Rainfall Amount Prediction for the year 2020 for Vidarbha

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ABSTRACT- **For predicting the rainfall amount for the year 2020 for Monsoon months for Vidarbha, four independent methods have been used and the predicted value is equal to the average of these four values. The four methods are: (1) the Time Series method, (2) the Root Mean Square (RMS) value based month-wise by carrying out the linear regression, (3) the Fast Fourier Transform (FFT) method and Artificial Neural Network (ANN) method where the weights are determined based on records going back to 1872.**
The predicted amount of the rainfall this Monsoon season will be slightly above the average of past 32 years. This should be good for farmers waiting for good rain as well as replenishing the underground water reserves, other water storage facilities, and hydro-power.

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

I. INTRODUCTION

The rainfall in Vidarbha has been good so far this year but Vidarbha has been known to be deficient in rain resulting in drought and severe water shortages [1-5]. The wells go dry and as a result water is made available to people by trains and tankers. The city of Nagpur many times undergoes severe water crisis. Here in the city of Nagpur due to water shortage - had allowed only 50% of its raw water to be used for domestic purposes. Five districts in Amravati division in Vidarbha faced shortage of water in the past due to the drop in the water stock that fell very low. The average water stock in the reservoirs in five districts had in the past dropped to 19.71%. . This had resulted in the reservoirs running dry faster than their annual rate. The drop in the water level had led to a rise in the number of water tankers being used for supply of potable water. Some of the districts in Marathwada too had been facing shortage of drinking water. Even after satisfactory rainfall in last year or two in Marathwada, Aurangabad district had the state's highest number for supplying potable water. Hegde in his work says –"that70% of the earth surface is covered with water, which amounts to 1400 million cubic kilometres (km^3). Earth's out of the total fresh water reserves, 68.7% is frozen in ice caps, 30% is stored underground and only 0.3% water is available on the surface of the earth. Out of the surface water, 87% is stored in lakes, 11% in swamp and 2% in rivers. As all the sweet water is not extractable, only 1% of the total water can be used by human [5]. Other references applicable for this region are available in public domain [6- 20].Water shortage also affects the hydropower generation [21].

Considering the facts mentioned above, it would be helpful if accurate model is used to predict Monsoon rainfall far in advance to that of the IMD predictions which come at the last moment for the farmers who cannot plan ahead of time. The same is applicable to the various governments at different levels. This way, the farmers get freedom to plant the crop of their choice and how much to plant? The farmers are usually under heavy loans and a drought plays havoc with their financial planning. In case of advance knowledge about a drought -it will help farmers in avoiding loans. Not only this, if one expects floods due to heavy rainfall to be expected then appropriate measures can be taken.

One can refer to work of some scientists working in this area [22-28]. The rainfall predictions by IMD can be seen in [29]. References 30, and 31 show the details of the Time Series method and FFT method.

II. RESULTS AND DISCUSSIONS

Figure 1 shows the map of India and the location of Vidarbha. In India, the south - west Monsoon arrives on the land where it faces the Western Ghats mountain range before raining over Vidarbha - much of the rain is blocked due to these Ghats. However it gets the rain from the southern side where another set of mountain ranges called the Eastern Ghats which are not as high as the previous mountain range.

Figure 2 shows the rainfall for the month of June. It shows the actual rainfall as well as those approximated by: (1) Artificial Neural Network (ANN) method, (2) Root Mean Square (RMS) values of the month of June, (3) Time Series Method, (4) the Fast Fourier Transform method and the actual rain values. The actual rain values vary drastically from year to year as do the ones by FFT and ANN methods. The RMS and the Time Series methods are based on regression analysis where the errors are minimized using a linear regression method - so these curves are straight line estimations. This figure shows the actual rainfall to be quite erratic from year to year. The change in the magnitude of the rainfall is quite high. As can be seen in Table 1 and Fig 2, the results for the year 2020 that are obtained by these methods yield close values.

Figure 3 shows the results for the month of July. It also shows the actual rainfall and those calculated by FFT and other methods. The amount of rain in July is more than that of June but there is slight increase in the difference between the values obtained by different methods. The values for

August as shown in Figure 4 are less than those of July but the divergence between the results by various methods is less. Figure 5 values for September are less than that of August.

