

Analysis of rainfall trends over Nanded of Maharashtra, India

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Abstract

Changing climate is great cause of concern for all over the world especially rain fed developing country since change in amount and intensity of rainfall adversely affect all sectors of country. Attempt was made to study variation in monthly, seasonal and annual rainfall over Nanded of Maharashtra state of India during period from 1969 to 2010. Annual rainfall trends showed insignificant falling trends. Winter and summer rainfall trends shows decreasing rainfall trends. Monsoon and post monsoon rainfall trends shows increasing trends .maximum increasing trend were observed for post monsoon and it was 9.81mm/year. Analysis of monthly trends reveals that monthly rainfall of six months shows increasing trends and six months shows decreasing trends.

Key words-Annual, seasonal, Monthly rainfall trends

Introduction

Climate change and global warming are believed worldwide as the most crucial environmental problem that world undergoing today (working group 123 IPCC,

2007; Anser khan et al., 2014,). The urbanization has also produced several environment difficulties extending from the local to the global scale (Kim and Baik, 2005; Zhao et al., 2006) counting increased air and water pollution and decreased water supply (Liu and Diamon 2005; Shao et al., 2006, Kadam and Karnewar “a”, 2015) Due to all the anthropogenic happenings normal behavior of climate parameter get changed specially temperature and rainfall (Karnewar and kadam, 2015 “b”). One of the pointers of climate change is rainfall (Adger et al., 2003; Frinch et al., 2002; Novorthy and Stetan, 2007) since it affect every sector of human life hence study of rainfall is very indispensable and cannot be over emphasized (Obot and Onyeukwu, 2010).

Numerous scholars studied on inequality and trends in rainfall on universal level. Nicholson and Grist (2001) in west Africa ,Rodrigo et al.,(2000) in Spain , Rotstayn and Lohman (2002) in north Africa , Jayewardene (2005) in Sri Lanka, Murphy and Timbal (2007), Smadi and Zghol (2006) in Jordan, Partal and Kahya (2006) in turkey

found deteriorating rainfall trends over their respective country while some other scholar like Nicholls and Lavery (2006), Akinremi et al., (2001) in North Africa found growing rainfall trends over their respective country. Many researchers have also tried to study annual, seasonal and monthly rainfall trends in India. Long term trends in small spatial scale was informed by Koteswaram and Alvi

(1969), Jagannathan and Parthasarathy (1973), Jagannathan and Bhalme (1973), Naidu et al., (1999) and Singh and Sontakke (1999) Rupa Kumar et al., (1992) have found significant growing trends along the west coast, north Andhra Pradesh and north west India. Guhathakurta and Rajeevan (2007) observed falling trends.

Study Area

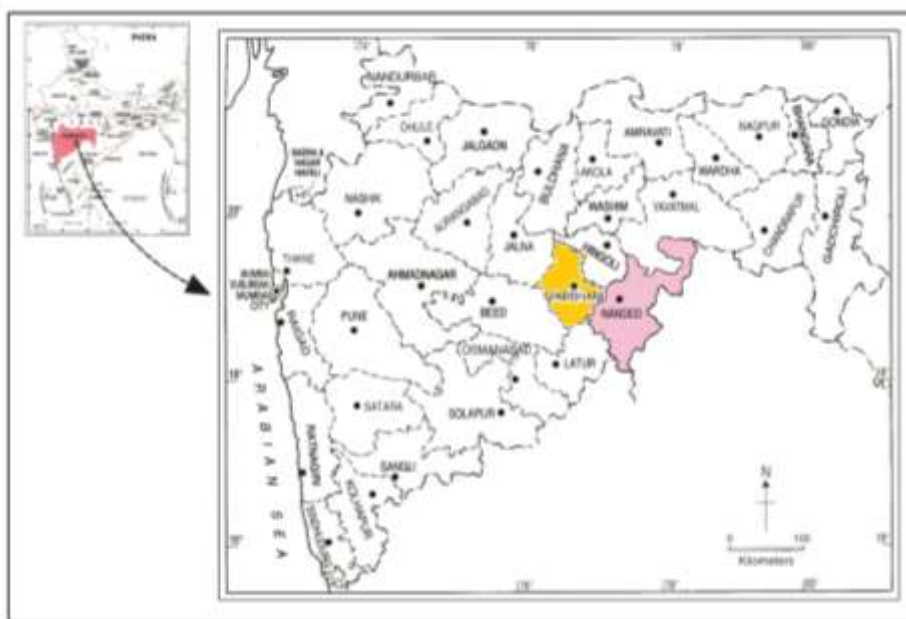


Figure: 1 showing study areas map of Nanded

Nanded is the second leading city in Marathwada division of Maharashtra located on the bank of Godavari, having altitude 362 m above sea level. Nanded is the center of operations of Nanded District in the Marathwada, found in the Deccan

