Our Heritage

ISSN: 0474-9030

Vol-68-Issue-1-January 2020

Characteristics of Rainfall Intensity in Marathwada region of Maharashtra (India)

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Abstract:

Rainfall intensity is the ratio of actual rainfall and the rainfall at any place or region in particular time. The time may be hours, day, week and month or as per requirement. The study of rainfall intensity is very much necessary to understand the actual situation of water availability. The present study through the light on temporal and spatial distribution of rainfall intensity during 1980 to 2016. The research work is carried out by using Rainfall Intensity Index. And the IDW method is used for computing spatial variation of intensity through Arc GIS software. The intensity is computed for monthly, seasonal and annual time period for 96 stations. The rainfall intensity is computed for 96 stations for the 37 years (1980-2016). The annual rainfall intensity is varies and ranges from 8.8mm to 24.4mm/day.

Key words: Rainfall, Intensity, temporal, spatial, annual, ArcGIS.

Introduction:

Rainfall intensity is the ratio of actual rainfall and the rainfall at any place or region in particular time. The time may be hours, day, week, and month or as per requirement. The study of rainfall intensity is very much necessary to understand the actual situation of water availability. The availability of water influences on animate and inanimate life in the environment, and also economic activities of society. The variation in rainfall intensity is responsible for creation of some natural calamities, such as drought, flood, low evaporation rate, soil erosion, siltation etc. The rainfall data from recording rain gauge stations shows that rainfall is often confined to a few hours a day and some time even for period shorter than an hour. The period during which given amount of rain occurs is important because heavier rainfall leaves to greater runoff, greater soil erosion and less infiltration in to the water table (V.S. Kumar and et al. (2007)). The rainfall intensity shows the rainfall proportion with the time, in the present study rainfall intensity is computed with rainy days. As per the IMD guidelines the day which receives rainfall equal to or more than 2.5 mm/day is considered as rainy day.

Study region:

The present research work is carried out for Marathwada region of Maharashtra state in India. The study region lies in upper Godavari basin which extends from 17^0 35' north to 20^0 40' north latitude and 74^0 40' east to 78^0 19' east Longitude. The study region covers 64434 sq. km. which is 20.95% of states area. Population of the region is 1.87 cores (2011). The study region has been divided in eight districts for administrative purpose with 76 tahsils. The region characterized by Deccan trap mostly found basalt rock. Major part of region covered by deep black soil, it formed from basalt rock. The climate of study region is typical hot and dries with high temperature. It ranges from 20^0C to 40^0C some time it goes more than 40^0C in summer and also it falls down below 20^0C in winter season. The study region receives 771.80mm. average annual rainfall. It receives from south western monsoon winds. Near about 70% rainfall receives during June to September i.e. monsoon season.

Objective:

ISSN: 0474-9030

Vol-68-Issue-1-January 2020

The main objective of this research is to understand the temporal and spatial distribution of rainfall intensity over Marathwada region of Maharashtra State.

***Data and Methods*:**

Rainfall intensity is evaluated based on monthly average rainfall data. The rainfall data is gathered from Indian Meteorological Department, Pune and Hydrology project, Water Resource Department, Govt. of Maharashtra, Nashik for the period of 1980 to2016.

The statistical measure of rainfall intensity is computed monthly, seasonal and annual for 96 stations for the study period (1980-2016). The rainfall intensity is calculated by using following formula.

RI= ARF/NRD

Whereas RI= Rainfall intensity, ARF= Actual Rainfall, NRD= No. of Rainy Days.

The IDW method is used for computing spatial variation of intensity through Arc GIS software.

Result and Discussion:

The research work is carried out by using Rainfall Intensity Index. The intensity is computed for monthly, seasonal and annual time period for 96 stations. The stations are about equally distributed over study area. It is discussed as fallow as.

Seasonal and monthly Rainfall Intensity:

Monthly and seasonal rainfall intensity is most affected on short term agricultural activities. Such as time of crop sowing, monthly crop growth condition, crop deceases, production of insects and maturity and harvesting time of crops. Hence it is mostly signify to study the monthly intensity of rainfall. Fig. 2-I&II (A to L) and fig. 01(B to E) depicts the monthly and seasonal intensity of rainfall in Marathwada region, it described as fallow.

Winter Season:

Rainfall intensity of winter season is ranges from 0.08mm to 39.77mm/day. The highest intensity is recorded at Salegaon and lowest at Vaijapur station of A'bad district. There are 34 stations have below 10 mm rainfall per day. The 07 stations have more than 20mm per day rainfall. Fig. 01(B) represents the rainfall intensity of winter season. North eastern part of Latur , eastern part of Nanded are having more than 20mm/day. But central to southern part of A'bad, Jalna, southern part of Parbhani and western and central Beed have less than 10mm/day rainfall intensity. Monthly variation of rainfall intensity of winter season is shown in fig. 02(I-A and B) for January and February month. In the month of January monthly rainfall intensity varies from 1.72mm to 39.77mm/day at Ranjani and Salegaon stations accordingly. The 27 stations belong less than 10mm/day, 18 stations above 20mm/day and 51 stations have between 10 to 20mm/day rainfall intensity. The February month is shown in fig.02-I (B), it varies from less than 0.09mm to 21mm/day, observed at Rohina, Sarkhani and Wadhona stations respectively.