The rain amount for the month of August is shown in Figure 4. It shows that the actual rainfall differs fairly high from year to year in the beginning. However, in the later period it appears to converge towards the mean value.

The rainfall amounts for September are shown in Figure 5. It shows that there will be less rain in September as compared to July or August yet, it will be more than that of June. Figure 6 shows the total rain values for the months of June to September. Here, the values obtained by various methods are closer to each other. As is shown in Table 1, the total predicted amount which is the average of the four methods, is slightly higher than the 32 year average values (see Table 1).

Figure 7 shows the frequency distribution of the total rainfall values. It shows that the mean value is the highest. However, there are higher amplitudes present in the higher frequency numbers thereby indicating the high fluctuation in rain values.

III. CONCLUSIONS

1. Looking at the Table 1 one can say that this year, the rainfall will be slightly more than the average of the last 32 years.

2. All the four methods yield results that are close to each other.

3. The presence of higher amplitudes among higher frequencies indicate high fluctuations in the time history of rain.

4. Slightly higher rain than the past 32 year average values show that the water shortage this year would not be that serious.

5. Though the month-wise vary much from year to year but the total values shown in Fig. 6 show very little scatter.

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TABLE 1: RAIN FORECAST IN CENTIMETERS FOR VIDARBHA DURING 2020 MONSOON MONTHS

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
ANN	2020	18.2	32.1	28.2	22.0	100.0	
TIME SERIES	2020	20.4	28.5	26.8	24.2	99.9	
FFT	2020	20.3	28.1	30.1	16.9	95.3	
RMS	2020	19.5	34.7	27.3	20.8	102.3	
PREDICTED AMOUNT	2020	18.0	32.5	28.6	20.3	99.4	More than the 32 Year Average Value
32 YEAR AVERAGE		19.1	30.5	28.5	17.1	95.2	
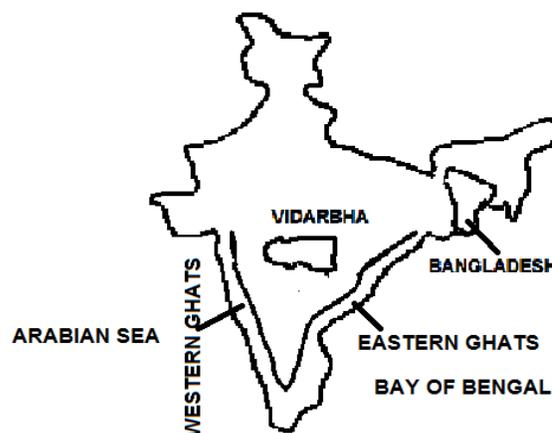
FIG. 1 LOCATION OF VIDARBHA BETWEEN EASTERN AND WESTERN GHATS

