# Detection of rainfall trends over Sangli of Maharashtra, India

[1] Miss Patil Shweta Chandrakant, [2] Prof. Sheetal V. Deshamukh

[1]PG Student, [2]Asst.Prof. Bharti Vidyapeeth(Deemed) University, Pune
*Yashwantaro Mohite Institute of Management Karad, Maharashtra*
[1]PG & MCA Department,
[1]PG Student , Karad, India .

*Abstract:* Climate change is an important reason why it is rained in developing countries of the world, especially because changes in rainfall and intensity are unfavorable. affects all sectors of the country. In this study, an exploratory analysis of rainfall data was performed. This survey aims to identify seasonal and annual trends in pre-monsoon and post-monsoon monsoons at 9 sites in the high rain region. The data used includes the seasons and rainfall at the station from 1981 to 2012. Estimate the size of the trend using nonparametric statistical tools such as the Sen'sestimator slope estimator and the Mann-Kendall trend test. The rainfall series observed at post monsoon at stations Jath and Kavathe Mahankal are statistically significant ($p < 0.10$, $p < 0.15$). A downward trend was detected at the Atapadi and Tasgaon stations, but this tendency is not statistically important. In the place the first rains are light and the night-time rains are unpredictable, so deficiency takes place frequently. The monthly and annual rainy days of statistics of Vita and Tasgaon stations found from India Meteorological Department have been analysed on the computer the use of Microsoft Excel. Correlation among normal annual rainfall and average rainy days are designed for every station.

**IndexTerms**: Rainfall time series , Annual, seasonal, Monthly rainfall trends, Sangli, Maharashtra state

## I. INTRODUCTION

Sangli region falls for the most part in Krishna bowl and almost in Bhima bowl. Consequently, it is isolated into different channel structures. There are 10 tahasils in Sangli area viz (1) Atpadi (2) Islampur (3) Jat (4) Kavathe Mahankal (5) Miraj (6) Palus (7) Sangli (8) Shirala and (9) Tasgaon.

The environment of Sangli area is for the most part hot and dry. In the uneven areas of the locale, the environment is cool.The whole region can be isolated into three interesting parts dependent on geography, climatology and precipitation viz.

1. Western uneven space of Shirala tahsil with strong precipitation.
2. The dish space of Krishna, Warna and Yerala rivers, Walwa, tahsil and western piece of Tasgaon and Miraj tahsils with average rainfall
3.Eastern drought slanted locale which contains eastern piece of Miraj, and Tasgaon tahsils,north-eastern piece of Khanapur tahsil and whole of Atpadi, Kavathe Mahankal and Jath .

### *A.Study Area*

The current study is concentrated on rainfalls trends in Sangli areas of Maharashtra state. The current examination is centered around Precipitation drifts in Sangli areas of Maharashtra state. The Sangli area lies between 160 45' and 700 33' north longitudes and 73042' and 750 40' east scopes. The locale is partitioned in to 10 tehsils with a space of 8591.3kilometers and a populace of 2822143. Topographically the region is isolated into three zones, viz. western zone, focal zone and eastern zone. The region lies in the Sothern some portion of Maharashtra state.

The normal yearly precipitation of Sangli locale was 615.5 mm which was gotten in 42 stormy days with the most noteworthy of 56 blustery days during 2006 and the most reduced of 22 stormy days during 1972. Out of all out yearly precipitation about 72.1 percent precipitation was gotten in South-West (SW) rainstorm season just, while staying 27.9 percent from Upper east (NE), winter and summer rainstorm. Among the aggregate precipitation got in SW rainstorm season, June to September month and October recorded higher precipitation than residual months. This precipitation concurs with conceptive phase of kharif crops just as ideal planting of rabi crops. The normal month to

The normal month to month precipitation variety was in the scope of 18.7 percent to 114.7 percent in long stretches of the September and February, separately.