Pre Monsoon:

The pre monsoon season rainfall intensity observed from 4.41mm to 23.14mm/day at Supegaon and Limbaganesh stations orderly. Fig. 01(C) shows the spatial variation of rainfall intensity over Marathwada region. The 36 stations found with less than 10mm, 58 stations intensity is between 10-20mm

ISSN: 0474-9030

Vol-68-Issue-1-January 2020

and only 02 stations observed intensity is more than 20mm/day. It indicates that the most part of study region belongs to 10-20mm/day rainfall. With compare to annual intensity there are 02 stations are observed with higher than annual.

The monthly variation of rainfall intensity is varies month to month. The March month variation is shown in fig.02-I(C). It is observed that it ranges from less than one to 26.29mm/ day at Salegaon, Pishor, Ladsangvi, Limbaganesh and Suratgaon in orderly. There are 45 stations are observed with less than 10mm, 43 stations between 10-20mm and 8 stations more than 20mm/day rainfall intensity. The figure

Table no.01 Statistical Measures of Seasonal Rainfall Intensity (1980-2016)

Stations	Wint	PM	Mon	PoM	ANN	Stations	Wint	PM	Mon	PoM	ANN	Stations	Wint	PM	Mon	PoM	ANN
A'bad	11.2	11.7	20.9	15.5	19.5	Kalamb	14.3	12.7	17.6	17.5	17.2	Pathri	3.0	9.9	16.1	19.0	16.0
Ahamadpur	13.1	12.3	19.1	19.2	18.6	Kandhar	10.7	12.8	18.4	19.1	18.1	Patoda_B	14.9	12.4	16.4	17.0	16.2
Alni	16.6	11.6	16.1	15.7	15.8	Kannad	18.0	10.9	14.3	15.5	14.3	Patoda_N	10.3	9.4	15.5	16.6	15.3
Ambad	13.8	13.4	17.9	15.8	17.5	Karajkhed	21.1	7.1	22.3	14.8	14.3	Phulambri	7.3	12.7	15.4	18.6	15.6
Ambejogai	16.8	9.7	15.4	16.7	15.3	Karajkheda_O	18.0	13.2	25.5	16.3	14.7	Pishor	9.6	15.1	15.7	17.6	15.8
Ashti	7.0	11.5	18.2	18.0	17.7	Kasarshirshi	16.4	13.9	31.9	19.8	18.2	Ranjni	6.7	8.5	20.2	18.9	19.7
Aurad_Sh	11.3	8.4	11.0	11.6	10.9	Kesrali	9.3	9.2	14.2	14.1	14.0	Rohina	21.7	9.6	17.2	19.4	17.2
Ausa	9.1	9.7	11.6	13.3	11.6	Khultabad	7.1	12.5	17.0	16.4	16.8	Salegaon	39.8	9.8	21.3	22.3	21.4
Awadshirpur	10.0	4.8	11.4	11.5	11.0	Kinwat	14.0	9.8	20.7	18.0	20.0	Sarkhani	8.3	6.0	15.7	11.3	15.0
Beed	9.0	12.9	18.5	17.3	18.0	Kuppa	10.7	8.2	12.4	12.9	12.3	Sarola	18.8	19.7	15.5	16.5	15.8
Bembli	10.3	13.2	14.1	17.8	14.5	Ladsangvi	5.3	8.6	14.7	14.1	14.4	Shahagad	6.4	6.7	11.6	11.4	11.3
Bhavnepangri	3.9	4.9	10.6	8.1	10.0	LimbaGanesh	4.4	23.1	17.3	20.0	17.7	Shevali	11.1	18.7	23.5	22.0	23.1
Bhokar	17.9	14.1	21.3	20.4	20.9	Limboti	10.5	6.6	12.2	12.9	12.0	Shivani	15.8	9.5	21.2	20.4	20.8
Bhokardan	16.8	14.5	15.6	17.4	15.7	Lohara	6.1	8.1	14.5	11.2	14.0	Shivna	17.6	17.9	15.6	16.2	15.7
Bhoom	14.5	15.1	15.4	13.7	15.1	Lohgaon	13.5	11.0	21.3	20.4	20.8	Sillod	10.6	13.0	15.5	18.2	15.7
Billoli	18.5	17.0	21.0	22.7	21.0	Loni_kh	5.9	8.2	16.0	13.7	15.5	Soygaon	10.1	13.1	17.2	19.0	17.2
Chandani	22.4	16.0	17.4	16.2	17.2	Mahur	8.0	9.8	22.3	17.4	21.7	Sundgi	10.9	8.2	14.6	16.4	14.5
Chikalthana	8.7	13.9	18.2	17.9	17.8	Majalgaon	10.4	13.2	17.8	20.3	17.8	Supegaon	6.8	4.4	14.5	15.4	14.2
Degloor	13.7	11.5	17.3	19.9	17.3	Malegaon	15.8	9.3	16.6	17.1	16.3	Suratgaon	20.5	17.1	18.9	17.1	18.6
Dhorkin	3.7	11.8	15.0	13.2	14.6	Mukhed	12.0	11.4	17.8	19.6	17.7	Surdi	17.0	11.4	18.2	18.0	17.8
Gangakhed	8.3	11.1	15.9	18.7	16.1	Murti	17.2	19.9	24.3	26.4	24.4	Taka	22.0	9.5	15.1	17.4	15.1
Gangapur	11.0	7.7	15.0	16.5	15.0	Nagamthan	5.1	7.7	8.8	10.7	8.8	Takalkhopa	7.7	10.2	18.7	17.8	18.4
Georai	13.0	14.5	17.7	20.0	17.9	Nanded	11.7	10.9	19.4	17.8	18.7	Takli	8.1	6.9	10.7	9.4	10.2
Golpangri	3.3	7.1	9.5	8.1	9.1	Nitur	13.8	8.5	16.3	18.5	16.1	Tamsa	14.9	14.9	21.7	26.5	21.9
Hirapur	5.6	7.3	9.8	10.2	9.8	O'bad	10.3	14.5	16.5	16.1	16.3	Tawrajkheda	17.3	12.8	16.2	19.1	16.4
Hiwarkheda	16.3	10.7	19.9	21.0	19.9	Omerga	12.9	11.9	15.8	14.9	15.4	Udgir	9.8	12.2	18.1	19.1	17.7
Jadhala	3.8	5.0	18.4	9.9	15.7	Padoli	18.4	10.8	14.8	14.6	14.6	Umri	18.6	7.3	19.0	18.6	18.5
Jafrabad	9.9	15.6	17.2	20.1	17.3	Palam	8.7	7.1	16.3	15.7	15.7	Vaijapur	0.1	11.0	15.0	16.1	15.0
Jamb_bk	19.0	13.0	16.2	14.6	15.8	Palaswadi	5.4	9.9	15.4	14.7	15.3	Vida	14.6	17.4	21.0	20.6	20.7
Jawala_BK	13.1	11.4	18.6	16.0	18.1	Paranda	14.4	13.4	16.9	16.2	16.6	Wadhona	28.1	21.7	22.0	23.8	22.3

