Prediction of Monsoon Rain for the Year 2023 for Vidarbha

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ABSTRACT - The present work deals with the monsoon rain forecast for Vidarbha, a region which suffers from frequent drought conditions. The forecasting is carried out using the rain data for the past 32 years. It uses 4 methods Witch are: the Time Series method, The Root Mean Squared method (RMS), the Artificial Neural Network method (ANN) , and the Fast Fourier Transform method (FFT).

The results are shown in form of graphs for each of the four months -June, July, August, September, and the total rain. The prediction is based on the average of all these methods.

KEYWORDS: Monsoon rain prediction, Fast Fourier Transform method, Water shortage, Drought and Famine

1. INTRODUCTION AND LITERATURE SURVEY

India is affected by water shortages [1-5]. Drought and famine conditions require transportation of water by trains and trucks for domestic and other consumption [6-11]. In certain districts of Amravati division, the water storage can drop to 19.7%. Many of the districts of Marathawada experienced similar situations recently. Of the surface water in India, 87% is stored in lakes, whereas 2% is stored in rivers, and the balance 11% in swamps. Since all these sweet water is not extractable - only 1% can be used for drinking [12]. One can refer to other references in this area in public domain [13- 27].

Similarly, water shortages affect the generation of electrical power using hydroelectricity plants- drastically [28].

In view of serious uncertainty in availability of water due to monsoon rains, this work is carried out about seven months ahead of time. It provides sufficient information before the monsoon season for planning In the fields of agriculture, power generation, and other relevant industries and civil governments.

The monsoon rain predictions are also made by the Indian Meteorological Department (IMD) In the month of April. However, the monsoon starts in the month of June -therefore there is very little advance notice for planning for agriculture and other needs.

In addition, this work helps in warning against floods if the predicted rain amount is very high.

One can also refer to the literature available regarding water availability in [29-35]. The rainfall data is made available by IMD also and it can be seen in [36].

References 37, and 38 discuss the details about the Time Series method and FFT method whereas one can find the details of the ANN method in [39].

2. METHODOLOGY

In this work, the quantity of rainfall in each of the months of June, July ,August, and September are calculated 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 are discussed in [35-40].

In the Time Series method, linear regression analysis is carried out the errors are calculated. 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. Then, an overall trend is calculated and the quantities of rain in each of these months are determined. Even in this case like other methods, the time history of 32 years is considered.

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 1875. 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

Here, one uses the relationship between input and output using a linear system of equation

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

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 input and output vectors one arrives at the weight matrix through a iterative process.

3. RESULTS AND DISCUSSIONS

In Fig. 1, one sees the location of Vidarbha in India as well as the two mountain ranges along the western and eastern coasts. The monsoon approaches from the western side and it obstructs the rainfall in the areas east of this range. The western range is higher than the eastern range so the obstruction by the eastern range will be less. in this way one

can see that the Vidarbha is primarily affected by the obstruction of the western range.

In Fig. 2, the results of ANN method fluctuate on both - the higher and the lower side of the other methods.

Fig. 3 shows the results for the month of July. It also shows that the actual rainfall values change very drastically. The amount of rain in July is more than that of June. This is also shown in the Table 1.

The rain amount values for August are less than that of July which can be seen in Table 1 and in the Fig. 4.

Regarding September, Fig. 5 shoes that the rain values are much less then those of r July or August. This is because this rainfall tapers off by September and the monsoon almost withdraws towards the south.

The total amount of rain fallen is the sum of the rain values fallen in the months of June, July, August, and September. This is shown in Fig. 6 as well as in Table 1. In this case, the values obtained by different methods are much closer than in those in individual months.

Fig. 7 shows the frequency distribution of the total rainfall values. This figure does not show the static values. One can see that different frequencies have very different amplitudes, and some are greater than four. Those amplitudes which are greater than 4 are numbers 1, 3, 12, and 13. The numbers 12 and 13 explain the rapid change in rainfall amount.

TheTable 1 shows the average of past 32 years. The predicted rain amount for the year 2023 is the average obtained by all the full methods. This predicted amount is greater than the average of past 32 years.

4. CONCLUSIONS

1. Table 1 shows that this year the rain will be significantly more than past 32 years average.
2. Fig. 7 Shows that there are several high amplitude frequencies present.
3. Fig. 6 Shows that the total rain amounts calculated by various methods do not show vast differences.