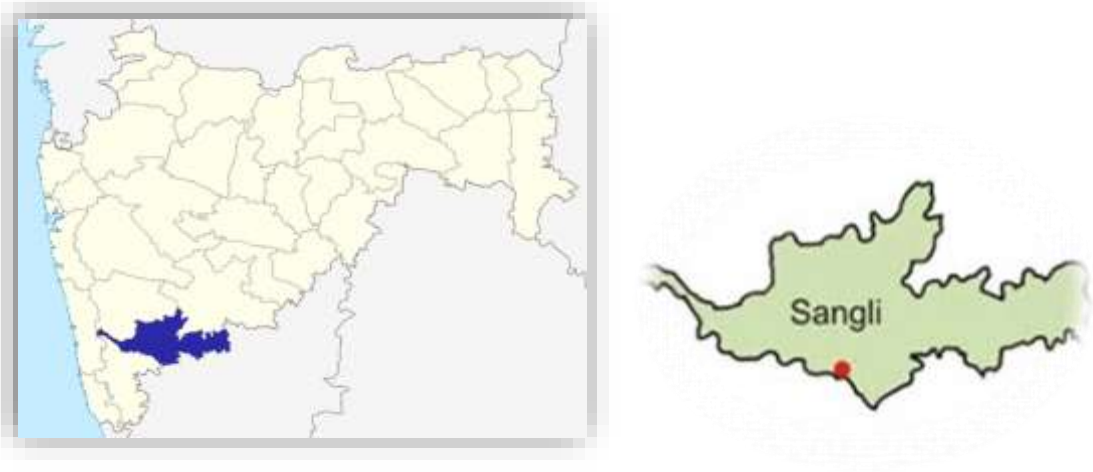


*Figure: 1 showing study areas map of Sangli*

| Sr. No. | Station | Elevation (mas*l ) | Mean Annual Rainfall (in mm) |
|---|---|---|---|
| 1 | Atapadi | 552 | 419.61 |
| 2 | Islampur | 590 | 732.80 |
| 3 | Jath | 567 | 569.01 |
| 4 | Kavthe Mahankal | 627 | 477.48 |
| 5 | Miraj | 562 | 587.00 |
| 6 | Palus | 570 | 339.81 |
| 7 | Sangli | 549 | 517.66 |
| 8 | Shirala | 1040 | 1004.94 |
| 9 | Tasgoan | 585 | 598.77 |

*Table 1: Rainfall Stations in Sangli*

## III) METHOD OLOGY

### *A. Material & Methods :*

The data used for this assessment is discretionary data. The is data procured from the Indian Meteorological Office , Pune. The data fuse the records of consistently precipitation recorded at nine meteorological stations in Sangli region. The precipitation records fuse discernments crossing from 1981 to 2012 and cover a period over 32 years. For the said reason we consider four series of season-wise data explicitly winter season (January and February),- pre monsoon season (Walk, April and May), Tempest season (June, July, August and September),- post monsoon season (October and November) and fifth series as an rainfall nual data for all stations. The time span series is enough long to finish quantifiable assessment. As various hydrological time series data are not commonly scattered,- parametric non tests were enjoyed over parametric tests.

### B. Sen's Slope Estimator:

Past assessments have used different methodologies for design revelation. Example examination of a period series involves the greatness of example and its genuine significance. When in doubt, the degree of example in a period series is settled in light of everything utilizing parametric tests like backslide examination or using paranonmetric procedure for instance, Sen's assessor procedure. Both these techniques expect an immediate example in the time series. Sen's inclination assessor has been for the most part used for choosing the significance of pattern in hydro-meteorological time series. In this strategy, the inclinations ( ) of all data sets are first calculated by

where, X j and Xi are data values at time j and i (j i) > The median of these N values of is Sen's estimator of slope which is calculated as:

A positive worth of E shows a vertical (expanding) pattern and a negative worth demonstrates a descending (lessening pattern ) in the time series.

### *C. Mann-Kendal Test:*

The MK test checks the invalid theory of no pattern versus the other option theory of the presence increasing of order increasing pattern. i.e.,H0 : There is no pattern in the information esteems versus H1 : There exists pattern in the information esteems.