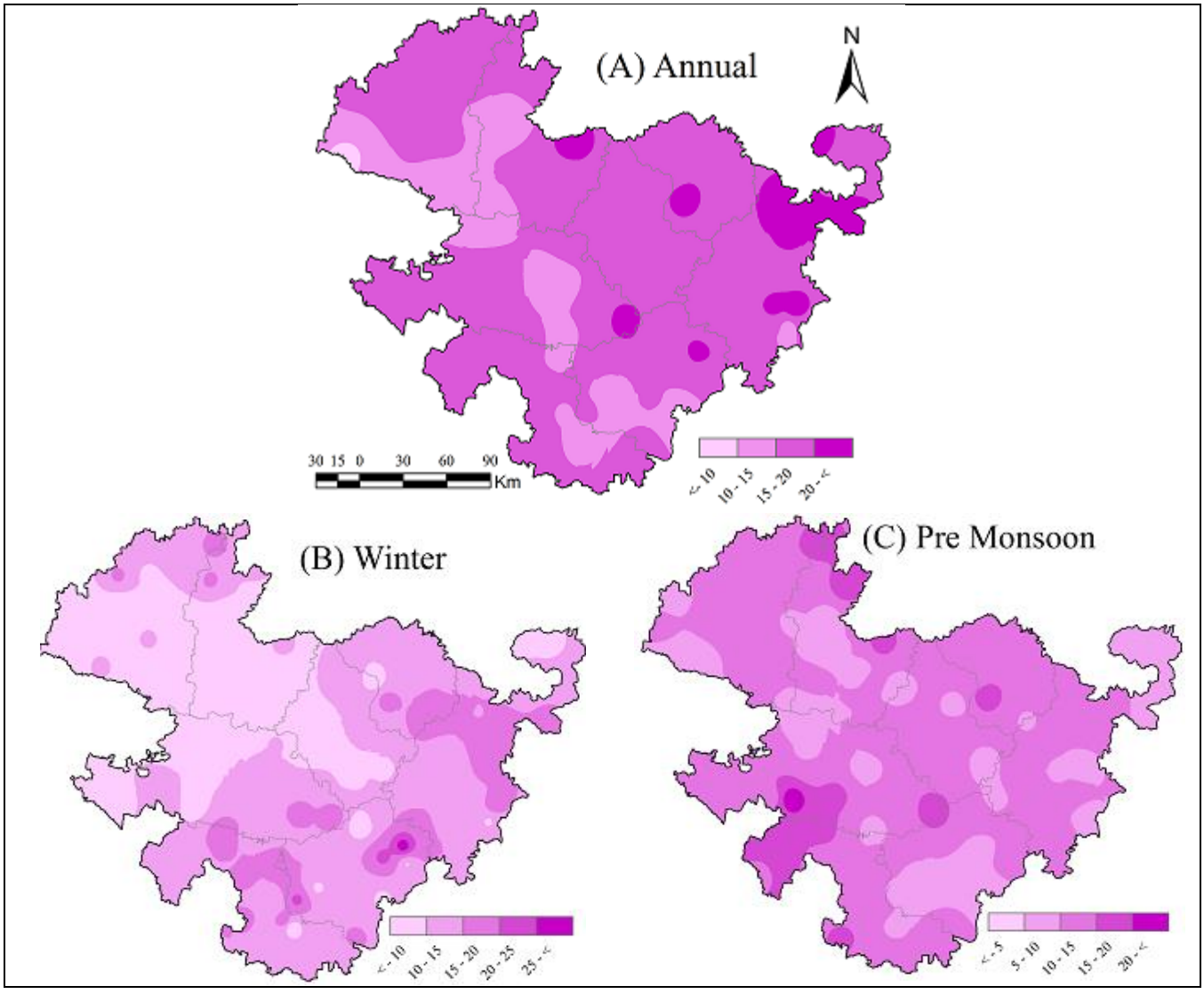
ISSN: 0474-9030

Vol-68-Issue-1-January 2020

Jawlabazar	17.0	19.7	22.7	27.8	23.0	**Parbhani**	14.5	12.1	21.1	19.5	20.1	**Yermala**	14.8	11.3	15.4	15.9	15.3
Jintur	13.8	10.6	16.6	17.6	16.5	**Partur**	5.8	11.0	18.0	17.7	17.4	**Zari**	10.2	7.4	15.4	16.3	15.2

*Complied by Author

shows the spatial distribution of rainfall intensity of March month. In north part of Marathwada Nanded, Hingoli and Parbhani, in south part southern Beed, O'bad and south Latur; north Jalna, south Hingoli have rainfall intensity is more than 10mm/day. In the month of April the Golpangri (1.45mm) has recorded less and Jawlabazar (20.21mm) highest rainfall intensity. The 62 stations have less than 10mm, 33 stations between 10-20mm and one station more than 20mm/day intensity. The May month experiences the dry climate, but some time due to stormy condition heavy rainfall may occurs within short



ISSN: 0474-9030

Vol-68-Issue-1-January 2020

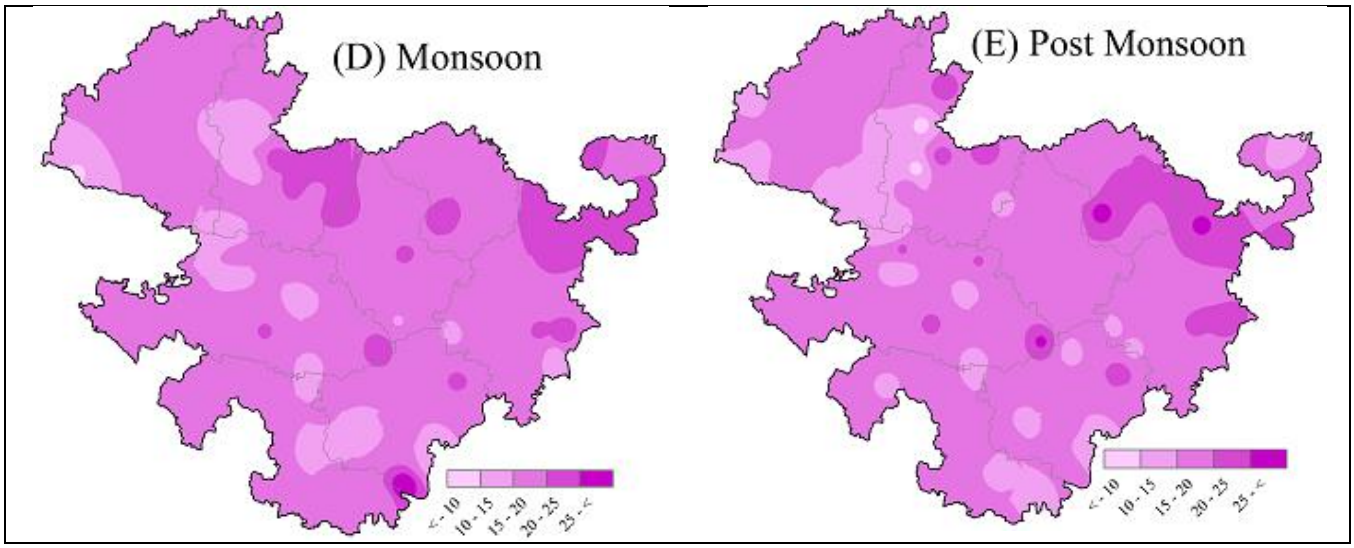


Fig.no. 01 Annual and Seasonal Rainfall Intensity (1980-2016)

period of time. Hence monthly intensity is observed higher than other two months. The minimum rainfall intensity is observed at Supegaon (4.89mm) and highest (31.00mm) at Palaswadi. 29 stations found below 10mm, 58 stations 1020mm and 09 stations more than 20mm/day. It is clear that the rainfall intensity is more than the other two months.

