Prediction of Monsoon Rain of Telangana for The Year 2024

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Abstract

In this work, the prediction of monsoon rain 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 estimate the rainfall - the average value for these methods is used.

It is a fact that the average value of the rain in Telangana is low as compared to other parts of India. There was unusually high rainfall amount that had taken place last year here, yet one needs to make this forecast so that the farmers do not get surprised if the rainfall is low in the coming year.

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

Introduction and Literature Survey

What goes in favor for India is its large cultivatable land and the weather where one can raise crops around the year as opposed to many of the industrialized countries where they have only one crop. However, the negative aspect here is that about 70% of the land is dependent on monsoon rain for irrigation [1]. Other relevant references in this respect can be seen in [2-5].

What is true for Telangana is that the farmers have to borrow money from banks or the money lenders at higher interest rates. If the monsoon rain becomes uncertain or there is a shortage of rainfall, then the sufficient amount of money cannot be made from cultivation. This imposes a heavy burden on the farmers as they cannot pay back the loan. This financial problem even results in farmer suicide.

Secondly, large number of farmers do not even have the land and as a result, they have to rent the land from landowners which takes place in the month of April whereas the monsoon starts from the month of June. Therefore, there is a shortage of time for the farmers to make plans for planting the crops. Thirdly, the forecast from the meteorological department of India (IMD) is also publishes in the month of April rather than earlier. This also does not help the farmers to make informed decisions about planting of crops. The farmer has to take the risk of purchasing seeds, renting tractors for tilling land, purchasing of fertilizers etc. In case the crops fail then many times this compels the farmers to commit suicide [6-21].

The water shortage is experienced by the people living in the cities when the reservoirs do not have sufficient water. The same problem arises for the industries which consume large amount of water.

Not only the farmers or the people, but even hydropower generation is also affected by shortage of rainfall [22].

The purpose of this research is to make forecasts available well in advance -about seven months ahead of the onset of the rainfall.

The research work of many others in this respect can be seen in [25-31].

Methodology

In this work one has to calculate the rainfall amount using four methods which are: (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 a 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 month's 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 1876. 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, a similar process is used for the prediction of the rainfall data expected in the year 2024.

In the ANN method one has a relationship of the form

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

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 minimize the errors in Eq. (1). Having known the weight metrics [W], one uses the 32 element input vector having the year 2023 as the last element and calculates the output vector which contains the values of rain amount for the year 2024. This predicted value will be the last element of the output vector.
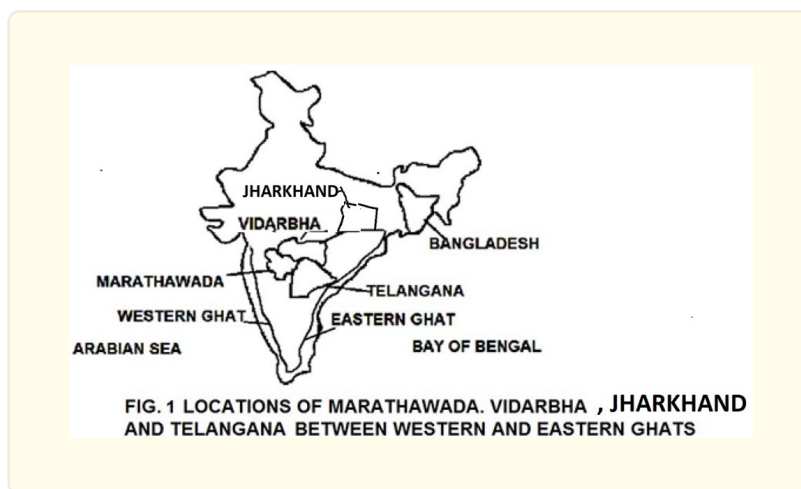
One can see the location of Telangana in Fig. 1. The summary of the results are shown in Table 1, whereas, the details of the results are shown in Figs 2 to 7.

