Forecasting of Rain for Vidarbha for the Year 2024

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Abstract— **In this work the rain is forecasted for the year 2024 for Vidarbha which is known to be rain deficient. This work uses 32- year rain history of Vidarbha. To forecast the rain, four different methods are used. These methods are: Root Mean Square method(RMS), Fast Fourier Transform (FFT)) method, Time Series method, and the Artificial Neural Network (ANN) method. For the purpose of forecasting the results are calculated for each of the methods and then their average is computed which becomes the forecast amount.**

The forecasted results are plotted for the months of June ,July, August, September and then the total sum of these four months results are also plotted.

Since the results are based on rain data of past 32 years-it is possible to come up with the forecast about seven months ahead of the start of the monsoon season. The forecast of the rain amount seven months ahead of time helps farmers to plan their crop planting unlike some other forecasts which are made just about two months ahead of time which does not give sufficient notice to the farmers before they plant the crops.

Index Terms— **Monsoon rain prediction, Fast Fourier Transform method, Water shortage, Drought and Famine**

I. INTRODUCTION AND LITERATURE SURVEY

In India irrigation requires large amount of water and about 70% of the agricultural land is dependent on monsoon rains. Due to the uncertainty of the monsoon rains - water shortage is a perennial problem[1-6]. Let alone the agriculture even water for daily needs is many times transported by truck and train[7-12 . In many areas of Amravati division, the water storage levels can drop to 19.7%. It is a well known fact that Marathawada area suffers from extreme shortage of water.

Water is stored on the surface, or it is in the rivers and ponds or lakes or in the swamps. India's 87% of these surface water is stored in lakes, whereas it is 2% in the rivers and the balance 11% is in swamps. Another fact to remember is that only 1% of this Sweetwater can be of use for drinking [13]. Relevant references on this topic can be seen in [14-28].

The shortage of water also affects the hydropower generation because the level of water in the dams becomes low [29].

Major part of the availability of water in India comes from the monsoon rains which take place between the months of June to September. This research is based on past 32 years of rain data already available at the time of research, therefore it is possible to forecast well ahead of time- about seven months ahead of setting in of the monsoon. This information can be used in the fields of agriculture, power generation , municipal water supply or other industries which have high consumption of water.

In India, forecast for the monsoon rains is made by Indian Meteorological Department (IMD) In the month of April. However, this prediction of the rain amount is not that much of help for the farmers or others who need water because there is insufficient time for preparation.

Another fact to note is that in case of heavy amount of water due to monsoon rains can result in flooding of the rivers. This prediction will help in avoiding damages due to flood if the information is available much before time.

There are relevant literature available in the public domain [30-36]. One can get yearly rain data from IMD [37].

One can refer to the details of various methods discussed in this work in [38-41].

II. METHODOLOGY

In this research the monsoon months have been divided into four parts which are months of June, July ,August, and September. The available data is used to calculate the predicted amount by first coming of the amount for each of the methods first and then taking the average of these four. These four methods 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).

In the Time Series method, linear regression analysis is carried out. Based on the information available in the regression analysis one can project the rainfall amount for the coming coming year. The straight line which satisfies the minimum error criteria is selected.

In the Time Series method, each of the months of June, July, August and September are considered as separate seasons of a year. In this method by combining the data from the four months-overall trend is calculated. After this, this information is utilized for the monthly rain amounts.

In the 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 used as an input and the 33rd year data is used as the output. One repeats the process until we come to the current year. This way one trains the network and then use is made for the prediction for the next year.

In this ANN method one uses the relationship which is linear and given as

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

Where {O} and {I} are output and input vectors of sizes mx1 and nx1 respectively. The size of the weight matrix [W] is mxn. By using several sets of input and output vectors one arrives at the weight matrix through an iterative process.