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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	**2023**	30.1	26.0	24.5	27.3	107.9	
FFT	**2023**	19.8	31.0	37.6	17.3	105.6	
ANN	**2023**	24.8	28.6	21.2	22.5	97.0	
RMS	**2023**	20.8	36.6	28.2	23.1	108.7	
PREDICTED AMOUNT	**2023**	23.9	30.6	27.9	22.6	104.8	More than the 32 Year Average Value
32 YEAR AVERAGE		18.6	31.5	27.4	17.5	94.9	

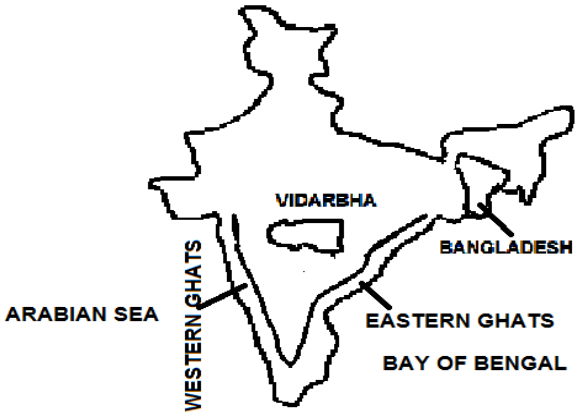
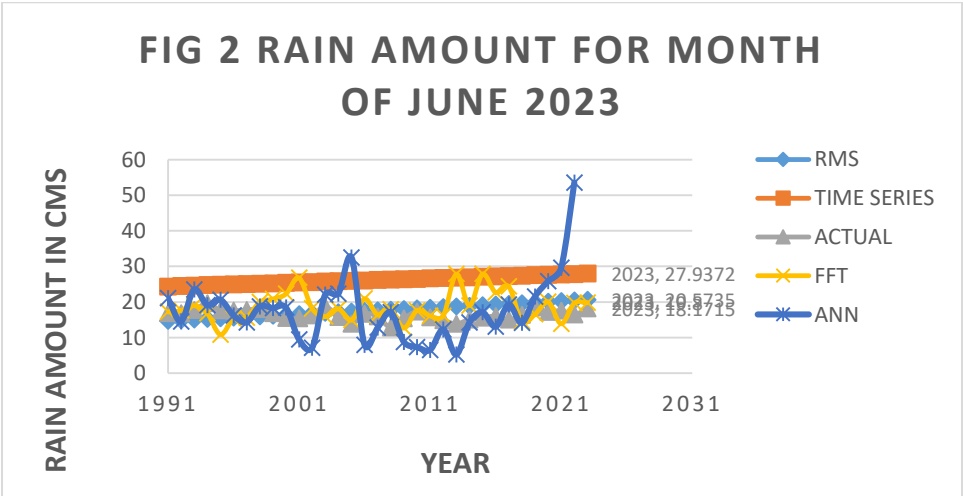


