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ADVANCEMENTS IN CANCER MANAGEMENT: FACULTATIVE ANAEROBE SALMONELLA

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Article Info

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Abstract

Climate change has been identified as a major factor affecting agricultural production in many regions of the world. This study explores the impact of climate change on agricultural production in the Sangli district of Maharashtra, India, using geospatial technology, and analysis of climate data collected from 48 points across the study area for 35 years. The study uses spatial interpolation to calculate seven climate parameters, namely annual precipitation, average annual air temperature, UNEP aridity index, rain erosivity, rain seasonality, wind speed, and potential evapotranspiration. The results indicate that changing spatio-temporal variations in precipitation have impacted agricultural production, with decadal variations in annual precipitation and fewer rainy days, while precipitation intensity and extreme precipitation days and extreme rainfall intensity remained relatively stable. The analysis of annual precipitation intensity trends is consistent while overall average temperature has increased. Additionally, different dry spell areas were observed at different time scales exhibited in the last 35 years due to variations in the precipitation values during the period. The results underscore the importance of understanding the impact of climate change on agricultural production and using geospatial technology to study climatic patterns to improve planning and interventions to address the challenges arising from climate change.

Introduction

Climate change has become a significant environmental concern worldwide, with implications for agricultural production. This issue is particularly relevant in arid and semi-arid regions where low rainfall and high evapotranspiration rates can reduce the soil moisture required for plant growth, leading to lower biomass production. The Sangli district of Maharashtra, India, with its climate-sensitive agricultural system, is especially vulnerable to the effects of climate change. To address these concerns, the study employs geospatial technology to examine the impact of climate change on agricultural production in the region. The analysis considers seven

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climate parameters, including annual precipitation, average annual air temperature, UNEP aridity index, rain erosivity, rain seasonality, wind speed, and potential evapotranspiration. Using spatial interpolation, the study collects climate data from 48 points across the study area for 35 years to investigate decadal variations in annual precipitation, the number of rainy days, precipitation intensity, extreme precipitation days, extreme rainfall intensity, and dry spell areas. The results indicate that changing spatio-temporal variations in precipitation have impacted agricultural production in the region. The findings highlight the need for better planning and interventions to address the challenges arising from climate change on agricultural production, emphasizing the importance of using geospatial technology to study climatic patterns to develop effective adaptation strategies.

Materials and Methods

The main objective of the study in this paper is to identify dry spell areas using climate data so as to identify the severity of drought condition in Sangli district of Maharashtra.

Study Area

Sangli district a study area shown in Fig.1 is located in the southern parts of the State and lies between $16^0 42'$ to $17^0 37'$ north latitude and $73^0 42'$ to $75^0 40'$ east longitudes covering an area of about 8596 km^2. It is bounded on the north by Satara and Solapur districts, on the west by Ratnagiri district, on the south by Kolhapur and on the east and south east by Bijapur district of Karnataka State.

There are ten tehasils in the district viz Tasgaon, Kadegaon, Palus, Khanapur, Atpadi, Valva, Shirala, Miraj, Jath and Kavthe-Mahakal.

According to Census of India 2011, the district having 8 census towns and 728 villages. The total geographical area (TGA) of the district is 8596 km^2 which constitutes 2.81% of the total area of the state.

Sangli has a semi-arid climate with three seasons, a hot, dry summer from the middle of February to the middle of June, a monsoon from the middle of June to late October and a mild cool season from early November to early February. The total rainfall is about 22 inches (580 mm).

