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Forecasting of Rain Amount for Telangana during the Monsoon of the Year 2022

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Abstract - In this work, the rain model for Telangana area whichis prone to drought – is investigated based on 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. The predicted rain amount is based on the average result obtained by each of these methods. One has to keep in mind that the rainfall in Telangana is highly unpredictable due to its location in the shadow of the Western Ghats as the monsoon approaches this area from the south-west direction.

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

I. INTRODUCTION AND LITERATURE SURVEY

It is a good fortune of India that it has I one of the largest areas in the world which is suitable for cultivation. Here, crops can be planted round the year unlike most of the western industrialized countries. Unfortunate 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].

In Telangana rain is highly unpredictable. As a consequence, the farmer's income is highly uncertain. The farmer has to borrowmoney from the banks or money lenders at extremely high interest rate. The farmers in India do not have sufficient money to do cultivation. The others involved in agriculture are not exposed to so much risk as farmers are because they sell on cash basis. In such cases, businesses such as fertilizer suppliers, machinery owners who own tractors to till the land, or the field owners from whom the farmers rent the field - collect money in advance. 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 [6-23].

In summer months , the researvoirs go dry due to insufficient rainfall which affects hydro power generation [23**]. T**he purpose of the present study is to improve the planning of power availability. The works of many researchers can be seen in**[2**5-32**].**

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 [33-36].

In the RMS method - one has to carry out the linear regression analysis based on minimizing the errors of data points(rain amounts in various years) from the regression line using root mean square (RMS) values. This is done by taking the data over 32 yearperiod. 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, each of the months (June, July, August, and September) are considered as separate seasons. Again, one looks at the time history of 32 years just like in the previous method. However, here the minimization is taken by combining each of the four seasons (June, July, August, and September).

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 1874. Here, for every 32 years of data 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 2022.

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

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

where {O} and {I} are output and input vectors respectively of sizes mx1 and nx1 respectively. The size of the weight matrix [W] is mxn.

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). After the minimization, the output vector is determined for the new input vector using the optimized matrix [W]. The output vector in this case will have the year 2022 as the last element of this vector.

The location of Telangana 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.**

Thefour methods mentioned earlier. **are :** the TimeSeries and RMS methods use linear regression analysis to arrive at the trend of the rainfall. **These can be distinguished** as **straight line plots.**

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 th 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 separated from 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. A**mong the other results- the** actual,**the FFT**, and ANN results are close to each other. G**raphs 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 2022, there will be moderatelygreater amount of rain than **the average of** past 32 years. **The results of various methods differ considerably from each other in this table.**

iN Fig. 3, the results of the Time Series method are again far greater thanthose of other methods results. Fig. 4 results are closer to each other,

Fig. 5 shows that the actual rain values differ considerably from the RMS values on several instants of times. However, the ANN method results are closer to the actual rain values.

In Fig 6, one can again see that the Time Series values differ considerably from other curves. However, the results of all other methods are in close vicinity of the actual rain values.

The result shown in Fig 7 indicate that frequency numbers 1,3, **4** , 13, and 14 have magnitudes above 4 centimeters and they cause heavier rainfall**.**

IV. CONCLUSIONS

1. The rainfall in the months of June **and July will be higher than the 32 year** average but **lower than this average in the months of August and Septembder**.
2. This excess total rain amount **will help** in building up **of** the reserves of water.
3. There is a need to implement **modern** agriculture techniques of using less water in agriculture **as has been** adopted in Israel.
4. Conservation of water is highly recommended in India in all walks of life as India is going through water crisis in large parts of India.
5. The curriculum in schools and universities should contain topics on water availability in various parts of India as the country is heading towards water crisis in many parts of the country.

