

Monsoon Rain Amount for Telangana for the Year 2023

Anand M. Sharan

Professor, Mechanical Engineering Department

Faculty of Engineering, Memorial University of Newfoundland, St. John's, Newfoundland, Canada

Abstract - In this work, forecasting of rain for Telangana, region which faces frequent drought, is done using four methods. These methods are: The Time Series method, The Root Mean Square (RMS) method, The Fast Fourier Transform (FFT) method, and the Artificial Neural Network (ANN) method. To predict the rainfall - an average of the four methods is used. The drought condition frequently arises because of the location of the Telangana which lies in the shadows of 2 mountain ranges which are the Western and the Eastern Ghats when the monsoon arises from the southwest direction.

Keywords: Monsoon rain prediction, rainfall frequency spectrum, drought and famine, crop failure, drinking water shortage.

I. INTRODUCTION AND LITERATURE SURVEY

India is fortunate because it has large cultivatable land. In addition, one can plant crops around the year due to the favorable weather condition, unlike most of the western industrialized countries. However, unfortunately another fact is that about two third of these areas are dependent upon monsoon rain and are without any other irrigation facilities [1]. Other relevant references in this respect can be seen in [2-5].

Due to the shortage of rain, the crops fail very frequently and consequently affecting the farmers income. In India, the farmers have to borrow money at high interest rate from banks and moneylenders. Most of the farmers end up facing the maximum risk because others like those who sell seeds or fertilizers get paid in cash by the farmers. Secondly, large majority of farmers do not own the land and have to enter into a contract with the landlords for renting the field for crop plantation. This contract is entered into the month of April normally which is before the monsoon arises. Hence, the farmer signs the contract under the uncertainty of the monsoon rain amount. Thus, in the case of crop failure due to the lack of rain- the risk is borne entirely by the farmer alone. If the rain is not sufficient then the farmer cannot pay back the loan and many commit suicide [6-21]. The water scarcity is experienced by city dwellers as well as many industries which are dependent on water. Water rationing is quite common in large parts of India due to the shortage of water in the rivers or reservoirs and wells.

In summer months, the reservoirs go dry due to insufficient rainfall which affects hydro power generation [22]. The purpose of the present study is to improve the planning of power availability. The works of many researchers can be seen in [25-31].

II. METHODOLOGY

As mentioned earlier, the calculations of the rainfall amounts are based on: (1) the Time Series method, (2) the Fast Fourier Transform method (FFT), (3) the Artificial Neural Network method (ANN), and Root Mean Square method (RMS). The details about these methods can be known by going through references [32-35].

In the RMS method, the errors are minimized with respect to a straight line. This is done by taking the data over 32 year period. It is carried out for each of the monsoon months (June, July, August, and September) separately over time history of 32 years.

In the Time Series method, one considers each of the months of June, July, August, and September as separate seasons. Again, one looks at the time history of 32 years just like in the previous method. Here, an overall trend is calculated and then each of the months results are found.

In the Artificial Neural Network (ANN) method one has to train the network using a batch of 32 year history – one at a time going back to the year 1875. Here, for every 32 years of data is used as an input and the 33rd year data as the output. In this way, one progresses to the current year. Having trained the network this way, then, similar process is used for the prediction of the rainfall data expected in the year 2023.

In other words, one expresses the relation of input and output using a linear system of equation

$$\{O\} = [W] \{I\} \quad (1)$$

where $\{O\}$ and $\{I\}$ are output and input vectors respectively of sizes $m \times 1$ and $n \times 1$ respectively. The size of the weight matrix $[W]$ is $m \times n$.

While training, various sets of input vectors and the corresponding output vectors are used and the search is for the elements of the $[W]$ matrix which minimizes the errors in Eq. (1). Having known the weight metrics $[W]$, one uses the 32 element input vector heavy the year 2022 as the last element and calculates the output vector which contains the values of rain amount for the year 2023. This predicted value will be the last element of the output vector.

The location of Telangana in India is shown in Fig. 1. The results of the calculations in the summary form are shown in the Table 1.