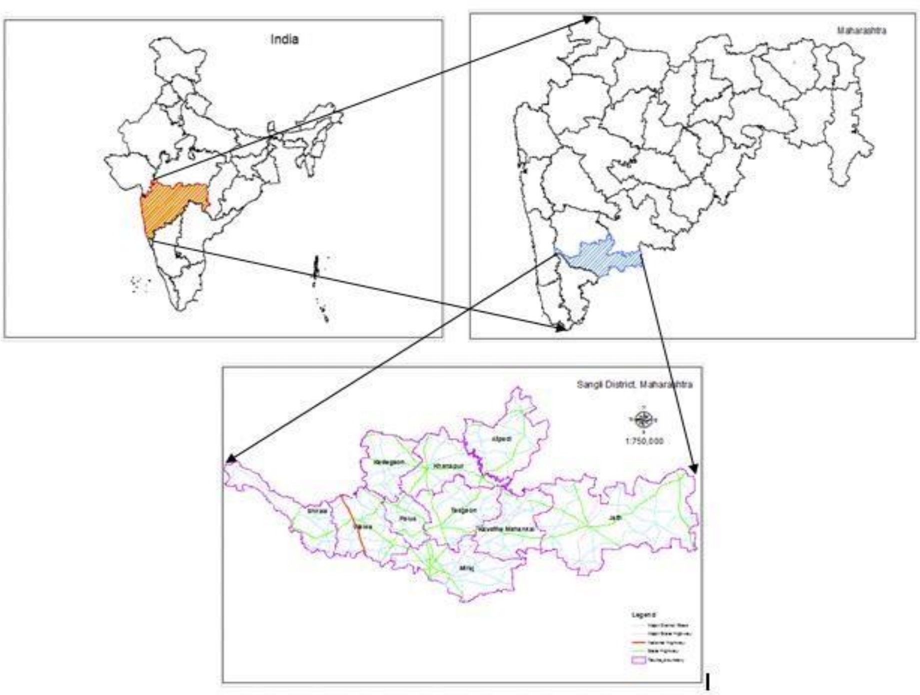

Fig. 1 Location map of the study area

Data used

Here we used data about Daily precipitation, maximum, minimum, air temperature, wind speed (at 2m above ground surface), humidity, vapor pressure collected from gridded data of (I) cell size (0.25° × 0.25°) from Indian Meteorological Department, Pune, (ii) gridded cell of size 0.31° × 0.31°air temperature and wind speed data of the National Centers for Environmental Prediction ([22], [23]) for 35 years of the period 1979 to 2013.From the available gridded climate analysis has been done for deriving seven different climate indicators to assess the dry spell areas.

Methodology

Geospatial technology including remote sensing, GIS, GPS encourages the critical analysis of vast dataset. Particularly GIS based framework offers the scientific understanding between the different dataset. In the present study Kriging tool has been extensively used to get proper spatially classified valued maps on different data layers. Fig.2 shows the different steps adopted in methodology.

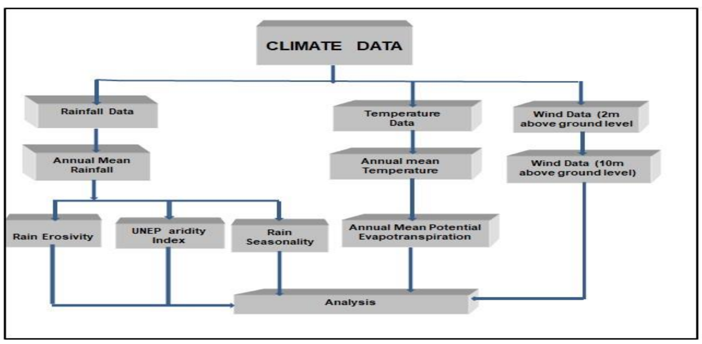

Fig.2 flow chart

1.1 Average annual rainfall

Arid and semi-arid climatic conditions with a lower amount of rainfall and higher rates of evapotranspiration will significantly decrease the soil moisture content available for plant growth causing lower biomass production (Agricultural University of Athens 2012). Average monthly rainfall of 48 points was calculated for the period 1979–2013.

The study area covering 48 points was calculated accordingly. Using spatial interpolation technique, rainfall spread across the entire area was calculated. The Following Fig.3 indicating the annual rainfall for years 1979, 1985, 1995, 2005 and 2013.

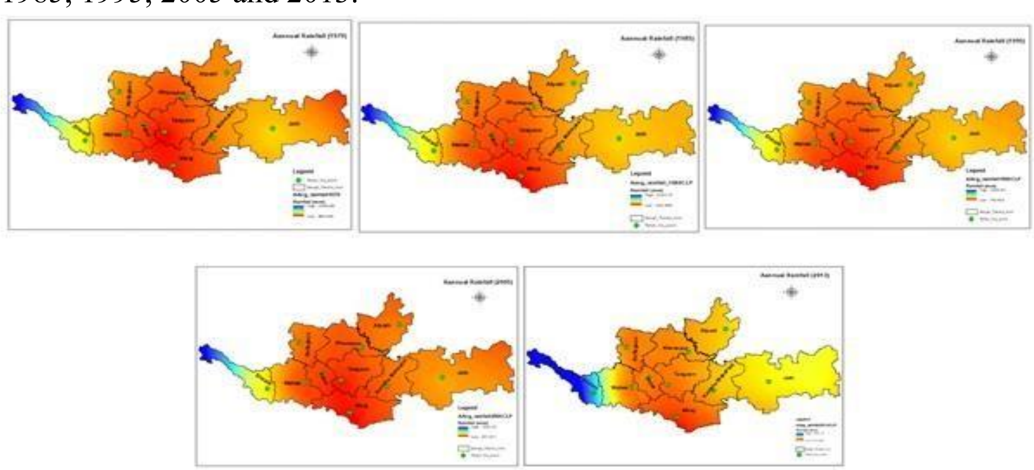

Fig.3 Annual Rainfall (1979,1985,1995,2005,2013)