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TABLE 1: RAIN FORECAST IN CENTIMETERS FOR TELANGANA DURING 2022MONSOON MONTHS

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
RMS VALUES	2022	15.1	29.6	15.1	16.1	75.9	
TIME SERIES	2022	29.8	28.0	28.6	16.7	103.1	
FAST FOURIER TRANSFORM (FFT)	2022	11.5	17.0	19.0	15.3	62.8	
ANN METHOD	2022	19.6	19.9	9.3	16.4	65.2	
PREDICTED AMOUNT	2022	13.9	17.2	18.9	11.7	76.8	Greater than 32 year average
32 YEAR AVERAGE		10.6	16.8	19.1	12.8	59.0	

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

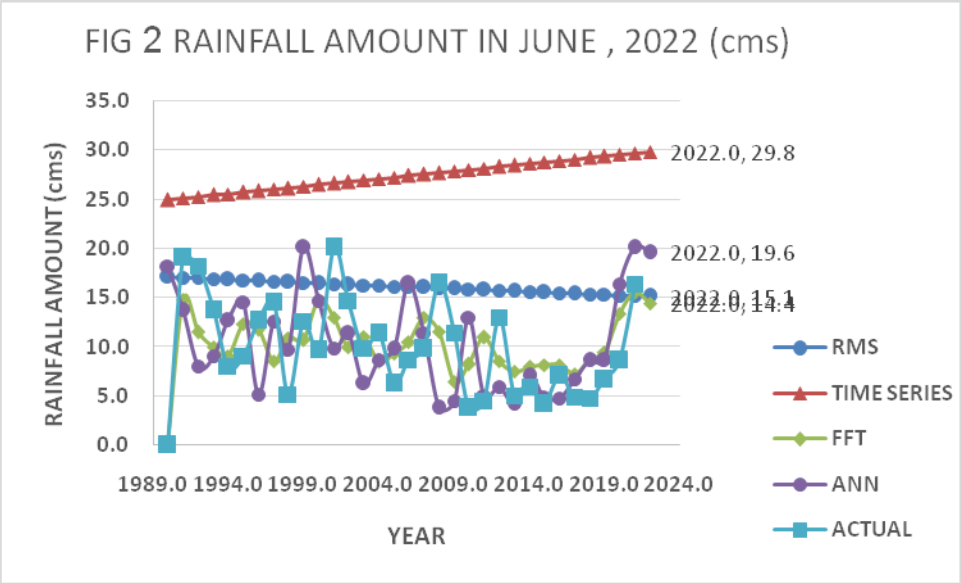


FIG 2 RAINFALL AMOUNT IN JUNE , 2022 (cms)
RAINFALL AMOUNT (cms)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1989.0 1994.0 1999.0 2004.0 2009.0 2014.0 2019.0 2024.0
YEAR
2022.0, 29.8
2022.0, 19.6
2022.0, 15.1
2022.0, 14.4
RMS
TIME SERIES
FFT
ANN
ACTUAL