Monsoon Season:

During the monsoon season the intensity of rainfall is observed between 8.78mm to 31.89mm/ day over Nagamthan and Kasarshirshi stations respectively. There are 03 stations (Golpangri, Hirapur and Nagamthan) are observed less than 10mm, 74 stations observed between 10-20mm and 19 stations are 20mm/day rainfall intensity. The spatial variation of monsoon intensity is shown in fig….(D), it depicts west A'bad, central part of O'bad and western and eastern part of Latur district have less than 10mm/day. South Latur, north east Jalna and Nanded are recorded more than 20mm/day rainfall intensity. Remaining most part of Marathwada is experiences rainfall intensity between 10-20mm/day. About 43 stations in monsoon seasons have found rainfall intensity is more than annual intensity but with less variation.

Monthly variation of rainfall intensity of monsoon season is also analyzed. The June month minimum (8.89mm/day) and maximum (26.48mm/day) intensity have observed at Hirapur and Hiwarkheda orderly. Golpangri (9.58mm), Awadshirpur (9.31mm) and Hirapur (8.89mm) stations are observed less than 10mm/day, 79 stations found with 10-20mm and 14 stations are having more than 20mm/day rainfall intensity. The fig. 01-I(F) shows the spatial variation of intensity of June month. The intensity increases toward north western and north eastern direction covering Jalna, A'bad, Parbhani, Hingoli and Nanded districts. Also increases toward south western part of Marathwada region over western and southern O'bad and Beed districts. The July months rainfall intensity is shown in fig. 02-II(G), intensity is ranges from 7.12mm to 23.78mm. Again Hirapur (7.78mm), Golpangri(8.95mm) and Nangamthan(7.12mm) stations found below 10mm/day, 78 stations between 10-20mm and 15 stations have more than 20mm/day. It means the rainfall intensity is similar to June month intensity. The intensity pattern of August month also observed similar to June and July months. But during the month of September it is recorded that intensity ranges from 10.43mm to 26.76mm /day. It indicates that the

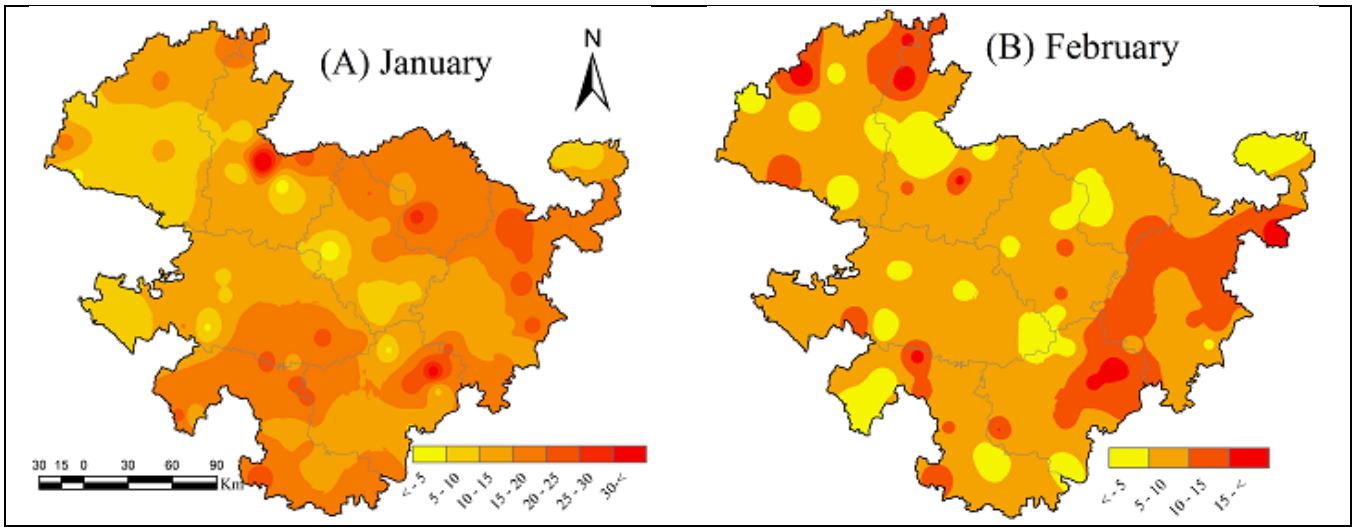
ISSN: 0474-9030

Vol-68-Issue-1-January 2020

intensity increased in September. Not a single station found below 10mm/day, most area covers with 69 stations with 10-20mm, 27 stations 20mm/day rainfall intensity.