1.2 Average annual air temperature

Since air temperature is a critical environmental factor in determining water stress, transpiration in growing vegetation, soil water evaporation, soil salinity and soil alkalinity [2] Higher temperature will have a negative effect on desertification. Monthly temperature was collected and annual mean air temperature (in ºC) has been calculated for 48 points in the study area. Using geospatial interpolation technique database was be generated and depicted in fig.4 given below:

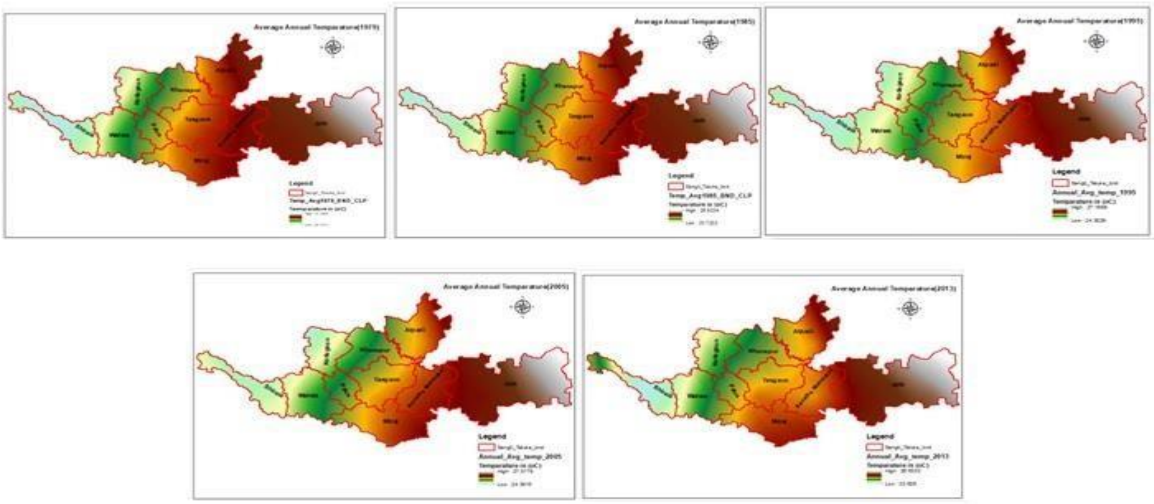

Fig.4 Mean Air Temperature

1.3Average annual Potential Evapotranspiration (PET)

Potential evapotranspiration is an important parameter for the assessment of salt affectedareas(Agricultural University of Athens, 2012). The areas under high evapotranspiration are more vulnerable to salinisation and thus lead to desertification. The purpose of including PET in the drought index calculation is to obtain a relative temporal estimation. Given below is the procedure to calculate PET(mm):

PET (Thornthwaite, 1948 formula) = $16K\,(10T/I)^{m}$…… (1)

where T is the monthly-mean temperature (8C); I is a heat index, was calculated, sum of 12 monthly index values *I* has been made.

Then PET being derived from mean monthly temperature using the formula

$I = (T/5)1.514$ ……………………………………..… (2)

m is a coefficient depending on I: $m = 6.75 \text{ X } 10^{-7} I^{3} - 7.71 \text{ X } 10^{'5} I^{2} + 1.79 \text{ X } 10^{-2} I + 0.492$;

and K is a correction coefficient computed as a function of the latitude and month,

K = (N/12) X (NDM /30) ……………………………… (3)

Here NDM is the number of days of the month and N is the maximum number of sun hours.Annual potential evapotranspiration has shown in fig.5.