Plateau. Nanded district has a physical area of 10,528 Sq. Km., which forms 3.41% of the total geographical area of Maharashtra State. The district of Nanded has between 18°.15' and 19°.55' North latitude and 77°.7' to 78°.15' east

longitudes (Yannawar et al., 2013, Karnewar and Kadam, 2015). The entire area under the Nanded Waghala City Municipal Corporation (NWCMC) jurisdiction is 51.76 Sq.km, (5,176.66 Ha). Nanded City is distributed in two parts i.e. Old Nanded (20.62 Sq.km) north of the Godavari river (on the left bank) and New Nanded (31.14 Sq.km) including of Waghala and six other newly fused villages and CIDCO area, south of the Godavari river (on the right bank).

Data and Methodology

The daily Rainfall (mm) of Nanded recorded by IMD Pune for period 1969-2010 was collected from Indian metrological Department, Pune since this study consist of annual, seasonal, monthly rainfall analysis of. Monthly Rainfall was calculated by taking arithmetic mean of daily rainfall of that particular month. Likewise, seasonal rainfall was also calculated by averaging daily temperature of that season. From the monthly values, annual (January-December) and seasonal 1.Winter: January, February, 2.Summer: March-May; 3.Monsoon: June-September; 4.Post monsoon: October. November December) time series of all parameters under study rainfall are prepared.

The monthly, seasonal and annual rainfall and coefficient of variation (coefficient of variation), coefficient of determination (COD), and standard deviation (SD), contribution for entire period of study (1969-2010) are computed and given in their respective Table 1 Similarly, mean, coefficient of variation of each month and season to the annual mean.

Rainfall features.

Rainfall characteristics of Nanded city are shown in table 1. Annual rainfall over Nanded from 1969 to 2010 is 877 mm with a standard deviation 226 mm. The coefficient of variation of annual rainfall for Nanded is 25.8%. The seasonal rainfall for winter, summer, monsoon, and Post monsoon is 8.73mm, 39.01mm, 774.4mm, and 120.38 mm respectively. Maximum rainfall was observed in monsoon which contributes near about 82 % to annual rainfall. Maximum coefficient of variation was observed in post monsoon season and it is 194.73 % which mean rainfall is more variable in post monsoon. Minimum coefficient of variation is observed in monsoon which means that rainfall is more stable in monsoon season. Maximum monthly rainfall was observed in July,

August, September and June are 233mm, 225mm, 163mm and 154 mm respectively. July contributes highest in monthly rainfall and it is 24.70% to the annual rainfall. Rainfall in January (4.14mm) is least and contributes only 0.44% to the annual

rainfall. The coefficient of variation is highest during December (557%) and least during June (52.7%) it means that rainfall is more variable in December and least variable in June.

Table 1 Monthly, Seasonal and annual mean of rainfall over Nanded from 1969 to 2010.

Month	Mean (mm)	SD	C.OV (%)	COD	Increase	Contribution (%)
January	4.14	6.44	155.66	0.0032	-1.2	0.44
February	4.59	12.87	280.51	0.0206	-6.1	0.49
March	7	11.5	164.32	0.0362	-9.5	0.74
April	6.27	9.49	151.34	0.1677	14.7	0.67
May	25.74	34.81	135.22	0.0113	12.4	2.73
June	154.03	81.16	52.69	0.0385	52.8	16.34
July	232.81	129.28	55.53	0.0485	97	24.70
August	224.5	130.61	58.18	0.0031	24.1	23.82
September	163.08	111.09	68.12	0.0329	-66.7	17.30
October	63.61	56.6	88.97	0.0356	-35.9	6.75
November	13.74	18.97	138.03	0.0207	-9.1	1.46
December	43.03	239.55	556.69	0.0003	1.2	4.57
winter	8.73	13.68	156.76	0.026	-7.7	0.93
Summer	39.01	37.81	96.93	0.0034	-7.4	4.14
Monsoon	774.4	208.24	26.89	0.0004	85.5	82.16
Po. Monsoon	120.38	234.42	194.73	0.0243	412.4	12.77
Annual	877	226.3	25.8	0.0004	-14.889	100.00

1. Analysis of Annual rainfall trends

Annual rainfall trends over Nanded showed insignificant falling trends of about 0.3545 mm/year. Near about 28 years (71.80%) shows annual rainfall less than that of mean annual rainfall and 14 years (28.20%) show annual rainfall more than that of mean annual rainfall. The maximum rainfall of 1583.00

mm was observed in 1983 and minimum annual rainfall of about 350.9 mm was observed in the year 1972. Annual rainfall of first half years (1969-1989) shows increasing trends. For first 21 years annual rainfall increased by 12.35 mm/year and total increase observed was 518.10 mm.

