Annexure-III (7c)

UNIVERSITY GRANTS COMMISSION
Western Regional Office,
Ganeshkhind, Pune-411007

SUMMRY OF THE WORK DONE (FINAL) OF MINOR RESEARCH PROJECT

1. Name of Principal Investigator: **Dr. Patil Maruti Krishna**
2. Title of the Research Project: "**Statistical Modeling of Rainfall Data in Sangli District**"
3. Period of Work done**:** **From 29.04.2013 to 28.04.2015**
4. Approximate time by which it is likely to be completed: **April 2015**

SUMMRY OF THE WORK DONE

Reading of the material required to fulfill the basic needs of the project entitled "**Statistical Modeling of Rainfall Data in Sangli District**" was done. Some research articles were studied in order to understand the recent trend in the subject.

Rainfall data is procured from Director Incharge, National Data Centre, India Meteorological Department, Shivajinagar , Pune.411 005. The rainfall data of 32 years (1981-2012) of Sangli district collected over 10 stations namely Shirala, Islampur, Kasegaon, Sangli, Miraj, Tasgaon, Jath, Kavathe Mahankal, Palus and Atpadi. We report statistical analysis of the rainfall data for different stations of Sangli district. The distribution of dry days and rainy days is studied. An attempt is made to study the seasonality index of rainfall for ten stations under study. The mean rainfall values of all ten stations were considered to represent the rainfall of the district.

Descriptive statistics were obtained for these ten stations. It includes average rainfall, median rainfall, maximum rainfall, minimum rainfall, total rainfall, number of rainy days and coefficient of variation of rainfall over these stations. Detection of trends in rainfall data is worked out with the help of nonparametric tests. Rainfall time series data were analyzed with Mann-Kendall test for all nine meteorological stations in Sangli district taking

annual and also seasonal rainfall data. Sen's slope estimator was also used to figure out the change per unit time of the trends observed in seasonal as well as annual time series.

Some of the interesting findings from the analysis of the data are as below.

1. Findings (Rainfall Data and Exploratory Analysis)

1. Shirala station receives maximum rainfall among all stations of Sangli district and the average rainfall of Shirala station is 1004.94 mm.
2. Palus station receives minimum rainfall among all stations of Sangli district and the average rainfall of Palus station is 339.81 mm.
3. The average rainfall of Sangli district is 400-450 mm.
4. Average rainy days for Shirala station are 63(17.22%). Shirala station has maximum number of rainy days. Average rainy days for Atpadi station are only 28(7.79%).
5. Average dry days for Shirala station are 302 (82.78%) where as average dry days for Atpadi station are 337 (92.21%).
6. Rainfall is purely seasonal. Most of the rain occurs in monsoon season. Shirala station receives 823.75 mm (81.97%) rainfall in monsoon, where as Atpadi station receives 286.17 mm (68.19%) rainfall in monsoon. Remaining rainfall of the total rainfall occurs in winter, pre-monsoon and post-monsoon season. During winter season all the stations of Sangli district receives very low rainfall (even much less than 6 mm). During pre-monsoon season maximum rainfall occurs at the Miraj station and it receives 64.48mm (10.98%) in average where as Palus station receives only 14.37mm (4.22%) in average which is minimum among all the stations.
7. Very less amount of rainfall is being received during the winter season and the variability is very high in all the stations of Sangli district. Maximum variability (387.30%) is over Palus and the lowest variability (199.46%) is over Kavathe Mahankal. Variability decreased as the monsoon set in and again it increased in the post-monsoon season. During monsoon season, in spite of very high rainfall, coefficient of variability of monsoon rainfall is very high in

Sangli (58.73%). At the same time the coefficient of variation is low in Shirala (31.44%). During monsoon season, western part of Sangli district get excessive rain due to strong westerlies from Arabian Sea and the presence of offshore through, whereas eastern parts of Sangli district get comparatively less rain.