The results of all calculations for the **monsoon period i.e. June to September are shown in Figs 2 to 7.**

The results of the RMS method and the Time Series methods are because of the regression analysis. On the other hand, **the FFT method generates a harmonic series plot whose Fourier Series coefficients are determined by a faster algorithm. The ANN method establishes a linear transformation matrix between the input and output spaces. The details about these numerical methods are given in Fig. 8.**

III. RESULTS AND DISCUSSIONS

Fig. 2 shows that the results of the Time Series method widely much above the other results. The results of the RMS method do follow the mean path with decreasing trend. However, the Time Series method shows highly increasing trend. Graphs exhibit fast changes in the actual rain amounts. Overall, the results show decreasing trend. The picture is clearer in the Table 1 which is a summary of the results. It shows that this year, year 2023, there will be moderately greater amount of rain than the average of past 32 years.

in Fig. 3, the results of the Time Series method are again far greater than those of other methods results. The ANN method reserves are quite fluctuating.

Fig. 4 results are closer to each other. The actual rain amounts quite fluctuating.

Fig. 5 shows that the Time Series method has increasing trend and is much above the other methods.

In Fig 6, it is clear that the Time Series method results are above the other methods with increasing trend. The results of the other methods are quite close.

The result shown in Fig 7 indicate that frequency numbers 1, and 2 are around or above 3 centimeters of amplitude and they cause heavy rain. Since these amplitudes are at low frequencies, therefore the results of the total rain would not fluctuate widely.

IV. CONCLUSIONS

1. The results in Table 1 show that the predicted rain amount for each of the months stay close to each other and the total rain amount will be above the 32 year average.
2. This increasing rain amount will help in increasing the water reserves in ponds and lakes.
3. Since the total rain amount average in this subdivision is quite low, therefore there is a need to modernize agriculture where one can get higher yield even when total rain remains low as is practiced in Israel.
4. There should be increased awareness campaign in India for water conservation as the country is heading towards the water crisis.

REFERENCES

- [1] The percentage of irrigated land in India is about, <https://www.vedantu.com/question-answer/the-percentage-of-irrigated-land-in-india-is-class-10-social-science-cbse-5fc86b12fc3d9653700e8cd1> Climate change is remaking South Asia's monsoon, <https://www.economist.com/asia/2021/06/19/climate-change-is-remaking-south-asias-monsoon>
- [2] A drink of clean water, https://www.compassion.ca/blog/a-drink-of-clean-water/?utm_source=google&utm_medium=paid-search&utm_campaign=&utm_term=water%20crisis%20in%20india&appeal=AdWords&gclid=CjwKCAiAvOeQBhBkEiwAxutUVGq8AavDjnNVQ40Y7nspEVMF7USwEgNl4V4IlyBZEm_3pZHVp32R-hoCdiIQAvD_BwE
- [3] Water Scarcity in India: A Human Crisis | India Loud & Clear | EP 7, https://www.videovolunteers.org/water-scarcity-in-india-a-human-crisis-i-india-loud-clear-i-ep-7/?gclid=CjwKCAiAvOeQBhBkEiwAxutUVBOSCMfysLVwJi8VmTyzlYFGRyW7YkISyG5C-n6jQenI51VWPTKlghoCJSgQAvD_BwE
- [4] India's water crisis: It is most acute for women - down to earth, <https://www.downtoearth.org.in/blog/water/india-s-water-crisis-it-is-most-acute-for-women-78472>
- [5] "Second wettest September in 27 years bridges monsoon deficit" (2021), <https://timesofindia.indiatimes.com/city/pune/this-month-2nd-wettest-sept-in-country-in-27-years-imd/articleshow/86626483.cms#:~:text=PUNE%3A%20This%20month%20has%20turned,monthly%20normal%20of%20166.6%20mm.wat%20er%20crisis%20in%20Hyderabad,2021,https://timesofindia.indiatimes.com/topic/water-crisis-in-Hyderabad>
- [6] Telangana third in country in farmer suicides,2010, <https://timesofindia.indiatimes.com/city/hyderabad/telangana-third-in-country-in-farmer-suicides-2010>