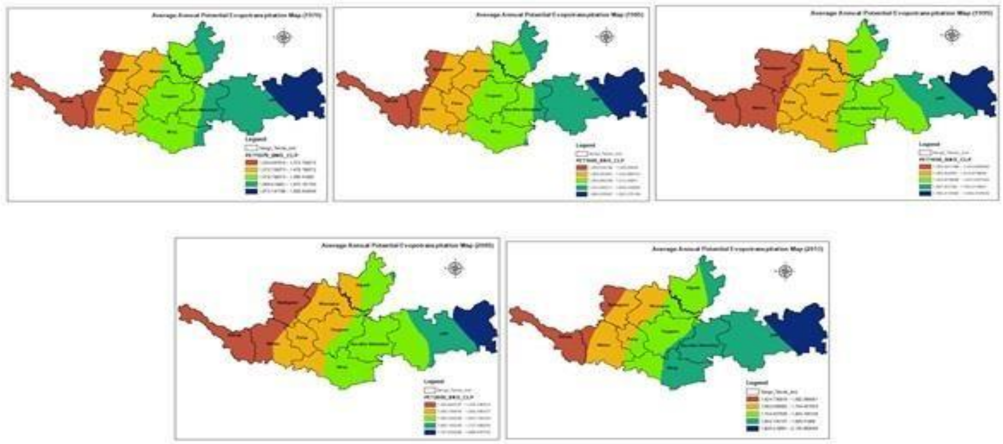

Fig.5 Annual potential evapotranspiration

1.4 Aridity index

Aridity index can be defined as the ratio between mean annual precipitation (P) and mean annual evapotranspiration (E To). The aridity index classifies the type of climate in relation to water availability. It is a critical environmental factor affecting the evolution of natural vegetation.The higher the Aridity Index of a region, greater the water resources variability and scarcity in time and more the vulnerability of area leads to desertification [2]. United Nations Environmental Programme (UNEP) aridity index (UNEP 1997) was calculated for the period 1979–2013 using equations (4) as follows and average annual Aridity has been expressed in fig.6

UNEP Aridity Index:

$$\text{Aridity index} = \frac{\text{Average annual rainfall (mm)}}{\text{Average annual PET (mm)}} \quad \ldots\ldots \quad (4)$$

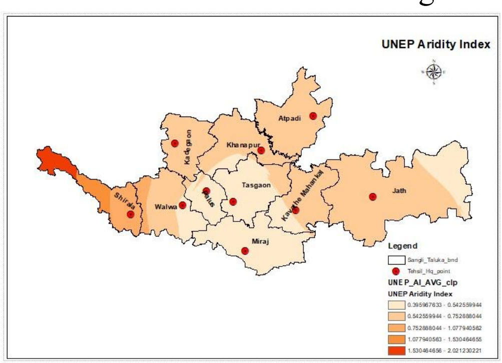

Fig. 6UNEP Aridity Index

Table 1. Aridity index classes and their description

Class	Description
> 0.65	Humid
0.50 – 0.65	Dry sub-humid
0.20 – 0.50	Semi arid
0.05 – 0.20	Arid
< 0.05	Hyper arid

1.5 Calculation of Average wind speed

Increase in the wind speed above the critical limit will cause land degradation and desertification in arid and semi-arid regions. When the terrain is sufficiently dry and significant proportion of the natural vegetation, especially the annual vegetation is dead. As rain moistens, it provides a greater resistance to the wind. Suppose new plants start sproutingthe resistance. As the wind speed used in the study was measured at 2 m height, it was converted to the standard height of 10 m using the equation given by FAO as follows:

$$u_{10} = \frac{\ln(67.8 \times 10 - 5.42) \times u_2}{} \qquad \ldots\ldots (5)$$

where u_{10} and u_2 are the wind speeds (m/s) at 10 m and 2 m above the ground surface, respectively. Following table shows the wind severity and its effect on crop in the study area. Table 2: Wind Speed ranges

Range of wind speed at 10m height	**Description**
0 - 2	Slight effect on crop
2 - 3.5	Moderately effected the crops and cropland
3.5 - 4.5	Severely effected
> 4.5	Very severely effected