Post Monsoon:

Post monsoon season also known as returning monsoon period. The rainfall intensity variation is observed from 8.08 to 27.77mm/day over Golpangri and Jawlabazar sequentially. There are four station (Golpangri, Bhavanepangri, Jadhala and Takli) falls below 10mm/day, 77 stations have 10-20mm and 15 stations observed with more than 20mm/day intensity. Nearby 65% stations recorded more intensity than the annual in this season. Monthly variation of rainfall intensity for the month of October, November and December is represented in fig. 02-II(J, K & L). The October month intensity of rainfall is observed with variation ranging from 8.51mm to 28.62mm/day. There are 02 stations found below 10mm, 69 stations intensity observed between 10-20mm/day and 27 stations rainfall intensity have more than 20mm/day. During November month it is recorded that intensity varies from 1.61mm to 24.40mm/day. In the month of December it ranges from 3.64mm to 33.48mm/day. The spatial variation of these months shown in fig. 02-II(J, K, & L). In October month Hingoli, Nanded and eastern Beed are found highest intensity. Western Jalna, A'bad, North western Beed and eastern part of Latur districts experiences less intensity. In the month of November and December western Marathwada covering Beed, south Jalna north A'bad, south Parbhani, and over Latur, O'bad and Nanded District it is seen that intensity is more than 20mm/day. Centeral Jalna and adjoining part of Latur, Parbhani and Nanded district experiences less than 10mm/day intensity.