**The statistics (S) is defined as:**

Where, N is the quantity of information focuses. Expecting (X j Xi ) T , the worth of Sign(T) is figured as follows

For huge N, the test is directed utilizing ordinary circulation with mean and fluctuation as follows: E(S) 0
and

Where, n is the quantity of tied gatherings and k t is the quantity of information focuses in the k'th tied gathering.The Standard Typical Variate (S.N.V.) is then figured as:.

In the event that the figured value is more prominent than basic worth i.e., , Z ZD/2 ! the invalid theory H0 is dismissed at D level of importance, where 0 D 1. The positive worth of S shows an 'up pattern', while a negative worth designates 'descending pattern'.

## IV) RESULTS AND DISCUSSION

### *A. Result of Monthly Rainfall Distribution:*

For study average annual rainfall (mm) of Sangli districts of Maharashtra month wise: In July there is high possibility of heavy rains with 108.77 mm in sangli and very low rainfall in Jan , Feb and Dec with 3.8 mm , 0.5 mm , 6.mm respectively .

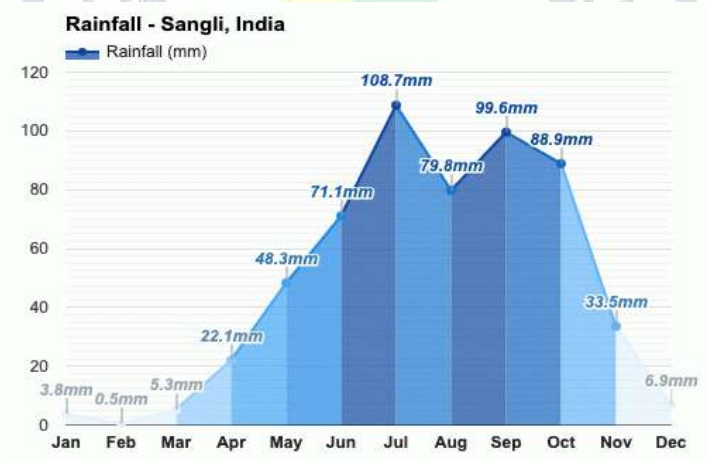


*Figure2: Monthly Rainfall Distribution*

***B. Result of anuual rainfall distribution with stations:***

| Block | Average annual rainfall (mm) |
|---|---|
| Miraj | 487 |
| Kavate-Mahankal | 493 |
| Tasgaon | 461 |
| Jat | 415 |
| Khanapur | 558 |
| Atapadi | 237 |
| Kadegaon | 545 |
| District | 459 |

*Figure 3:Average annual rainfall*

As per given figure , Avrage annual rainfall was calculated where lower rainfall in Atapadi and highest rainfall in khanapur as per given diagram.