Annual rainfalls of second half (1990-2009) shows decreasing trends of 2.16mm/year. The coefficient of variation of first half was 33.0 and for second half it was 11.20 that means rainfall was more varied in first half and more stable in second half. From Figure 2 it is evident that. For Nanded there were

28 years (66.7%) with below normal rainfall, only 14 (33.3%) years with above normal rainfall. Maximum negative departure was observed in 1976 which was -474 mm and. Maximum positive departure was observed in 1975 and it was 411 mm.

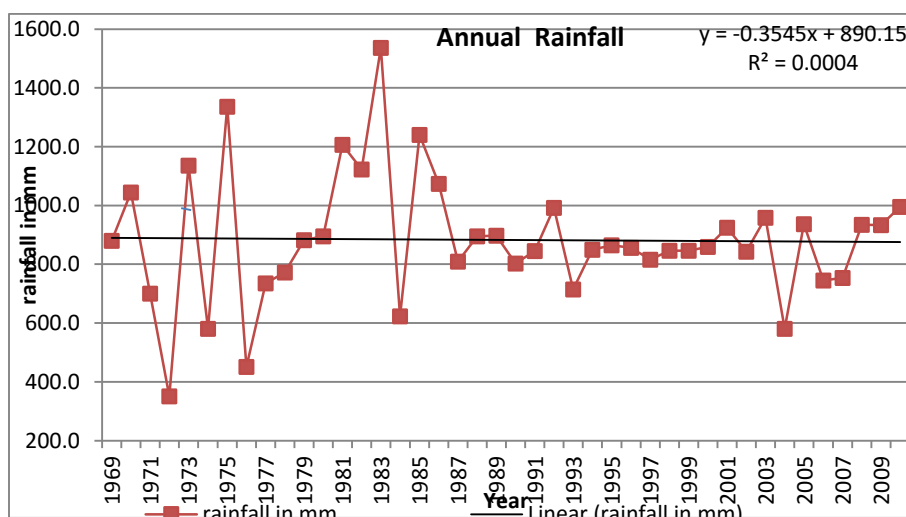


Figure 2. Annual rainfall trends over Nanded

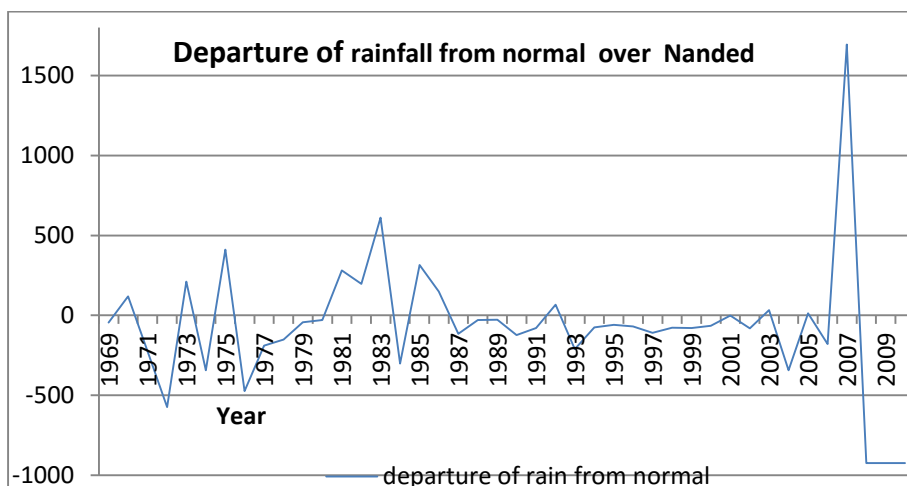
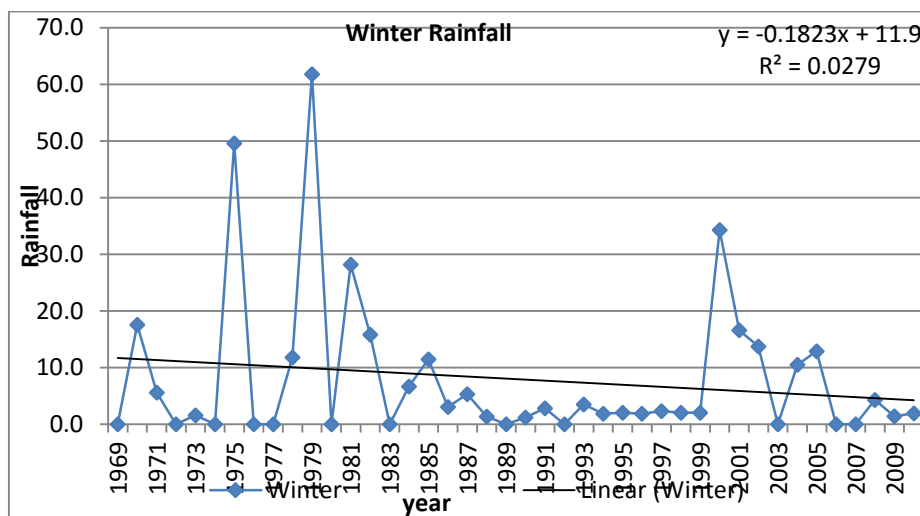