Here. The monsoon months are from June to September.

Here the regression analysis is used for computing the values of the RMS method and the Time Series method. On the other hand, the FFT method generates a harmonic series plot whose Fourier coefficients are determined by a faster algorithm called the Fast Fourier transform. The ANN method establishes a linear transformation matrix between the input and output spaces.

Method	Year	June	July	August	September	Total	Comments
RMS Method	2024	8.7	24.7	15.8	21.1	70.4	
Time Series Method	2024	19.1	31.5	29.1	16.7	96.4	
Fast Fourier Transform (FFT) Method	2024	9.3	25.7	18.0	17.4	70.4	
ANN Method	2024	5.7	28.6	20.4	36.6	91.3	
Predicted Amount	2024	10.7	27.6	20.8	23.0	82.1	Greater than 32 year average
32 Year Average		10.0	18.5	18.3	14.4	61.1	

Table 1: Rain Forecast In Centimeters for Telangana during 2024Monsoon Months.

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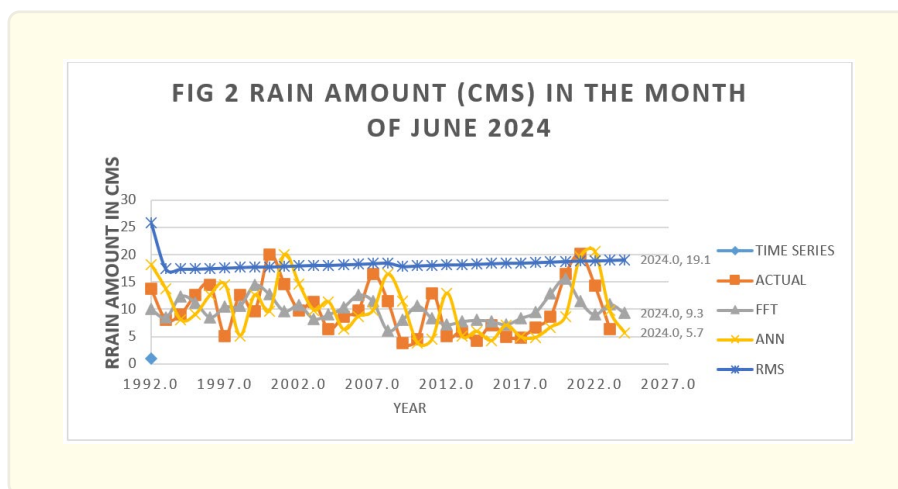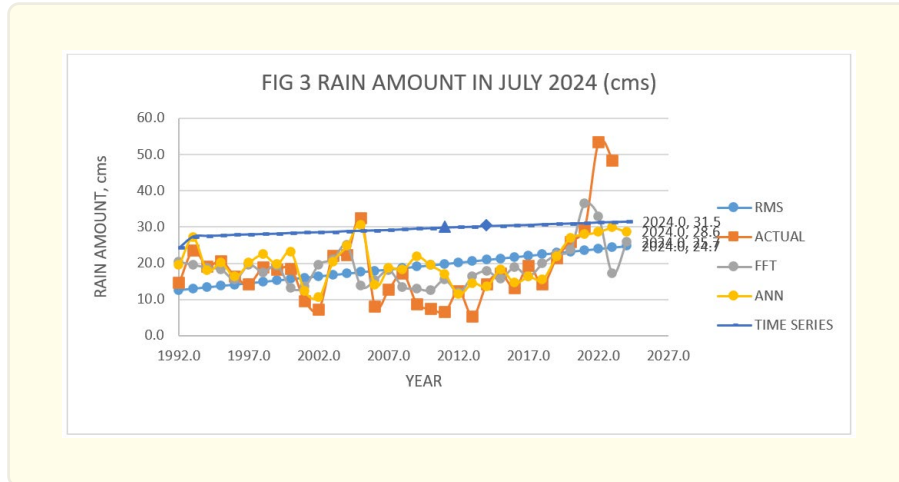
Results and Discussions

Fig. 2 shows the Time Series method calculations lead to higher results and the slope of this method has an increasing trend. The ANN method shows similar higher result as that of the Time Series method. The results of the rest of the other two methods are lower.