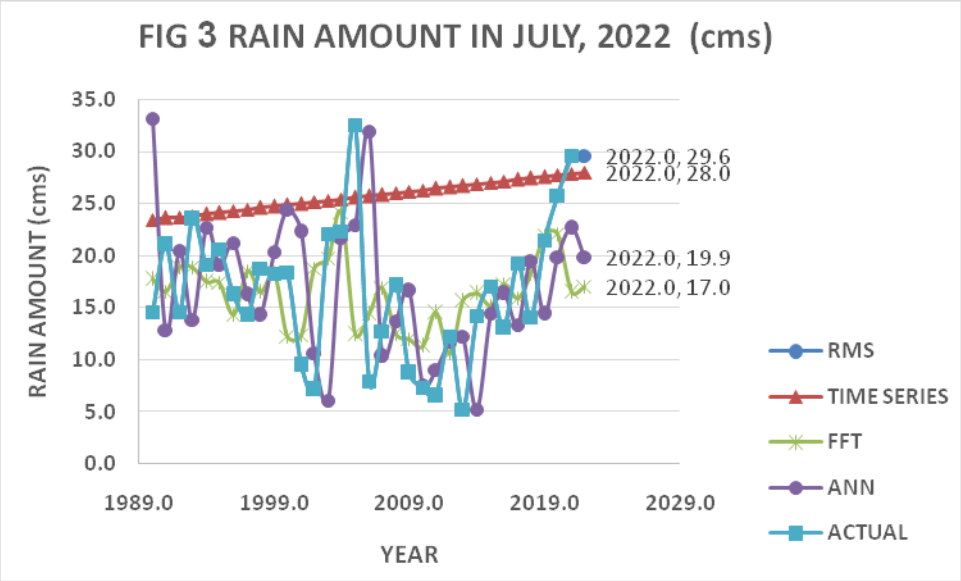


FIG 3 RAIN AMOUNT IN JULY, 2022 (cms)
RAIN AMOUNT (cms)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1989.0
1999.0
2009.0
2019.0
2029.0
YEAR
2022.0, 29.6
2022.0, 28.0
2022.0, 19.9
2022.0, 17.0
RMS
TIME SERIES
FFT
ANN
ACTUAL

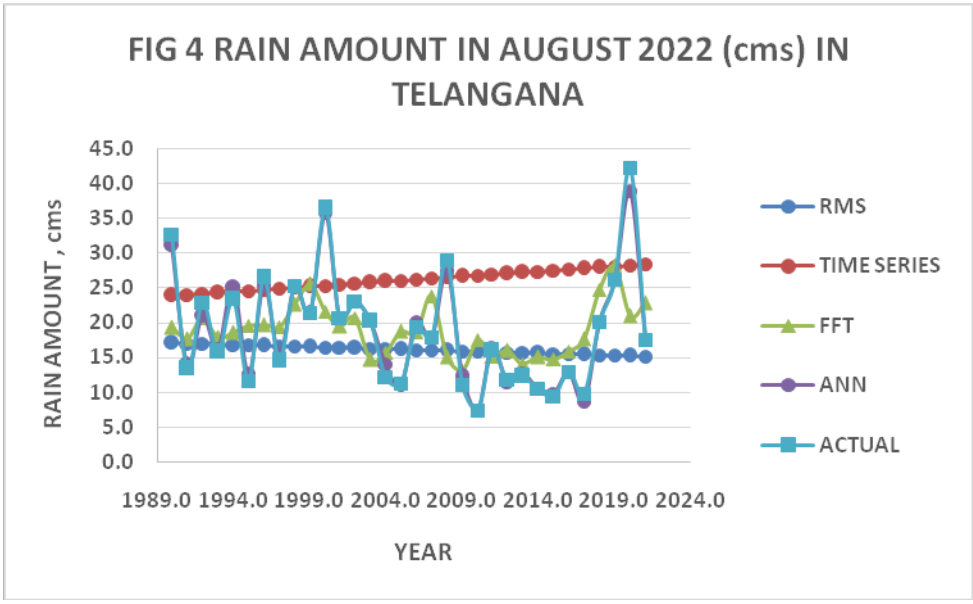


FIG 4 RAIN AMOUNT IN AUGUST 2022 (cms) IN TELANGANA
RAIN AMOUNT , cms
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1989.0 1994.0 1999.0 2004.0 2009.0 2014.0 2019.0 2024.0
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL

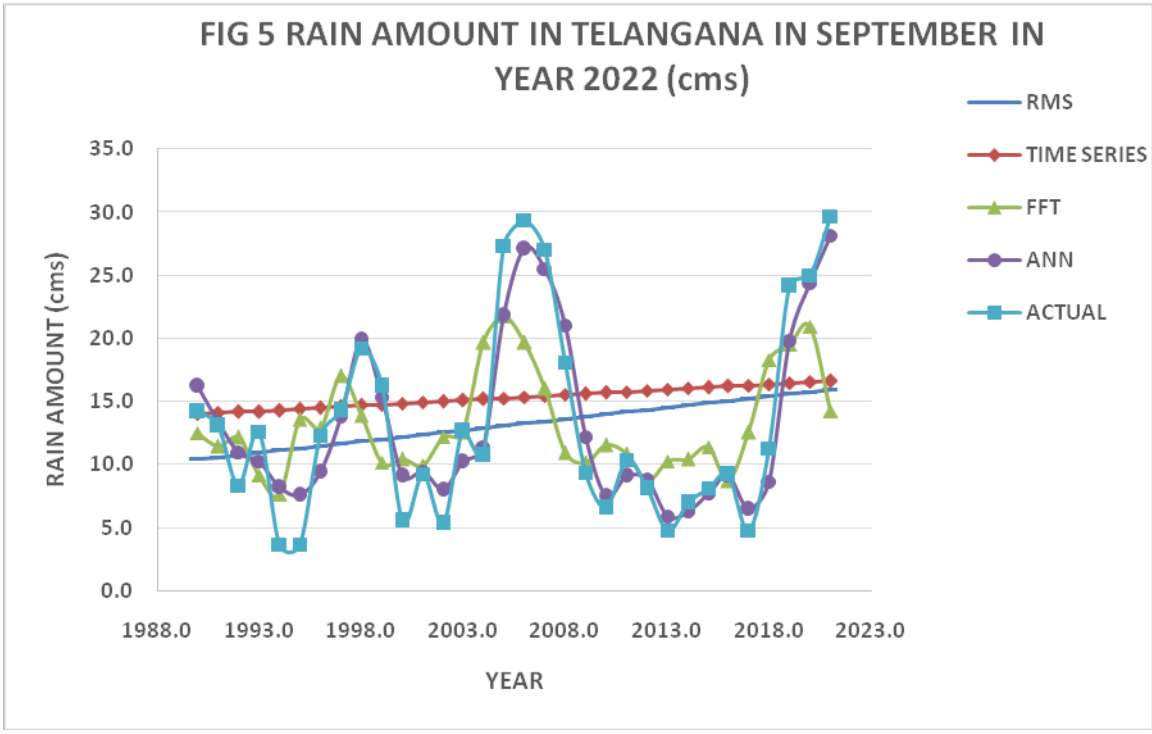


FIG 5 RAIN AMOUNT IN TELANGANA IN SEPTEMBER IN YEAR 2022 (cms)
RAIN AMOUNT (cms)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1988.0 1993.0 1998.0 2003.0 2008.0 2013.0 2018.0 2023.0
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL

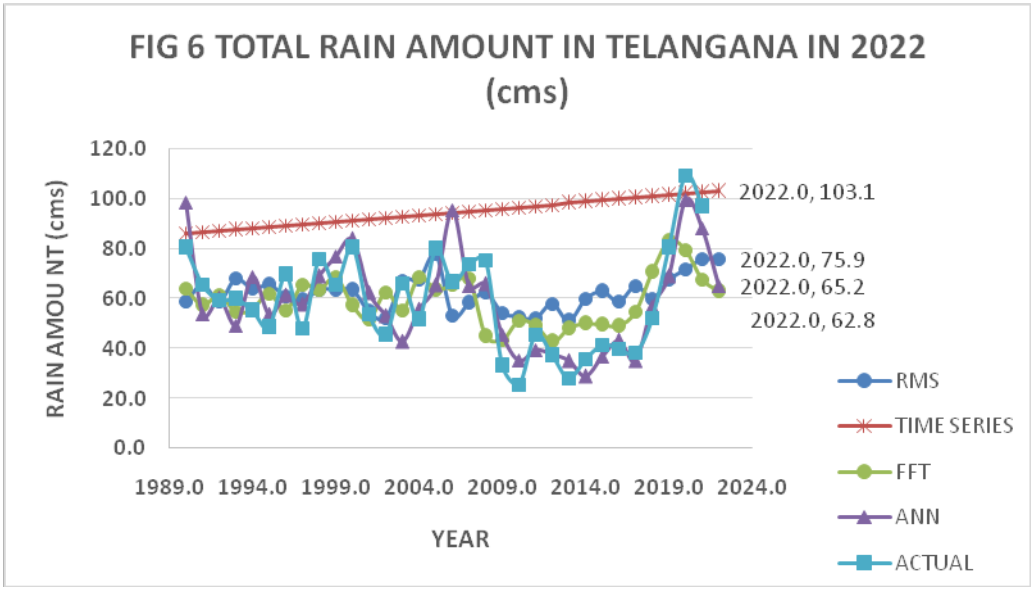


FIG 6 TOTAL RAIN AMOUNT IN TELANGANA IN 2022 (cms)
RAIN AMOU NT (cms)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
1989.0 1994.0 1999.0 2004.0 2009.0 2014.0 2019.0 2024.0
YEAR
2022.0, 103.1
2022.0, 75.9
2022.0, 65.2
2022.0, 62.8
RMS
TIME SERIES
FFT
ANN
ACTUAL