ISSN: 0474-9030

Vol-68-Issue-1-January 2020

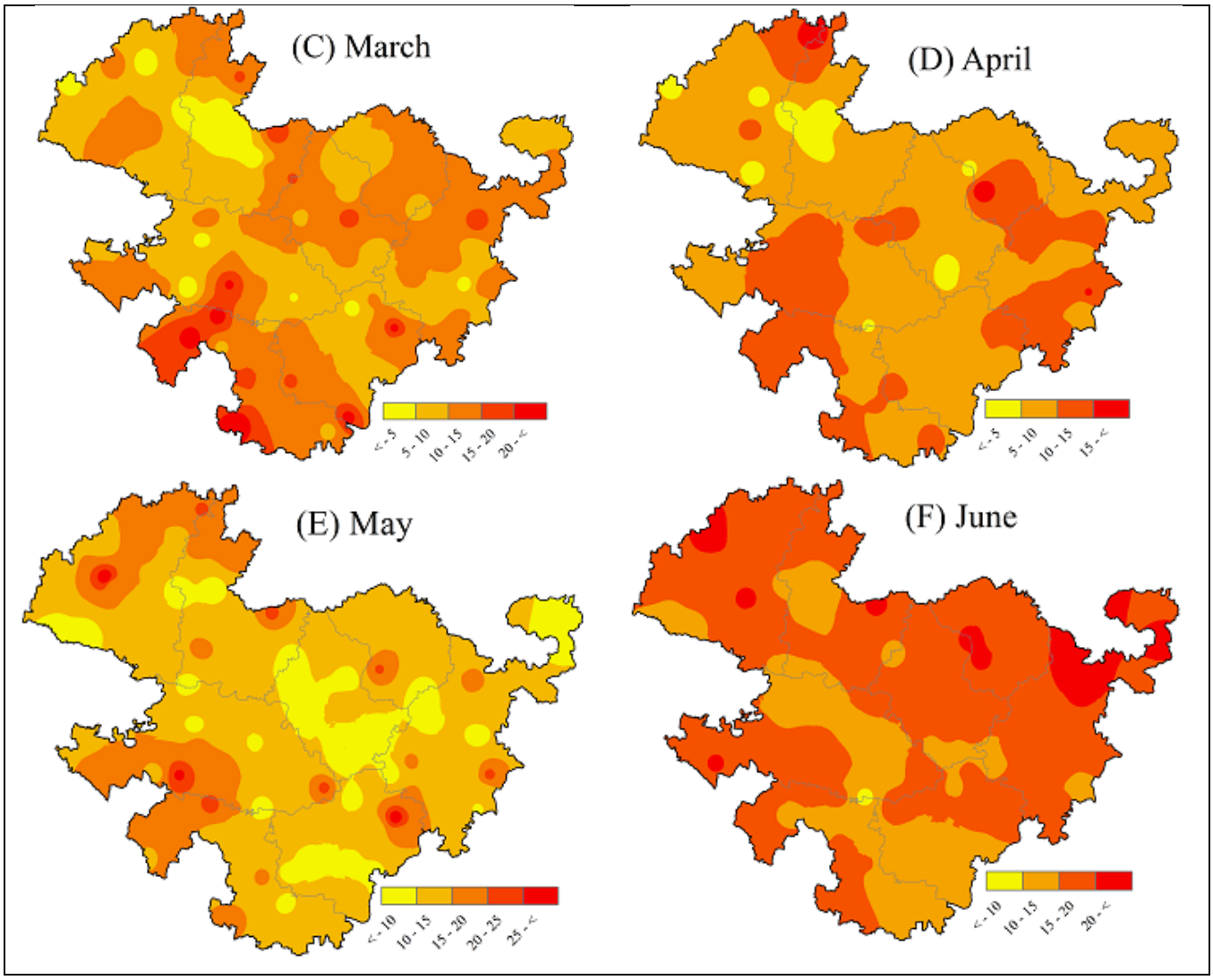