In Fig. 3, the results of the Time Series method shows increasing trend. The actual rainfall is fluctuating and has high variations. There was an exceptionally high amount of rainfall last year.
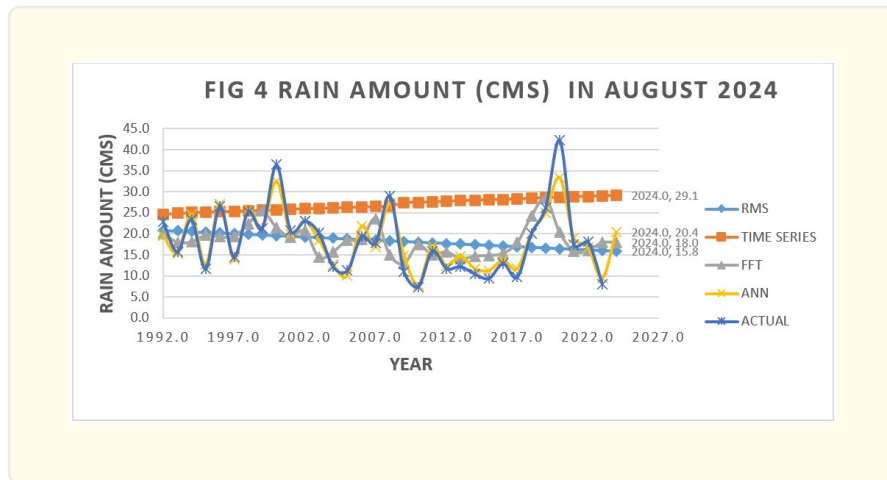

Fig. 4 shows the Time Series method has an increasing trend whereas the actual rain amount has rapid fluctuations. The Time Series method shows increasing trend.

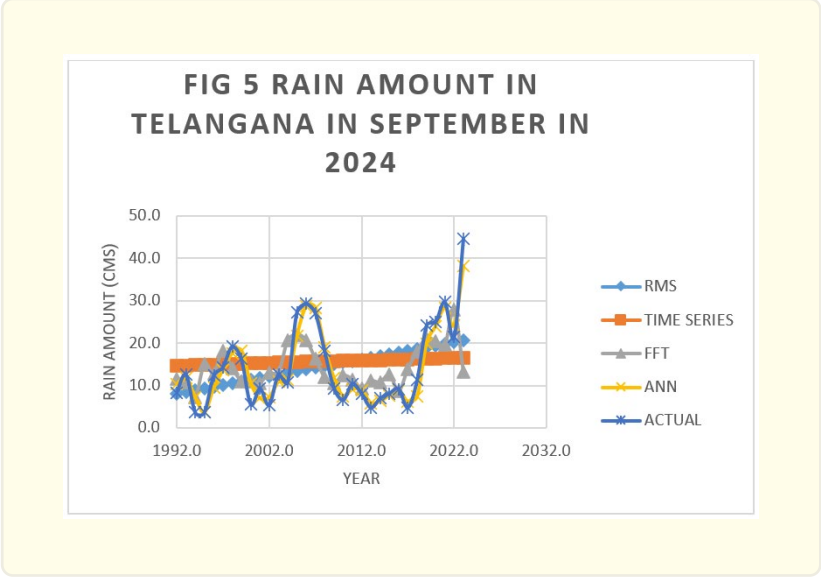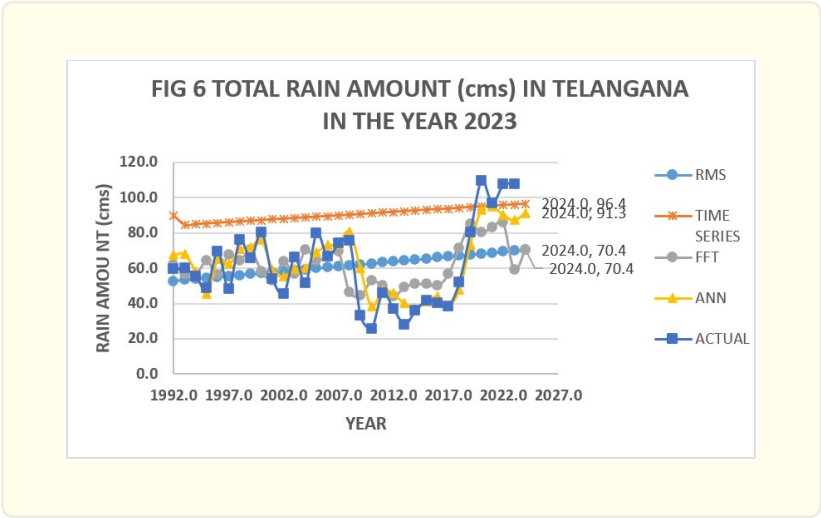FIG 5 RAIN AMOUNT IN TELANGANA IN SEPTEMBER IN 2024

