Plant Geography upon a Physiological Basis, Oxford, Clarendon Press PP. 35-51.

8. Jasbir Singh and Dhillon S.S. (1995): Agricultural Geography, Tata McGraw Hill Publishing Co. Delhi. P.63.

9. Monk house F. J. and Wilkinson H. P (1971): Map and Diagrams, London, Methuen and Company Limited. P 195.

10. Williamson, A. V. (1925), "Irrigation in the Indo-Gangetic Plains, Geographical Journal Vol.65-2 pp.141-153.

11. Mohanty, (2006): Spatio – temporal variability of summer monsoon rainfall over Orissa in relation to low pressure systems, j. Earth Syst. Sci. 115, No. 2 , pp. 203-218.

12.Kusure, B. C. (2012): Study of Spatio and temporal distribution of rainfall in Nagaland, International Journal of Geometrics and Geosciences, volume 2, pp. 712-722.