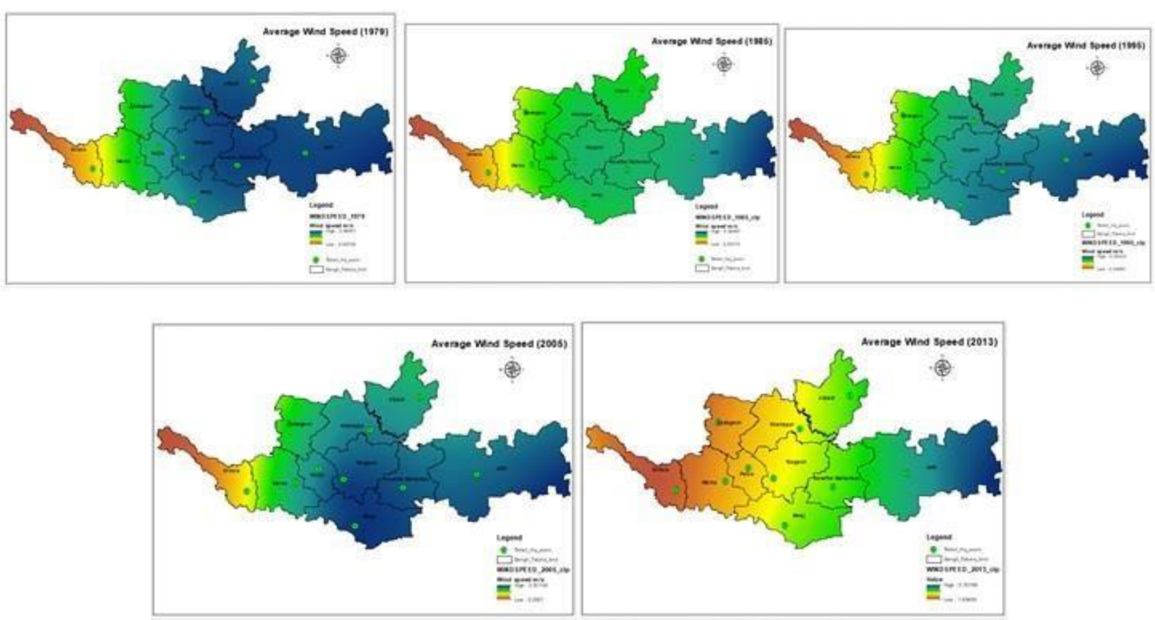

Fig.7 Wind Speed

1.6 Calculation of *Rain seasonality*

Rainfall seasonality is depending on the temporal distribution (monthly). It affects soil erosion, plant species composition and growth rate. Very high inter-annual rainfall and sudden and high-intensity rainfall variability causes long drought [2].

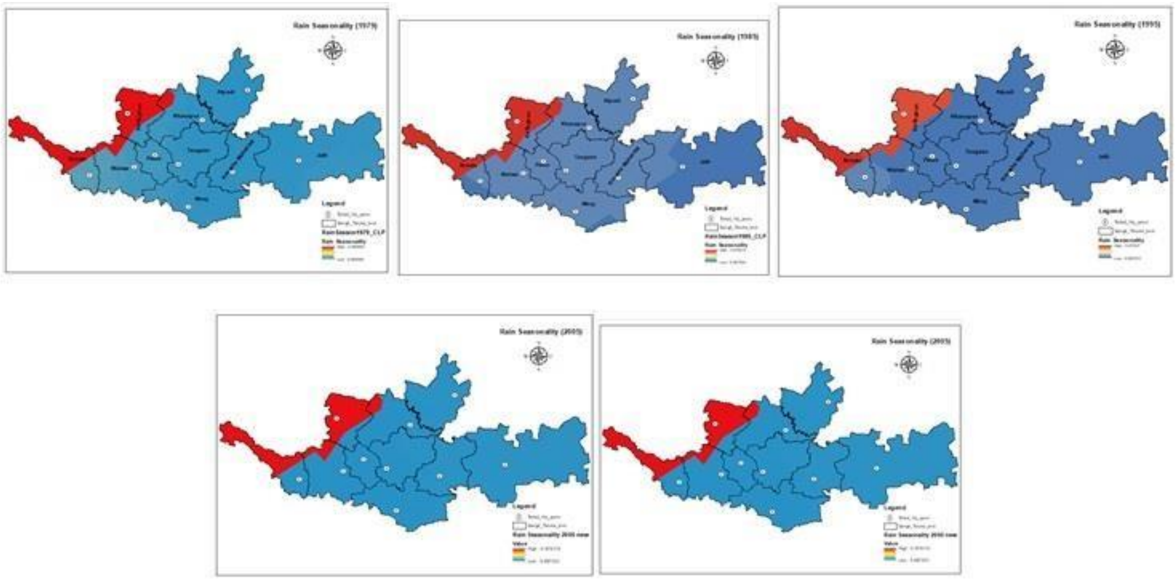

Fig.8 Rain Seasonality

Hence, higher rain seasonality will give a negative effect on desertification. Rain seasonality (SL*i*) was calculated for the period 1979–2013 using equation (6) [2] as follows:

$$SLi = (1/Ri) \sum_{n=1}^{12} \left| Xin - (Ri/12) \right| \quad \ldots\ldots\ldots\ldots\ldots(6)$$