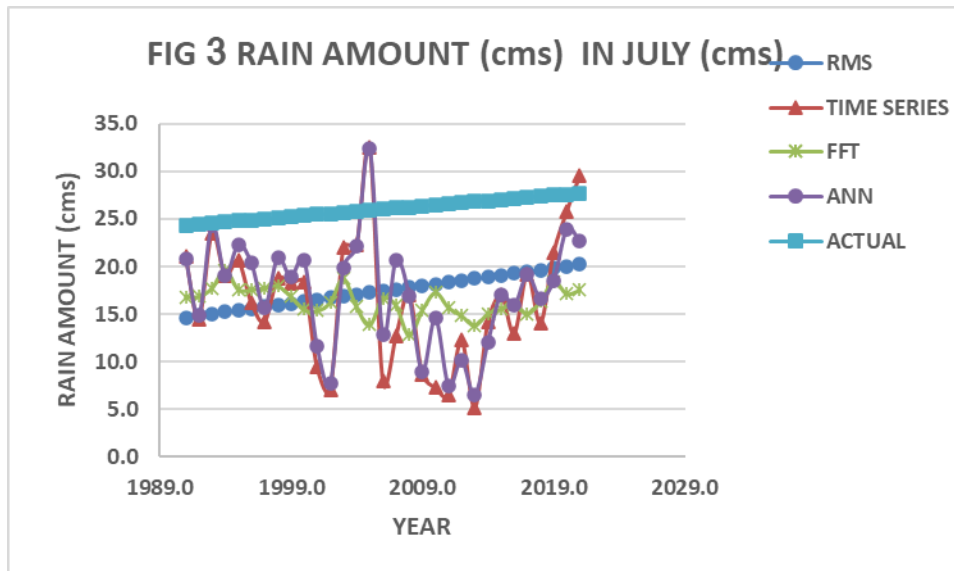
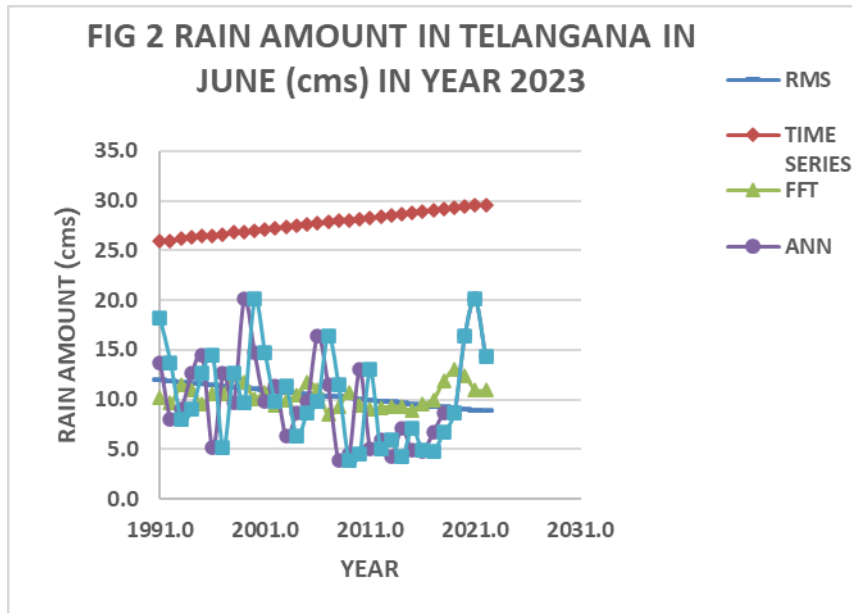
- suicides/articleshow/73181625.cms
- [7] Ground Report: Why Farmer Suicides in Telangana Continue Unabated, 2020, <https://thewire.in/agriculture/ground-report-why-farmer-suicides-in-telangana-continue-unabated>
- [8] Farmers Suicides, 2020, <http://medind.nic.in/jaw/t09/i2/jawt09i2pii.pdf>
- [9] Farmers' Suicides in the Vidarbha Region of Maharashtra, India a Qualitative Exploration of Their Causes, 2012, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291283/>
- [10] 300 Maharashtra farmers killed selves in November while part ..2020, <https://timesofindia.indiatimes.com/india/300-maharashtra-farmers-killed-selves-in-november-while-parties-jostled-for-power/articleshow/73076853.cms>
- [11] Farmer suicides in Maharashtra rise first time in 4 years, 2020, <https://timesofindia.indiatimes.com/city/mumbai/farmer-suicides-in-maharashtra-rise-first-time-in-4-years/articleshow/73601434.cms>
- [12] Farmer Suicides Doubled in Maharashtra In Last 4 Years , 2019, https://www.google.co.in/search?source=hp&ci=4dgyX6TDL4-C5wLRvIXIDg&q=5.%09Four+more+Maharashtra+farmers+commit+suicide&oq=5.%09Four+more+Maharashtra+farmers+commit+suicide&gs_lcp=CgZwc3ktYWlQAZfCCEQoAFQ7hZY7hZgsvVoAXAAeACAAaUBiAGlAZIBAzAuMZgBAKABAqABAaoBB2d3cy13aXqwAQA&scliclient=psy-ab&ved=0ahUKEwjkt-zu2ZPrAhUPwVvkKHVFeAekQ4dUDCAk&uact=5
- [13] Three Farmers Commit Suicide in Draught-Hit Marathwada Region, http://zeenews.india.com/news/maharashtra/three-farmers-commit-suicide-in-draught-hit-marathwada-region_1508366.html
- [14] India is already facing a water crisis—and it is only going to get worse, <https://thediplomat.com/2014/04/indias-worsening-water-crisis/>
- [15] In Gujarat's water crisis, key question: why is Narmada's level low this year?, <http://indianexpress.com/article/explained/in-gujarats-water-crisis-key-question-why-is-narmadas-level-low-this-year-5113688/>
- [16] Water shortage in Gujarat's Morbi forces people to dig holes in the ground, <http://indianexpress.com/photos/india-news/gujarat-morbi-water-crisis-narmada-river-5119373/>
- [17] Gujarat staring at water crisis this summer, <http://indianexpress.com/article/india/gujarat-staring-at-water-crisis-this-summer-5042137/>
- [18] Water scarcity threat to India and South Africa - Climate News Network <https://climatenewsnetwork.net/23742-2/>
- [19] India's escalating water crisis -, <https://www.livemint.com> › Politics › Policy India's potable water crisis is set to worsen , <https://www.livemint.com> › Politics › Policy