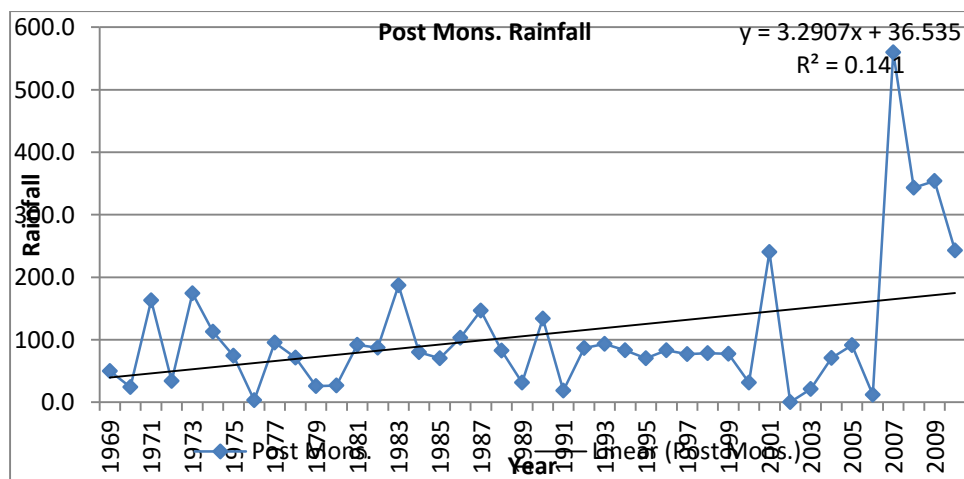
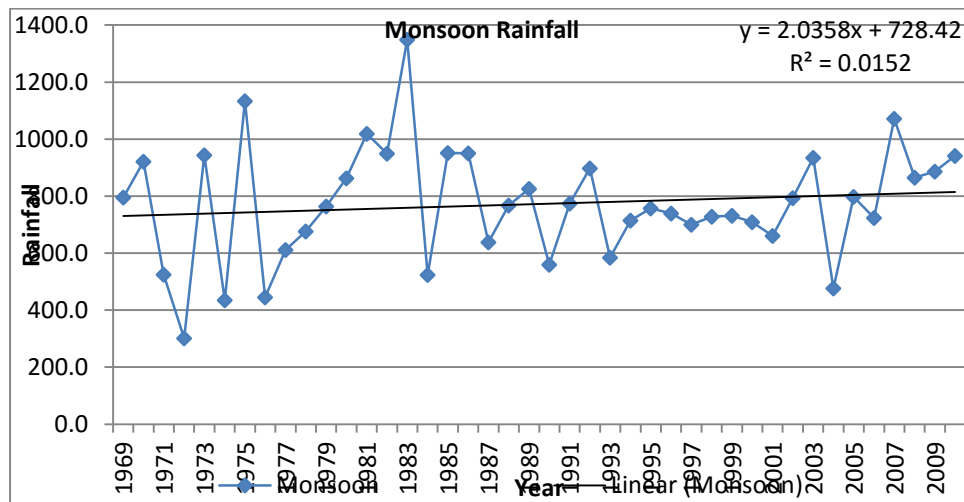
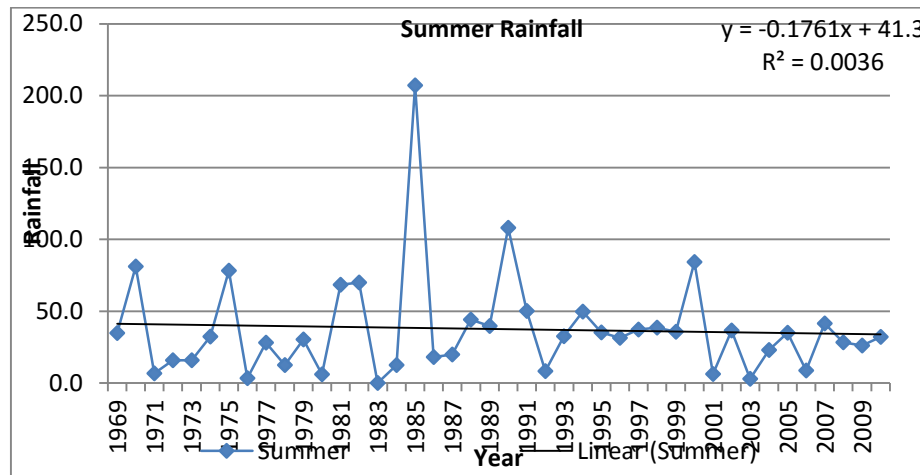
Figure 3 Departure of rainfall from normal over Nanded