FIG. 1 LOCATION OF VIDARBHA BETWEEN EASTERN AND WESTERN GHATS



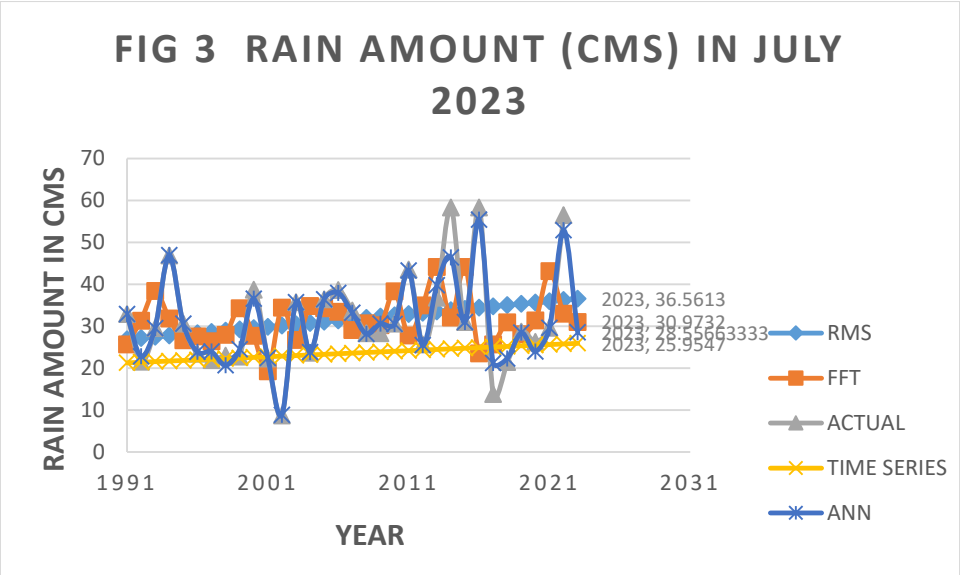


FIG 3 RAIN AMOUNT (CMS) IN JULY 2023
RAIN AMOUNT IN CMS
70
60
50
40
30
20
10
0
1991
2001
2011
2021
2031
YEAR
2023, 36.5613
2023, 30.9732
2023, 28.55663333
2023, 25.9547
RMS
FFT
ACTUAL
TIME SERIES
ANN

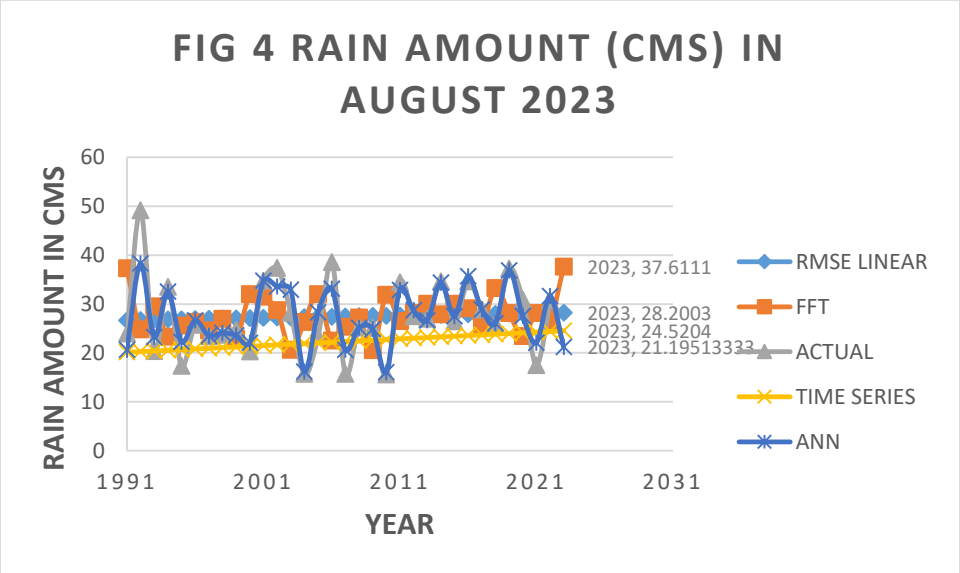


FIG 4 RAIN AMOUNT (CMS) IN AUGUST 2023
RAIN AMOUNT IN CMS
60
50
40
30
20
10
0
1991
2001
2011
2021
2031
YEAR
2023, 37.6111
2023, 28.2003
2023, 24.5204
2023, 21.19513333
RMSE LINEAR
FFT
ACTUAL
TIME SERIES
ANN