- [20] India's fast-growing cities face water crisis - Phys.org
- [21] <https://phys.org> › Earth › Environment
- [22] The Thirst for Power: Hydroelectricity in a Water Crisis World, <http://www.brinknews.com/the-thirst-for-power-hydroelectricity-in-a-water-crisis-world/>
- [23] Singh, P, and Borah, B., 2013, "Indian summer monsoon rainfall prediction using artificial neural network", Stoch Environ Res Risk Assess Vol 27:pp. 1585–1599
- [24] Gadgil, S and Srinivasan, J (2012). Monsoon Prediction: Are Dynamical Models Getting Better Than Statistical Models? , J Current Science VOL. 103, NO. 3, 10 August
- [25] Delsole, T. and Shukla, J. (2012). Climate Models Produce Skillful Predictions of Indian Summer Monsoon Rainfall. Geophys. Res. Lett Volume 39, Issue 9, May
- [26] Singh, K., Panda, J., Kant, S., 2020, A Study on Variability in Rainfall over India Contributed by Cyclonic Disturbances in Warming Climate Scenario, International Journal of Climatology, 40 (6), pp. 3208-3221.
- [27] Mathur, R., AchutaRao, K., 2020, A Modelling Exploration of the Sensitivity of the India's Climate to Irrigation, Climate Dynamics, 54 (3-4), pp. 1851-1872
- [28] Prathipati, V.K., Naidu, C.V., Konatham, P., 2029, Inconsistency in the frequency of rainfall events in the Indian summer monsoon season, International Journal of Climatology, 39 (13), pp. 4907-4923.
- [29] Rana, M., Singh, K.K., Kumari, N., Sanjay, J., Gohain, G.B., Kalra, N., 2019, Climate Change Impact and Response of Rice Yield, International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives, 42 (3/W6), pp. 245-250.
- [30] Mohanty, U.C., Nageswararao, M.M., Sinha, P., Nair, A., Singh, A., Rai, R.K., Kar, S.C., Ramesh, K.J., Singh, K.K., Ghosh, K., Rathore, L.S., Sharma, R., Kumar, A., Dhekale, B.S., Maurya, R.K.S., Sahoo, R.K., Dash, G.P., 2019, Evaluation of performance of seasonal precipitation prediction at regional scale over India , Theoretical and Applied Climatology, 135 (3-4), pp. 1123-1142.
- [31] Prediction of Rain in Bihar, India Based on Historical Bihar's Rain Data. http://www.engr.mun.ca/~asharan/RAINBIHAR/RAIN_BIHAR_V12.pdf
- [32] Rainfall Projections. <http://www.imdpune.gov.in/endofseasonreport2013.pdf>
- [33] Excel - Time Series Forecasting. <http://www.youtube.com/watch?v=gHdYEZA50KE>
- [34] Frequency Domain Using Excel. <http://online.sfsu.edu/jtai/downloads/ENGR%20302/Excel.FFT.pdf>
- [35] Sharan, A. M. and Balasubramanian, R, 1999, "Design Of Four-Bar Mechanism By Neural Network Methods ", 1999 International Journal of Modelling and Simulation, 19(1):1-6.