***C. Result of Tahasil wise seasonal rainfall (mm) variation in Sangli district :***

| Tahasil | Season wise rainfall (Nos.) and coefficient of variation (%) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | South-West | | | North -East | | | Summer | | | Winter | | | Annual | | |
| | RF (mm) | SD | CV (%) | RF (mm) | SD | CV (%) | RF (mm) | SD | CV (%) | RF (mm) | SD | CV (%) | RF (mm) | SD | CV (%) |
| Atpadi | 291.5 | 138.4 | 47.5 | 91.8 | 64.3 | 70.0 | 33.1 | 31.6 | 95.5 | 1.5 | 5.9 | 381.8 | 418.0 | 130.2 | 31.1 |
| Walwa | 525.1 | 203.2 | 38.7 | 137.2 | 88.6 | 64.6 | 68.2 | 71.7 | 105.2 | 3.4 | 11.6 | 344.0 | 733.8 | 234.2 | 31.9 |
| Jat | 412.9 | 167.1 | 40.5 | 137.1 | 97.7 | 71.2 | 63.3 | 55.9 | 88.4 | 1.9 | 7.2 | 377.7 | 615.1 | 181.3 | 29.5 |
| Kadegaon | 430.5 | 190.3 | 44.2 | 93.1 | 79.2 | 85.0 | 35.9 | 33.6 | 93.6 | 0.1 | 0.5 | 424.3 | 559.7 | 197.4 | 35.3 |
| Kavathemahankal | 339.0 | 148.3 | 43.8 | 131.4 | 68.5 | 52.1 | 55.8 | 53.8 | 96.3 | 1.0 | 2.4 | 250.9 | 527.1 | 148.1 | 28.1 |
| Khanapur | 474.8 | 176.4 | 37.2 | 133.7 | 80.9 | 60.5 | 51.8 | 56.0 | 108.0 | 0.7 | 1.5 | 230.3 | 660.9 | 213.5 | 32.3 |
| Miraj | 413.9 | 158.4 | 38.3 | 124.5 | 78.5 | 63.1 | 51.0 | 63.0 | 123.5 | 1.6 | 5.9 | 378.9 | 590.9 | 184.5 | 31.2 |
| Palus | 271.3 | 113.5 | 41.8 | 61.3 | 43.2 | 70.4 | 19.6 | 34.2 | 174.0 | 0.1 | 0.5 | 424.3 | 352.3 | 124.8 | 35.4 |
| Shirala | 858.7 | 238.8 | 27.8 | 129.7 | 80.5 | 62.1 | 81.3 | 84.6 | 104.1 | 2.1 | 8.1 | 379.2 | 1071.8 | 397.3 | 37.1 |
| Tasgaon | 428.7 | 145.0 | 33.8 | 130.3 | 68.2 | 52.3 | 73.4 | 53.7 | 73.1 | 3.3 | 12.8 | 392.9 | 635.7 | 187.2 | 29.4 |
| District mean per cent | 444.6 | 165.3 | 37.2 | 117.0 | 25.8 | 22.1 | 53.4 | 19.3 | 36.2 | 1.6 | 1.2 | 73.9 | 616.5 | 199.3 | 32.3 |
| Contributicn | | 72.1 | | | 19.0 | | | 8.7 | | | 0.3 | | | 100 | |

RF = Rainfall (mm), SD = Standard deviation, CV% = Co-efficient of variation (%)



*Table2: Tahasil wise seasonal rainfall (mm) variation in Sangli district*

From this all of perceptions it was closed that South-West storm assumed a significant part on the whole the tahasils of Sangli area which was guaranteed precipitation for kharif season yields of various developing periods, for example, brief term and medium span yields can be securely become under rainfed trimming framework. Nonetheless, the great quantum of precipitation got in North-East storm season (post-storm) could help in legitimate foundation and early development of rainfed rabi crops especially under substantial soils.

In light soils, the yields filled in rabi season under rainfed conditions may present dampness stress states of differing degree and thus on light soils the rabi harvests can be developed acceptably, if water system offices are accessible. Sahu (2008) completed likelihood examination of precipitation for Udhag-mandalam, They saw that at 80% likelihood level, the precipitation accessible in the primary (May-Aug.) and second (Sept.- Nov.) season are more than the water necessity of the harvests which were filled in that district. In the third (Dec.- April) season, the precipitation accessibility was adequately not to help any harvest without water system.

***D. Results of Mann-Kendal Test for Trend Detection:***

As below Table 3 gives the computations of Mama-Kendal Insights and huge values. P-values are additionally given. The descending patterns in the yearly just as occasional precipitation were exhibited for Atpadi, Sangli and Tasgaon stations, yet these patterns are measurably non-critical. For the Kavathe Mahankal and Jat h stations,

a powerless vertical pattern is noticed. The patterns in the post - storm precipitation information for both of these stations, taking most elevated and second most noteworthy qualities, are noticed measurably critical at 90% and 85 % certainty levels.