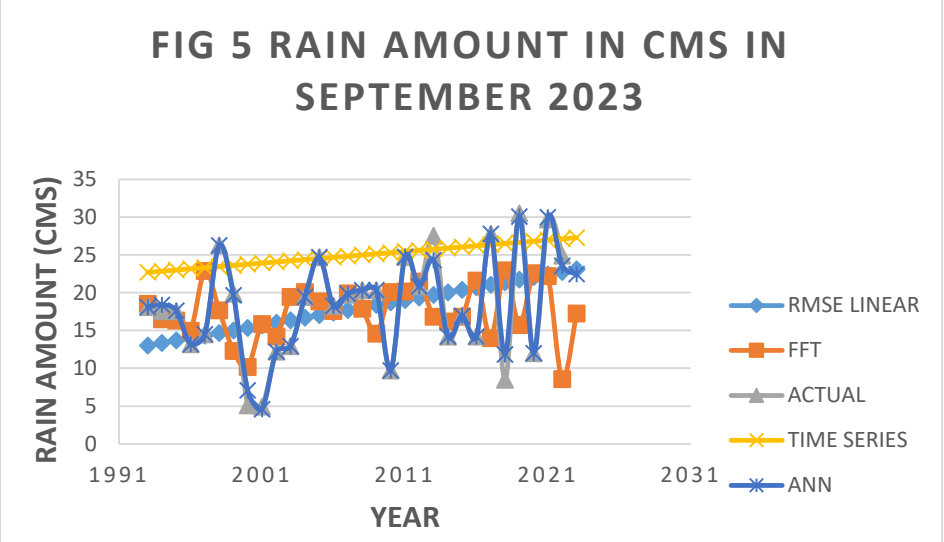
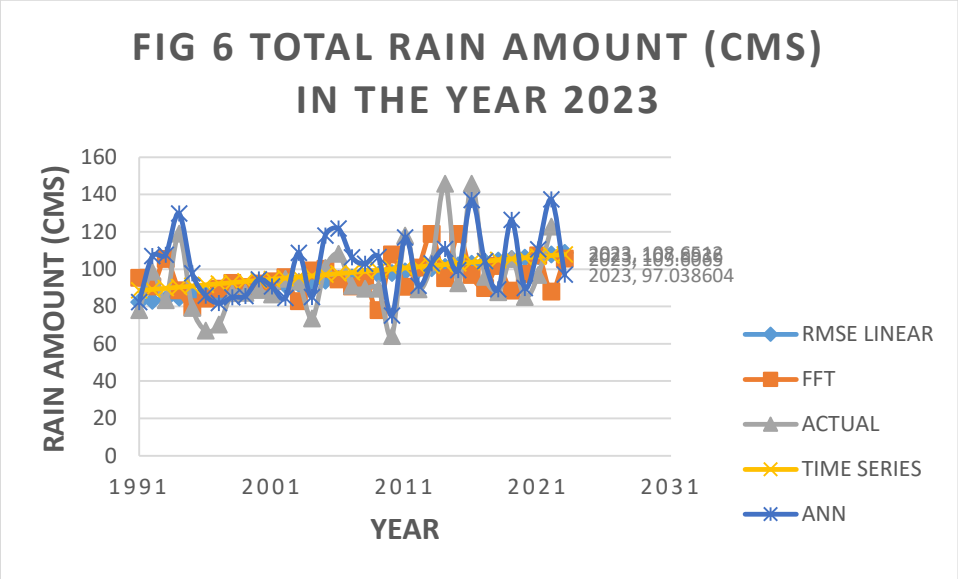
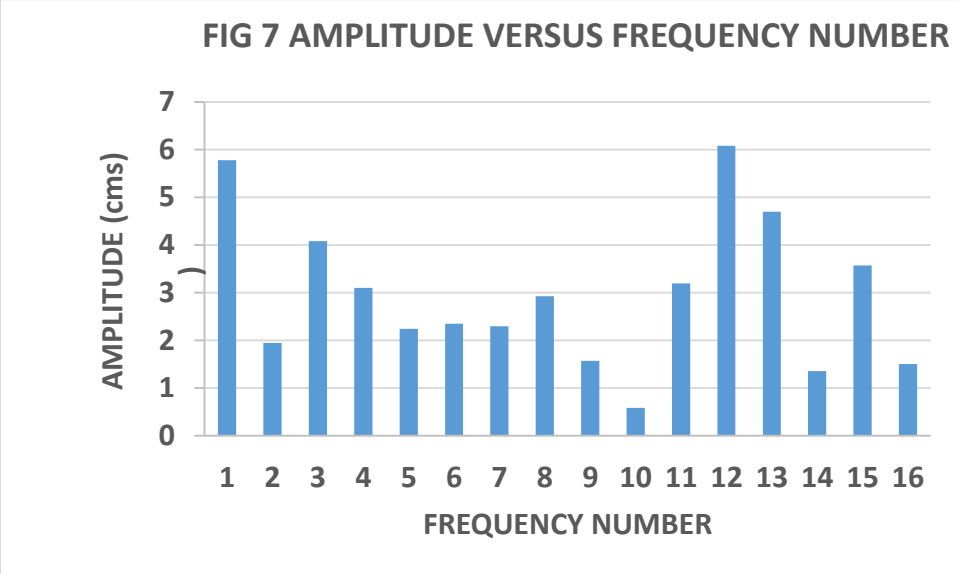


FIG 5 RAIN AMOUNT IN CMS IN SEPTEMBER 2023
RAIN AMOUNT (CMS)
35
30
25
20
15
10
5
0
1991
2001
2011
2021
2031
YEAR
RMSE LINEAR
FFT
ACTUAL
TIME SERIES
ANN





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