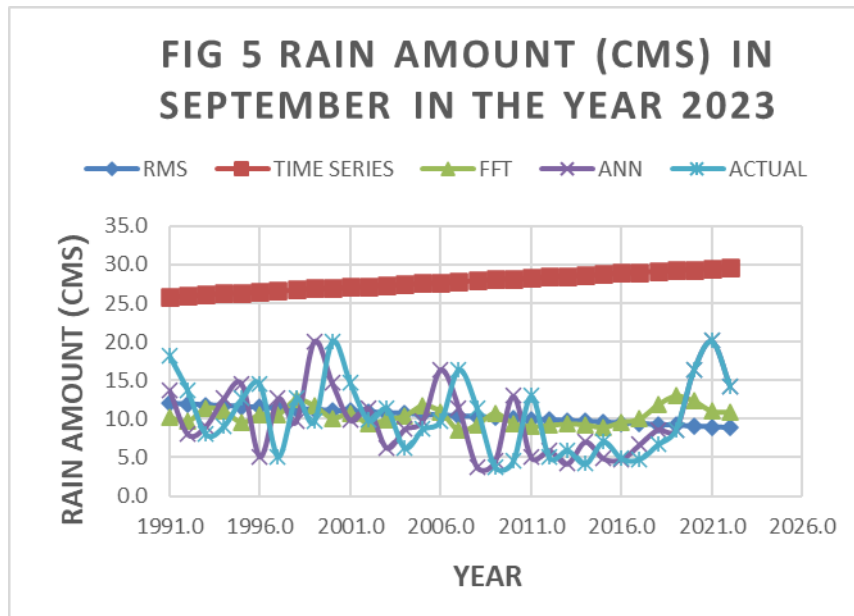
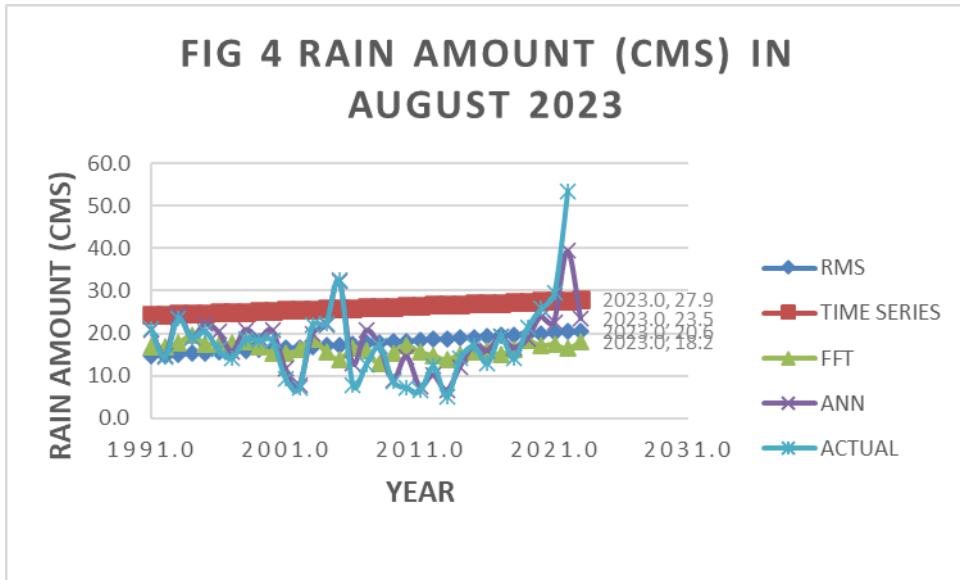
TABLE 1: RAIN FORECAST IN CENTIMETERS FOR TELANGANA DURING 2023 MONSOON MONTHS