III. RESULTS AND DISCUSSIONS

The locations of Western and Eastern Ghata as well as Vidarbha are shown in Figure 1. The monsoon approaches from the south- western side and the mountain ranges obstruct the monsoon clouds from approaching Vidarbha. Since the western range is higher than the eastern range, the western range affects the rainfall much more than the eastern range.

In Fig. 2, the results of the RMS and Time Series methods show an increasing trend. This plot also shows that the actual rainfall values rapidly change from year to year and also their magnitudes are high. Similarly, similar effects are seen in Figure 3 also.

Figure 3 shows that the actual rainfall is much more in July as compared to June and also the fluctuation of rain is quite rapid even in July.

The rain amount in August is less than that of July. This can be seen in Figure 4

For the month of September, the results are shown in Figure 5. The total amounts are less than those of July or August. The reason is that the monsoon has withdrawn or on the verge of being withdrawn.

The total amount of rain is shown in Figure 6. The gap between different methods is narrower as far as the total values are concerned.

Fig. 7 Shows a plot of amplitude versus frequency number. The significant frequencies are 1, 3, 12, and 13. The frequency number 3 can be identified due to the El Nino effect.

TheTable 1 shows the average rainfall in the past 32 years. The predicted value is slightly less than the 32-year average.

IV. CONCLUSION

1. Table 1 shows that in the coming year the rainfall amount will be slightly more than the 32-year average.

2. Fig. 7 shows that there are several significant frequencies present in the rainfall history.

3. The amount of rain calculated by various methods in Figure 6 do not differ very much as opposed to the other figures.

4 The results using different methods differ from each other by significant amounts.

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

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
TIME SERIES	**2024**	30.6	26.3	24.9	27.7	109.5	
FFT	**2024**	17.6	31.4	24.8	16.8	90.6	
ANN	**2024**	12.1	27.0	29.8	19.4	88.3	12.1027
RMS	**2024**	22.7	33.9	22.7	22.7	101.9	
PREDICTED AMOUNT	**2023**	20.7	29.6	25.5	21.6	97.6	Slightly more than the 32 Year Average Value
32 YEAR AVERAGE		18.2	31.9	27.1	18.2	95.4	