2 Findings (Probability Analysis of Dry and Wet Spells)

1. The probability of occurrence of dry week is very high until the end of 23rd week. The range of probability of occurrence of dry week from 1st to 23rd week is from 64.52 % to 100% for Shirala station. At the same time for Atpadi station the same probability of occurrence of dry week from 1st to 23rd week is from 77.42 % to 100%.
2. The probability of occurrence of dry week preceded by another dry week and that of dry week by another wet week from 1st to 23rd week vary from 22.58 % to 100% and 0% to 41.94% for Shirala station. The same probability for Atpadi station varies from 58.06% to 100% and 0% to 22.58% respectively.
3. From 24th to 41st week the probability of wet week increases. It varies from 29.03% to 80.65% for Shirala station. The same probability for Atpadi station varies from 9.68% to 61.29%. In the same period the probabilities of dry week varies from 19.35% to 70.97 for Shirala station. The same probability for Atpadi station varies from 38.71% to 90.32%.
4. The probability of occurrence of dry week preceded by another dry week and that of dry week by another wet week from 24th to 41st week vary from 0 % to 41.94% and 9.68% to 32.26% for Shirala station. The same probability for Atpadi station varies from 9.68% to 8.087% and 6.45% to 32.26% respectively.
5. The analysis of consecutive dry and wet spells reveals that there are 58.06% to 100% chances that two consecutive dry weeks will occur within the first 23rd weeks of the year for Atpadi station and the same probability for Shirala station is 22.58% to 100 %.

6. The probability of occurrence of three consecutive dry weeks is very high from 41.94% to 100% in the first 23rd weeks of the year for Atpadi station and the same probability for Shirala station is 6.45% to 100%. The corresponding values of 2 and 3 consecutive wet weeks from 1st to 23rd week are very low 0% to 6.45% and 0% to 3.23% for Atpadi station. The same probabilities for Shirala station are 0% to 22.58% and 0% to 16.13%.
7. From 24th to 41st week, the chances of occurring 2 and 3 consecutive dry weeks are only within 9.68% to 83.87% and 6.45% to 74.19% respectively for the Atpadi station. The same probability for Shirala station is within 0% to 38.71% and 0% to 35.48%. Further, the weeks will get sufficient rain with 2 consecutive wet weeks with the chance of 0% to 32.26%, whereas 3 consecutive wet weeks will have chance of deficit rain within 0% to 19.35% for Atpadi station. The same probability for Shirala station is within 12.90% to 58.06% and 3.23% to 45.16% during 24th to 41st week.
8. The study further reveals that the weeks 42nd onwards would remain under stress due to the chance that occurrences of 2 and 3 consecutive dry weeks are very high in the range of 64.52% to 96.77% and 61.29% to 96.77% for Atpadi station. The same probability for Shirala station is within 67.74% to 100% and 64.52% to 96.77%.

3 Findings (Seasonality Index of Rainfall in Sangli District)

1. Lower seasonality index value indicates better distribution of monthly rainfall among the months of the year.
2. Mean seasonality index for the stations of Sangli district is in the range 0.87776 to 1.0470. This indicates that rainfall is markedly seasonal with a long dry season and most rainfall occurs in less than 3 months.
3. An increasing trend in seasonality index is thus an indicator of alarming situation for the agriculture.

4. Analysis of seasonality index helps to have an idea about the distribution of the rainfall among the months.
5. We observe that all the stations receive most of the rainfall in Monsoon period. If we obtain seasonality index for monsoon only then it varies from 0.0665 to 0.3529. From rainfall regimes we see that rainfall spread throughout the Monsoon but with a definite wetter season.
6. Very less rainfall occurs in the months of January to May and October to December. The seasonality index for this period varies from 1.0276 to 1.2479. This means that there is extreme seasonality in the rainfall and most of the rain occurs within three months.

4 Findings (Detection of trend in rainfall data)

1. The rainfall time series are aggregated in the annual and also in seasonal time series (pre-monsoon, monsoon and post-monsoon) to further observe potential changes at the seasonal scale.
2. Rainfall time series data were analyzed with Mann-Kendall test for all nine meteorological stations in Sangli district taking annual and also seasonal rainfall data. The downward trends in the annual as well as seasonal rainfall were exhibited for Atpadi, Sangli and Tasgaon stations, but these trends are statistically non-significant.
3. For the Kavathe-Mahankal and Jath stations, a weak upward trend is observed. The trends in the post-monsoon rainfall data for both of these stations, taking highest and second highest values, are observed statistically significant at 90% and 85 % confidence levels.
4. Sen’s slope estimator was also used to figure out the change per unit time of the trends observed in seasonal as well as annual time series. Negative sign indicate downward slope and a positive sign an upward one. For seasonal time series data, statistically significant trend observed at Jath and Kavathe-Mahankal stations.

5. The trends observed at all stations were statistically insignificant, except post-monsoon time series of Kavathe-Mahankal and Jath stations. These results also indicated that for the analyzed time-period, there was no significant climate change in the study area. The results also suggest the need for further investigation on local environmental issues, which could be one of the major causes of climate change.

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