| METHOD | YEAR | JUNE | JULY | AUGUST | SEPTEMBER | TOTAL | COMMENTS |
|-------------------------------------|------|-------|-------|--------|-----------|-------|------------------------------|
| RMS METHOD | 2023 | 8.7 | 20.6 | 17.4 | 17.1 | 63.8 | |
| TIME SERIES METHOD | 2023 | 29.7 | 27.9 | 28.5 | 16.7 | 102.8 | |
| FAST FOURIER TRANSFORM (FFT) METHOD | 2023 | 11.5 | 17.0 | 19.0 | 15.3 | 62.8 | |
| ANN METHOD | 2023 | 18.7 | 23.5 | 18.5 | 30.4 | 91.2 | |
| PREDICTED AMOUNT | 2023 | 17.15 | 22.25 | 20.85 | 19.875 | 80.15 | Greater than 32 year average |
| 32 YEAR AVERAGE | | 14.0 | 18.0 | 15.9 | 36.6 | 59.8 | |



FIG. 1 LOCATIONS OF MARATHAWADA, VIDARBHA, JHARKHAND AND TELANGANA BETWEEN WESTERN AND EASTERN GHATS





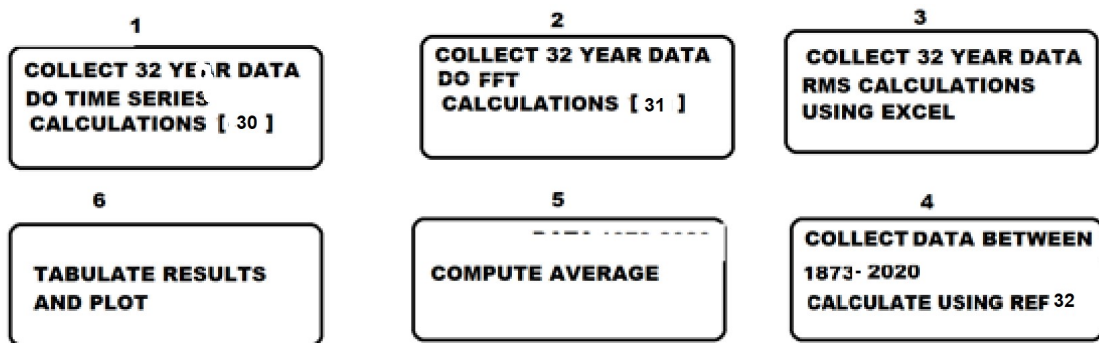
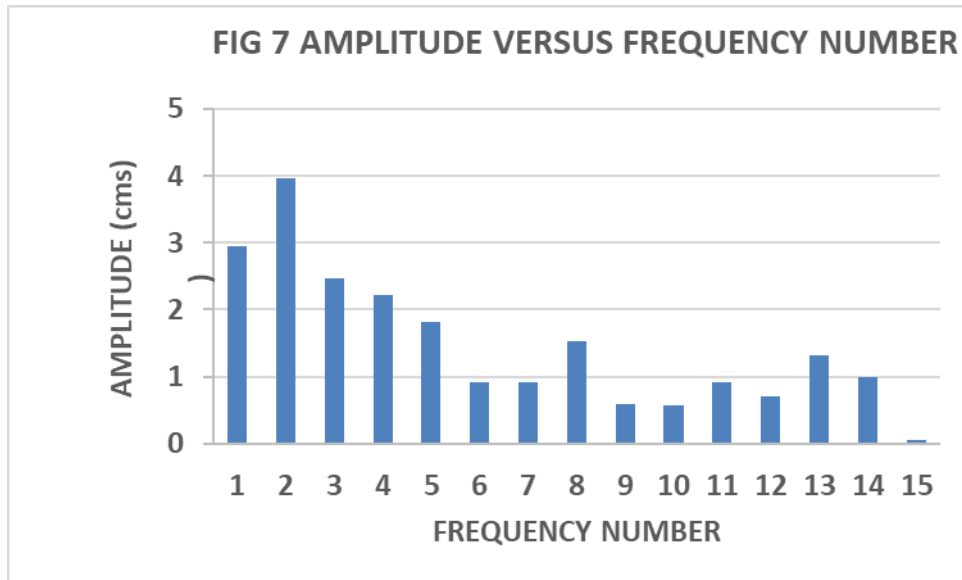
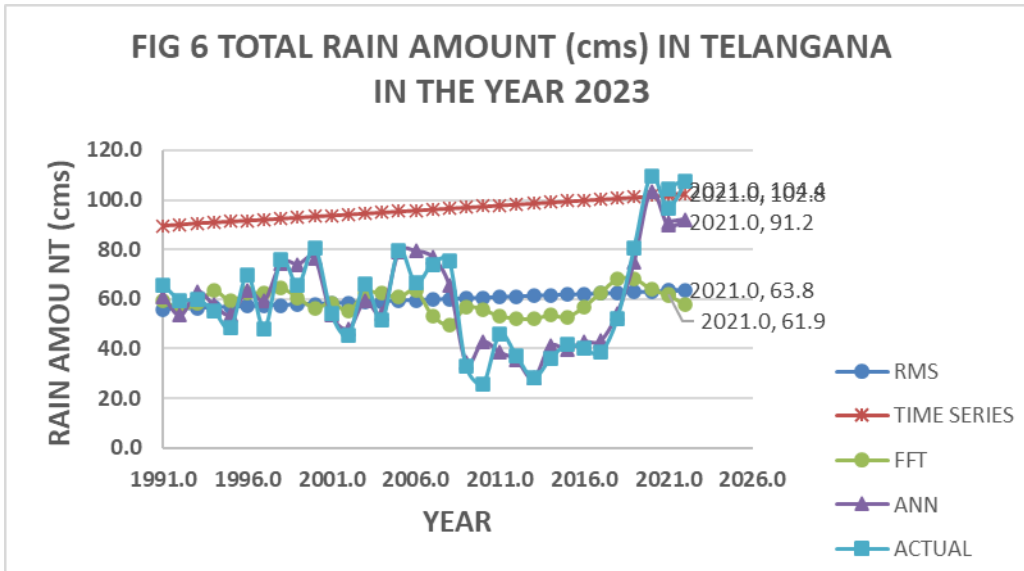


FIG. 8 NUMBERED BLOCK DIAGRAM OF THE COMPUTATIONS