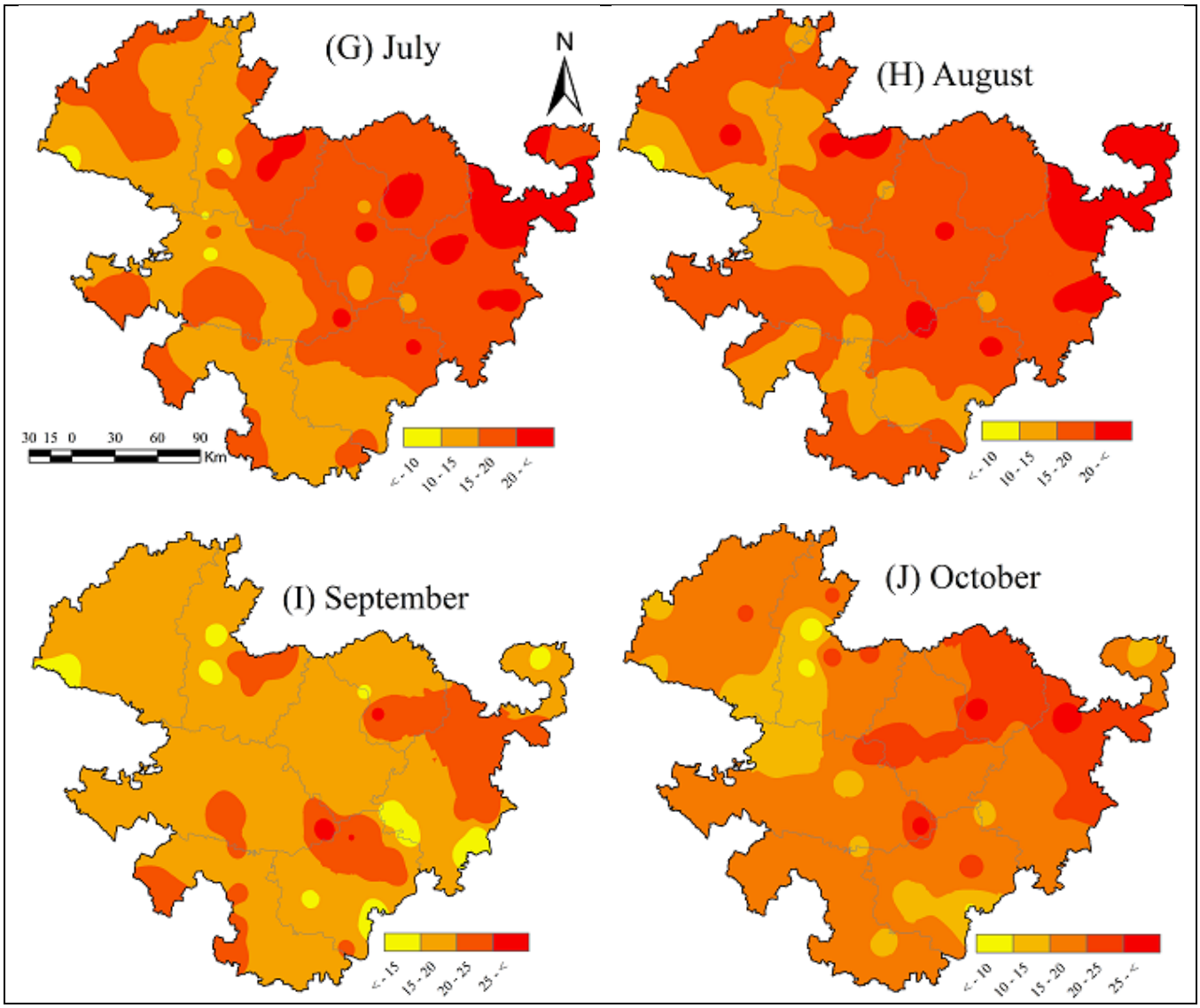


Fig. no.02 (I) Monthly Rainfall Intensity (1980 – 2016)