Fig. 5 shows that the actual rainfall amount has large variations and also the rain amount was high last year. The Time Series method also shows increasing trend.

FIG 6 TOTAL RAIN AMOUNT (cms) IN TELANGANA IN THE YEAR 2023

In Fig 6, the Time Series method shows increasing trend. The rain shown by this method is much higher as compared to the other methods. The actual rainfall last year was much higher as compared to other years.

FIG 7 AMPLITUDE (CMS) VERSUS FREQUENCY NUMBERS
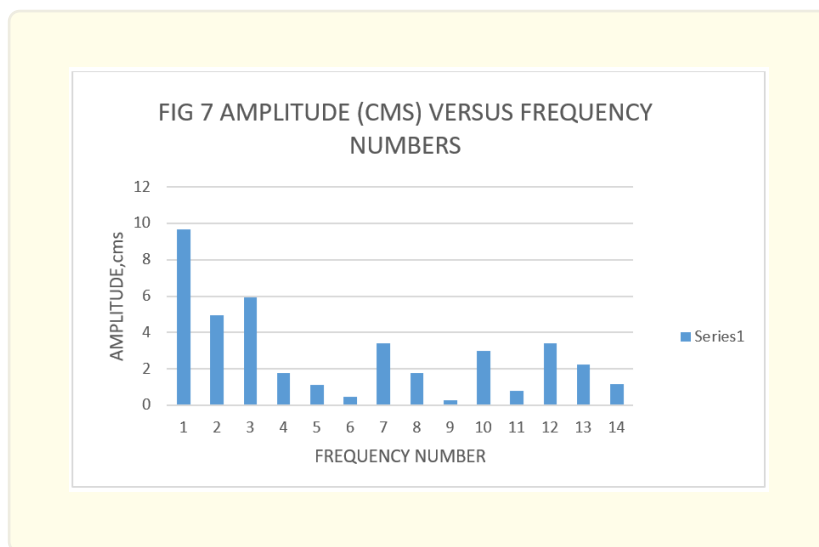
The result shown in Fig 7 indicates that frequency numbers 1-3 are above 4 centimeters in amplitude. The other frequencies are lower.

The results in the Table 1 show that the Time Series method and the ANN method yield higher results as compared to the other two methods. In the coming year- the predicted rainfall will be much above average of the last 32 years.

Conclusions

1. The results in Table 1 show that the predicted rain amount will be higher than the 32-year average.
2. This increased rain amount next year will help in increasing the water reserves in ponds and lakes.
3. Because of the low average amount of rain in this area over a long period of time, more reservoirs should be built to avoid the shortage of water.

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