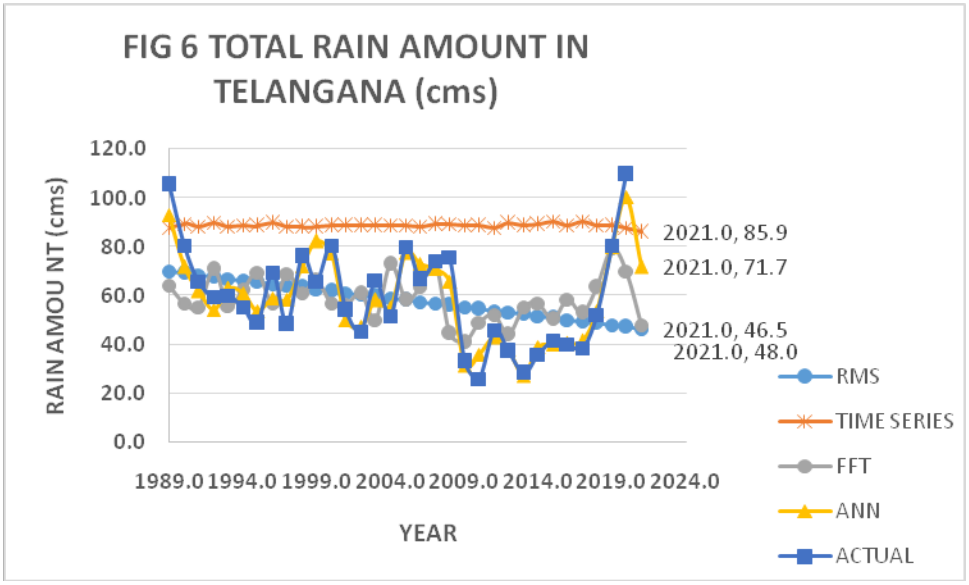
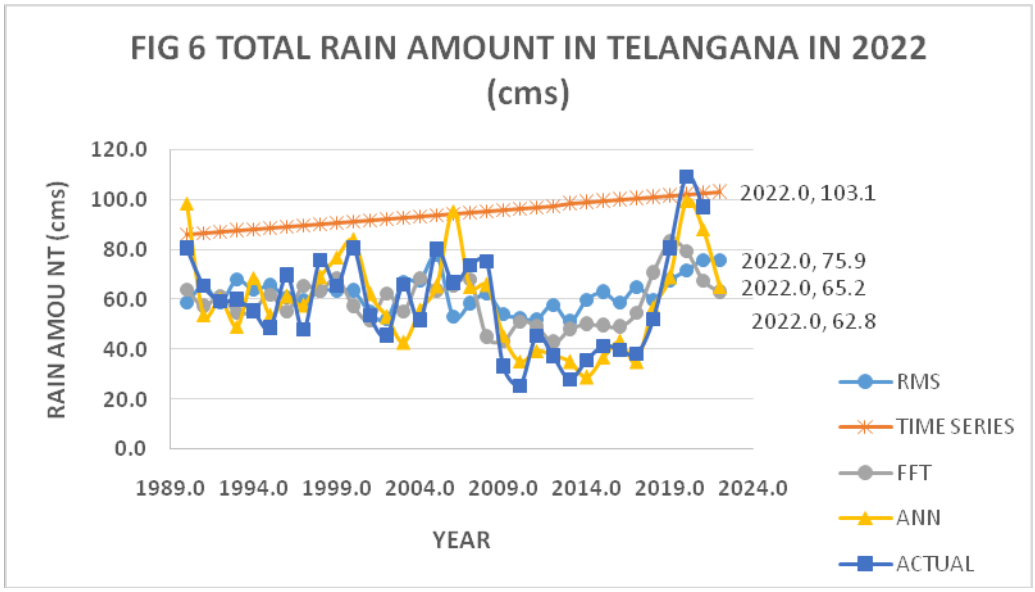
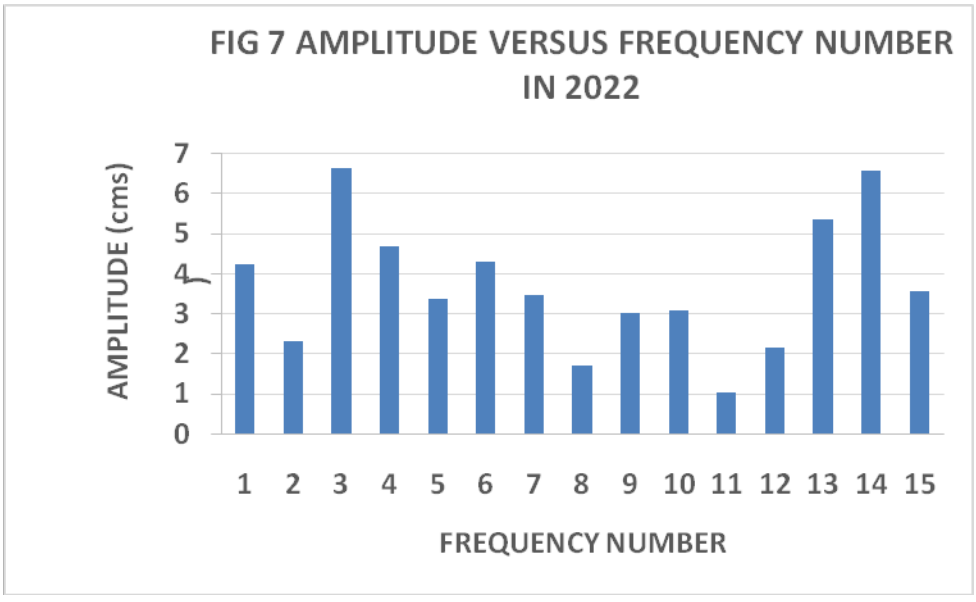