2. Seasonal rainfall trends

Long term winter rainfall shows decreasing trends. During this period the rainfall decreased by 0.1743/year and total decrease for this period was 7.30mm. Maximum winters rainfall was observed in the year 1979 and it was 61.80 mm. About 340.40 mm rainfall was observed in winter for the period of 42 years and winter contributes

0.93 % to the annual rainfall. Long term summer rainfall show slightly decreasing trends of about 0.173/year and total decrease for this period was 7.30 mm. Maximum Summer rainfall was observed in the year 1985 and it was 61.80mm. About 207.10mm rainfall was observed in summer for the period of 42 years and it contributes 4.14 % to the annual rainfall.





Long term monsoon rainfall trends show increasing trends. During this period, the rainfall increased by 2.554mm/year and total increase for this period was 107.20mm. Maximum monsoon rainfalls was observed in the year 1983 and it was 1344.40mm. About 30202 mm rainfall was observed in monsoon for the period of 42 years and it contributes 82.16% to the annual rainfall. Long term post monsoon rainfall trends show decreasing trends. During this period, the rainfall increased by 0.7097mm/year and total decrease for this period was 29.70mm. Maximum post monsoon rainfalls was observed in the year 2001 and it was 240.50mm. About 4695mm rainfall was observed in post monsoon for the period of 42 years and it contributes 12.78% to the annual rainfall.

3. Monthly rainfall trends

Behavior of monthly rainfall of Nanded has been studied for individual months by subjecting them to the linear trends. Maximum monthly rainfall was observed for July, August, September and June and it was 2532.81mm, 224.50mm, 163.10mm, and 154.00 mm respectively. January, February, March, September, October, November, show decreasing rainfall trends 6 months

(50%) shows decreasing rainfall a trend Maximum decreasing trends was observed in September and it was 1.59mm/year. Least decreasing trend of about 0.0003mm/year was observed in January.

Increasing monthly rainfall trends were observed for April, May, June, July, August, and December. Maximum increase was seen in June and it was 1.258mm/year and total increase for the period of 42 year was 52.8mm. Minimum increasing trends of about 0.0282mm/year was observed in December. For monthly rainfall, maximum coefficient of variation was observed for December and February and it was 556.69% and 280.51% respectively and minimum coefficient of variation was observed for June, July and August and it was 52.69%, 55.53% and 58.18% respectively. This means that monthly rainfall was more variable in December and February and it is more stable in June, July and August.

Conclusion

The aim of present study was to identify rainfall trends for the period of 1969 to 2010 over Nanded. Annual rainfall trends showed insignificant falling trends. Annual rainfall trends of first half years (1969-1989) shows increasing trends of about 12.35 mm/year.

While second half (1990-2010) shows decreasing trend of about 2.16mm/year. Out of 42 years annual rainfall of 28 years shows less annual rainfall and annual rainfall of 14 years shows more rainfall than that of normal rainfall. Winter and summer rainfall trends shows decreasing rainfall trends. Monsoon and post monsoon rainfall trends shows increasing trends. Maximum increasing trend were observed for post monsoon and it was 9.81mm/year. Analysis of monthly trends reveals that 6 months shows increasing trends and 6 months shows decreasing trends. Minimum increasing trends of about 0.0282mm/year was observed in December. Maximum decreasing trends was observed in September and it was 1.59mm/year. Maximum coefficient of variation was observed in post monsoon season and it is 194.73% which mean rainfall is more variable in post monsoon. Maximum coefficient of variation was observed in December and it was 556.69% and minimum coefficient of variation was observed in June and it was 52.70. This means that monthly rainfall was more variable in December it is more stable in June.

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