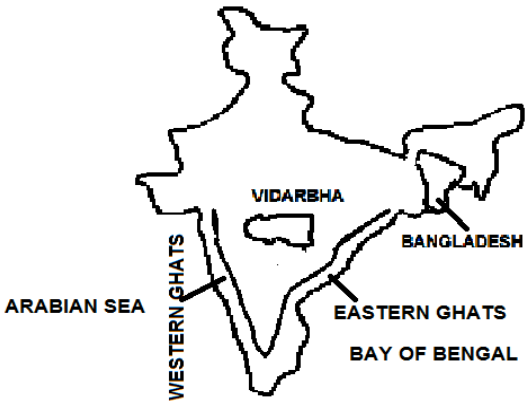
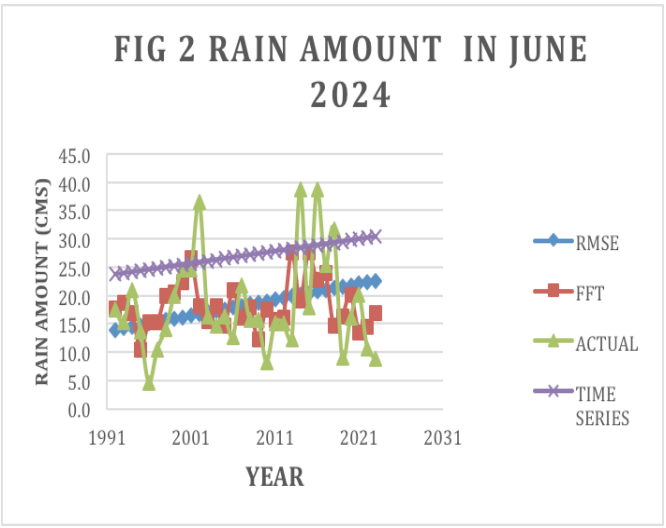
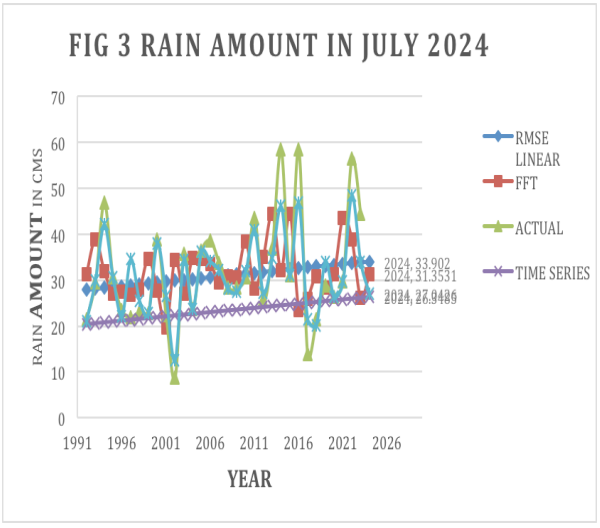
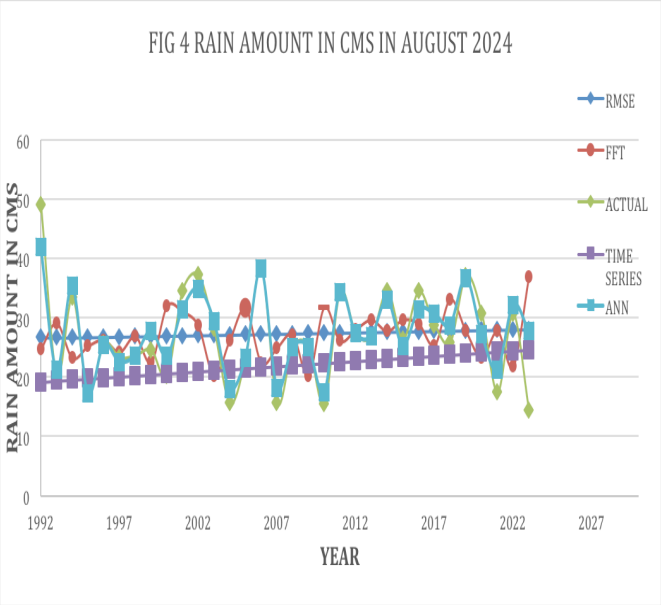
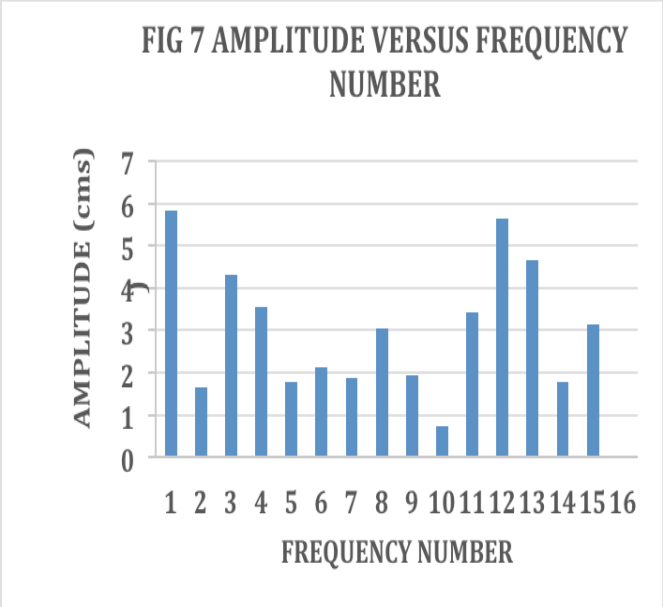


FIG. 1 LOCATION OF VIDARBHA BETWEEN EASTERN AND WESTERN GHATS









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