FIG 6 TOTAL RAIN AMOUNT IN TELANGANA (cms)
RAIN AMOU NT (cms)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
1989.0 1994.0 1999.0 2004.0 2009.0 2014.0 2019.0 2024.0
YEAR
2021.0, 85.9
2021.0, 71.7
2021.0, 46.5
2021.0, 48.0
RMS
TIME SERIES
FFT
ANN
ACTUAL

http://dx.doi.org/10.21172/ijiet.221.02





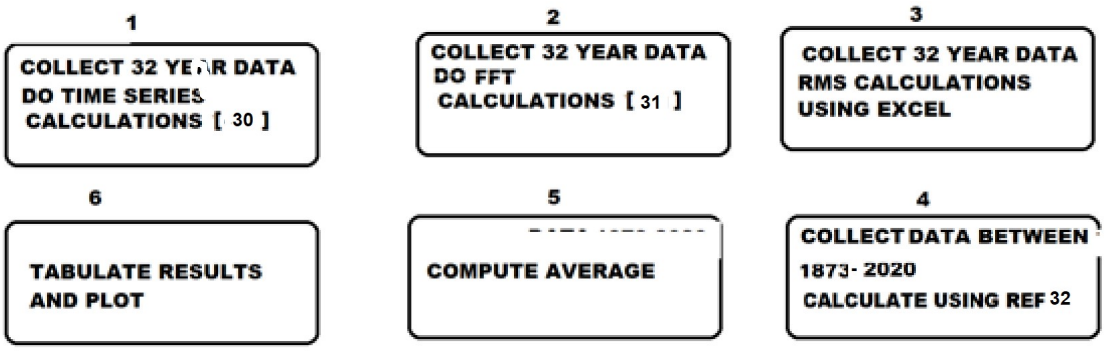


FIG. 8 NUMBERED BLOCK DIAGRAM OF THE COMPUTATIONS