Where *Ri* s the total annual precipitation for a particular year (mm) and *X in* is the monthly precipitation for month *n* (mm). Ranges of the Rain seasonality described as shown in table.3

Table 3: Rain Seasonality

Range	Description
< 0.20	Precipitation spread throughout the year
0.20 – 0.40	Precipitation spread throughout the year, but with a definite wetter season
0.40 – 0.60	Seasonal with short drier season
0.60 – 0.80	Seasonal
0.80 – 1.00	Marked seasonal with long dry season
1.0 – 1.20	Most precipitation in < 3 months
> 1.20	Extremely seasonal

1.7 Calculation of *Rain erosivity*

Rainfall erosivity is the sum of the ratio of Square of the total monthly precipitation to mean Annual precipitation (mm). Rainfall erosivity depends primarily on rainfall intensity and amount of total rainfall. High-rain erosivity indicates the greater erosive capacity of the overland water flow. Therefore, the high-rain erosivity will lead to high risk of desertification. It was calculated monthly and accumulated annually. Using modified Fournier index (FI) Rain erosivity was calculated for the period 1979–2013 using equation

(4) (Agricultural University of Athens 2010a) as follows:

$$FI = \sum_{i=1}^{12} Pi^2 / p \qquad \text{................(7)}$$

Where Pi is the precipitation total in i^{th} month , and p is the mean annual precipitation total (mm). The Fournier index is then classified as follows:

Table 4: Rain erosivity and classification

Description	Range
Very low	< 60
Low	60–90
Moderate	91-120
High	121-160
Very high	>160

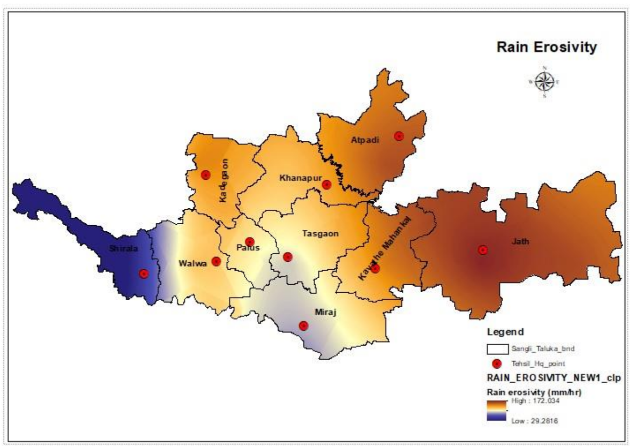

Fig. 9. Rain erosivity in Sangli district, Maharashtra

1.8 Results and discussion

Using spatial techniques, seven different parameters were calculated. Annual precipitation for 48 points is calculated and the results depicted in the form of maps. First and the foremost parameter annual average precipitation is concern, there were drastic variations in the annual precipitation, ranges from 285mm to 750mm and figure 2 shows, more than 60% of the TGA. Annual mean temperature has increased for the period 1979 – 2013. Therefore, degree of dryness will be more.

Potential Evapotranspiration data has proved that, one tehsil namely Jath was very severely affected, 2 tehsils Atpadi and Kavathemahankal and parts of Tasgaon was also affected severely. Whereas parts of Miraj tehsil and parts of Khanapur are moderately affected due to less amount of rainfall and other climatic conditions. UNEP has derived formula for Aridity Index, it has five ranges for different regions. Data has been organized, calculated and depicted using geospatial techniques, the results depicted in map proves that, the study area has scarcity of water. But most of the area was affected by water scarcity was moderate to severe.The rain seasonality was also analysed for the entire area and for period mentioned therein, Most of the precipitation has occurred seasonally i.e. from mid of June to September. As per the available data, wind speed at 10m above ground level was calculated using the formula (5) and resulted depicted in the form of maps as shown in fig.6 clarified that, there are climatic changes during the period 1979-2013. Rain erosivity is the water flow of a region or an area. The results clarified that, about 80% of the areas are affected moderate to severely and that leads to severe drought or desertification. In brief, that author(s) feels that, majority of the area falls under DPAP area, due to climatic variations. Hence all seven climatic parameters are essential to evaluate the water intensity of the study area.

Conclusions

The study analysed seven climate parameters using geospatial techniques. The methodology revealed the risk areas and threat from water severity and its associated effect responsible to leads desertification. The parameters shows there should be a proper action plan for the Drought prone areas and it is suggested that cropping pattern should be on rotation basis.

Otherwise the area may severely face water scarcity.

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