ISSN: 0474-9030

Vol-68-Issue-1-January 2020



ISSN: 0474-9030

Vol-68-Issue-1-January 2020

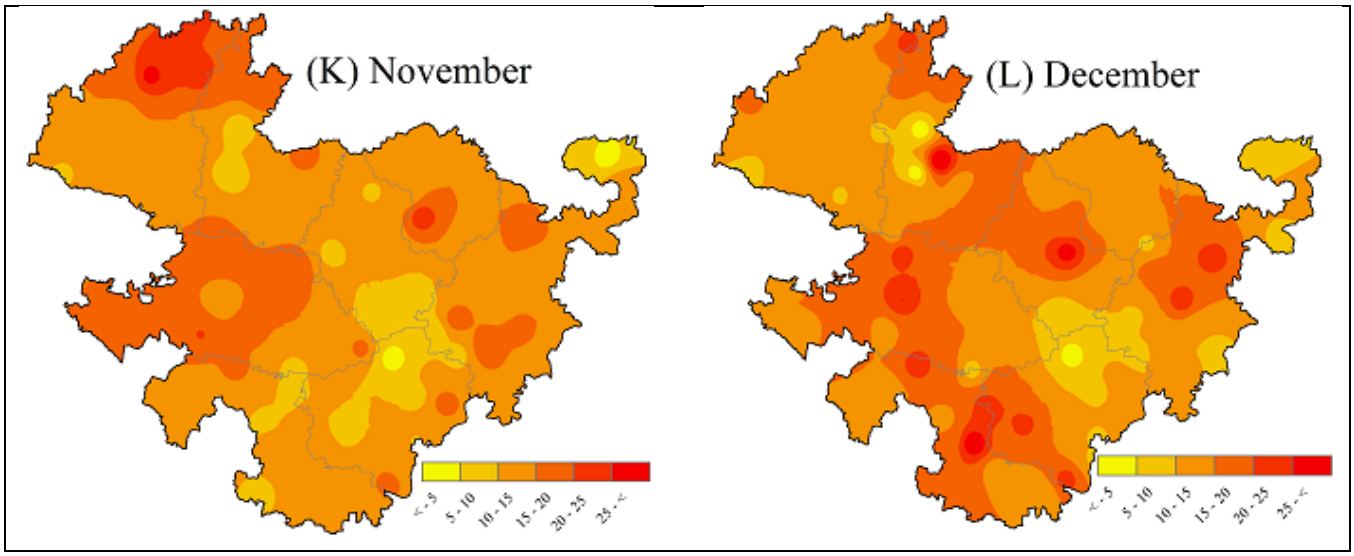


Fig. no. 02 (II) Monthly Rainfall Intensity (1980 – 2016)

Annual Intensity of Rainfall:

Fig. 01 and table 01 shows the amount of rainfall per day. The amount of rainfall per day by annual is ranges from 8.8mm to 24.4mm. The Nagamthan station of A'bad district has recorded very low rainfall intensity and the Murti of Nanded district has recorded highest (24.4mm/day) rainfall intensity. Golpangri and Hirapur also recorded 9.1mm and 9.8 mm intensity orderly. On the other hand after the Murti station Shahagad and Jawlabazar of Jalna district and Wadhona of Latur district recorded highest i.e. 23.13mm, 23.03mm and 22.29mm/day respectively. fig. 01(A) depicts the spatial distribution of rainfall intensity. About 14 stations covering eastern part of Nanded, central Hingoli, eastern patch of Beed and north eastern Jalna found with more than 20mm/day. The 79 stations belongs from north western Jalna, south eastern Latur and south A'bad observed with 10-20mm/day covers major part of Marathwada region and only three stations found with less than 10mm/day rainfall intensity.

Conclusion:

This paper represents the behavior of rainfall intensity over Marathwada region. The measurements have been conducted for 96 stations for the duration of 37 years. The analysis carried based on monthly, seasonal and annual scale. The data gives insight in the behavior of rainfall in region. In the diagram intensity is represent with 5mm/ day interval. With concern to monthly scenario the February month has recorded 06 stations with less than 1mm/day of intensity followed by march month at 04 stations while the maximum (39.77mm/day) intensity observed at Salegaon station in January Month. Followed by Bembli (33.48mm/day) of O'bad district in the month of December. As far as seasonal variation concern rainfall intensity is found that the lowest and highest intensity stations belong to winter season. The Salegaon (39.77mm/day) and Vaijapur (0.08mm/day) of A'bad district orderly. The annual picture of rainfall intensity is different. The higher intensity is observed at Murti (24.43mm/day) followed by Shevali (23.13mm/day) and Jawlabazar (23.03mm/day). The lowest intensity is recorded at Nagamthan (8.77mm/day) followed by Golpangri (9.14mm/day) and Hirapur (9.77mm/day). Over all the maximum stations are observed between 10 to 20 mm/day rainfall intensity.

ISSN: 0474-9030

Vol-68-Issue-1-January 2020

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ISSN: 0474-9030

Vol-68-Issue-1-January 2020