| | Atpadi | | | Islampur | | | Jath | | |
|---|---|---|---|---|---|---|---|---|---|
| **Rainfall Totals** | S-value | Z-value | P-value | S-value | Z-value | P-value | S-value | Z-value | P-value |
| Pre-monsoon | -19 | -0.2945 | 0.7684 | -89 | -1.4338 | 0.1516 | 53 | 0.8507 | 0.3949 |
| Monsoon | -49 | -0.7784 | 0.4363 | 57 | 0.9081 | 0.3638 | 65 | 1.0379 | 0.2993 |
| Post-monsoon | -16 | -0.2432 | 0.8078 | 63 | 1.0056 | 0.3146 | 108 | **1.7352*** | **0.0827*** |
| Annual | -26 | -0.4054 | 0.6852 | 33 | 0.5189 | 0.6038 | 71 | 1.1352 | 0.2563 |
| | **Kavathe Mahankal** | | | **Miraj** | | | **Shirala** | | |
| | S-value | Z-value | P-value | S-value | Z-value | P-value | S-value | Z-value | P-value |
| Pre-monsoon | 32 | 0.5037 | 0.6144 | -48 | -0.7656 | 0.4439 | -43 | -0.6871 | 0.492 |
| Monsoon | 87 | 1.3946 | 0.1631 | 68 | 1.0865 | 0.2773 | 33 | 0.519 | 0.6038 |
| Post-monsoon | 113 | **1.8162*** | **0.0693*** | 75 | 1.2 | 0.2301 | 11 | 0.1622 | 0.8712 |
| Annual | 92 | **1.4757#** | **0.14#** | 80 | 1.2811 | 0.2002 | 45 | 0.7135 | 0.4755 |
| | **Palus** | | | **Sangli** | | | **Tasgaon** | | |
| | S-value | Z-value | P-value | S-value | Z-value | P-value | S-value | Z-value | P-value |
| Pre-monsoon | 13 | 0.6055 | 0.5449 | -98 | **-1.6359** | **0.1019** | -97 | **-1.5639#** | **0.1178#** |
| Monsoon | -9 | -0.3959 | 0.6922 | -82 | -1.3145 | 0.1887 | -13 | -0.1946 | 0.8457 |
| Post-monsoon | -16 | -0.7423 | 0.4579 | -5 | -0.0675 | 0.9462 | -10 | -0.146 | 0.8839 |
| Annual | -3 | -0.099 | 0.9212 | -84 | -1.3469 | 0.178 | -73 | -1.1678 | 0.2429 |

*Table 3: Results of Mann-Kendal Test for Trend Detection*

**E) Result of Sen's slope Estimate (mm/per):**

| Station | Sen's slope estimate (β) | | | |
|---|---|---|---|---|
| | Pre-monsoon | Monsoon | Post-monsoon | Annual |
| Atpadi | 0.0000 | -2.3650 | -0.3804 | -1.7458 |
| Islampur | -1.0000 | 4.7735 | 1.7947 | 3.1149 |
| Jath | 0.4657 | 3.8478 | **3.3100*** | 5.3612 |
| Kavathe Mahankal | 0.3935 | 4.4171 | **3.1805*** | 6.0431 |
| Miraj | -0.4255 | 3.6912 | 2.0450 | 4.7525 |
| Palus | -0.4722 | 2.8722 | 0.1529 | 3.1554 |
| Sangli | 0.3333 | -5.8545 | -2.9000 | -5.6000 |
| Shirala | -0.6250 | -6.8792 | -6.8792 | -7.0742 |
| Tasgaon | -1.2156 | -0.6352 | -0.6588 | -7.1511 |

* specify statistically important at 90% confidence level

*Table 4: Result of Sen's slope estimate (mm/per):*

Sen's Slope estimator was additionally used to sort out the change per unit season of the patterns saw in occasional just as yearly time series. The calculations of the Sen's slant assessor for every one of the nine meteorological stations are introduced in the Table 4,

where a negative sign show descending incline and a positive sign an up one. For occasional time series information, measurably critical pattern saw at Jath and Kavathe Mahankal stations**.**

## VI. CONCLUSION

Application trend analysis shows that about sites are on the rise, while other sites are on the decline. Atpadi and Tasgaon stations continued to decline, while Kavathe Mahankal and Jath stations continued to rise. Except for the

post-monsoon time series of Kavathe Mahankal and Jath , the trends observed at all stations are not significant in statistics.
These results also indicate that there were no significant climate changes at sites during the analysis period. Survey area. The results also indicate that more research on local environmental issues is needed, which may be one of the main causes of climate change.

## VII. REFERENCES

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