FIG 2 RAIN AMOUNT IN JUNE 2020

FIG 3 RAIN AMOUNT IN JULY 2020

FIG 4 RAIN AMOUNT IN AUGUST 2020

FIG 5 RAIN AMOUNT IN SEPTEMBER 2020

FIG 6 TOTAL RAIN IN 2020 IN VIDARBHA

FIG 7 AMPLITUDE VERSUS FREQUENCY NUMBER
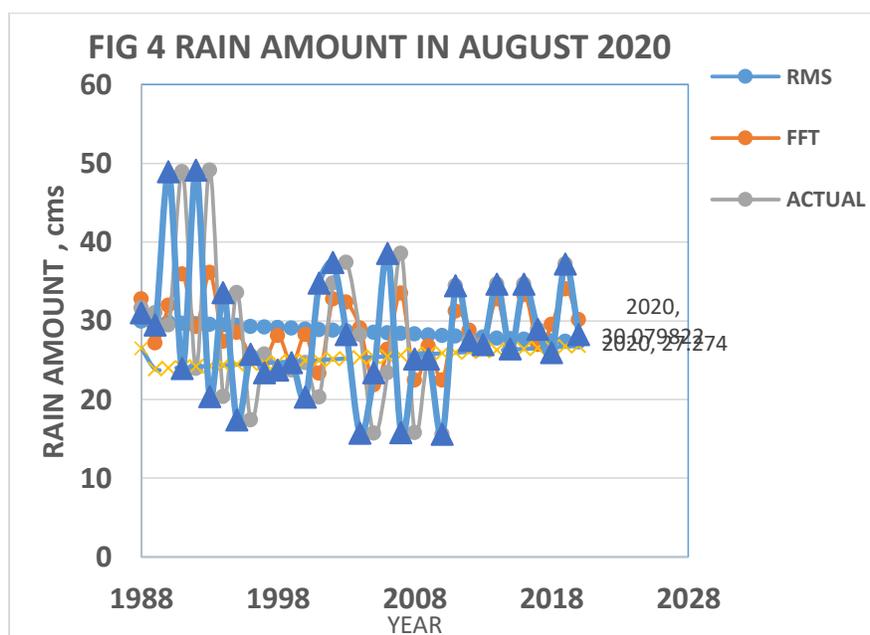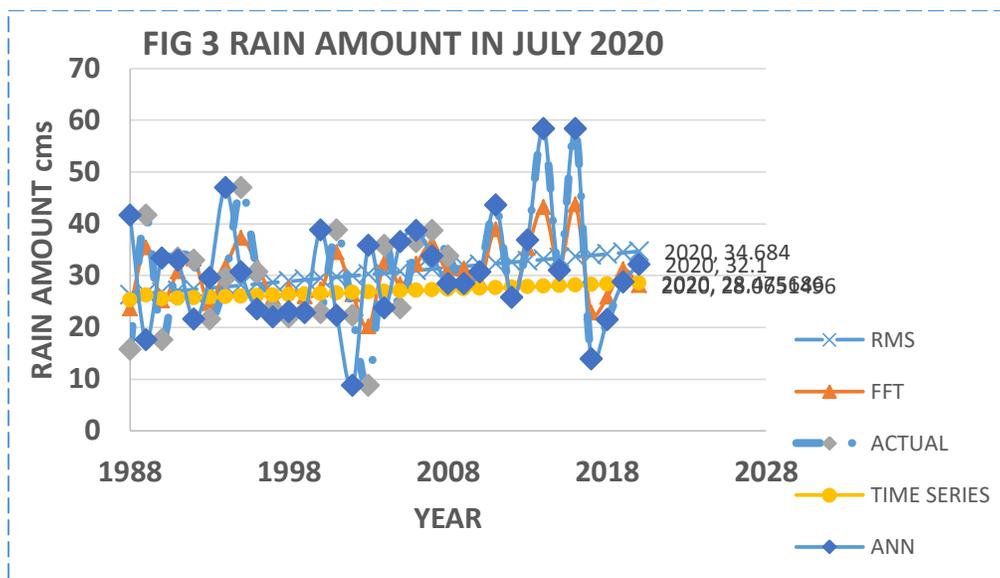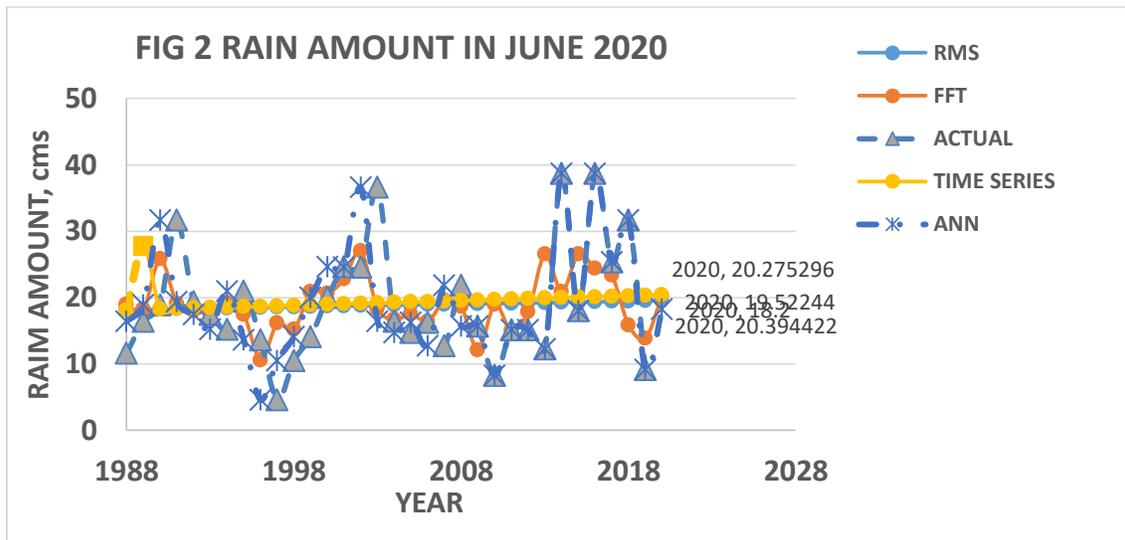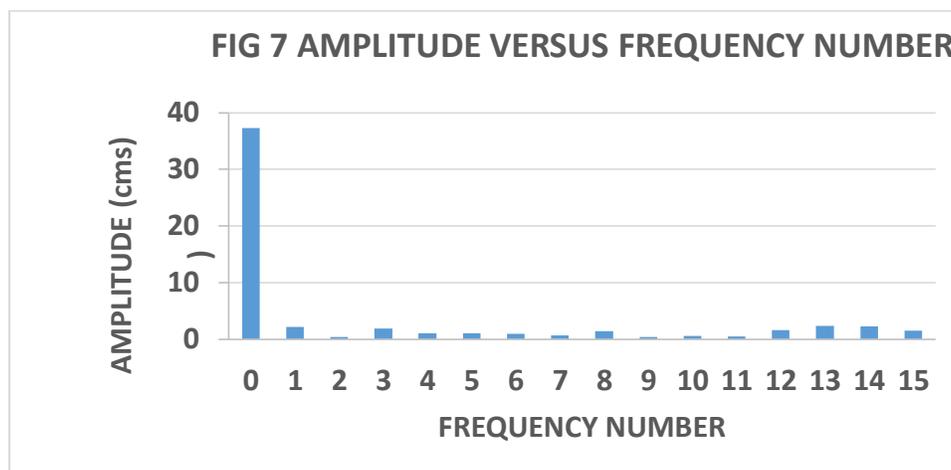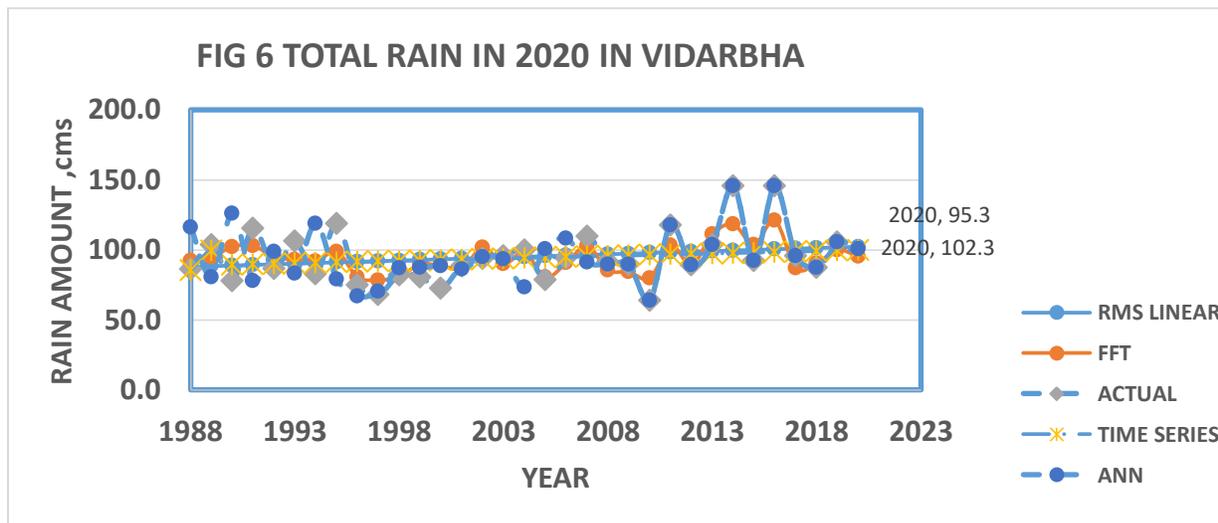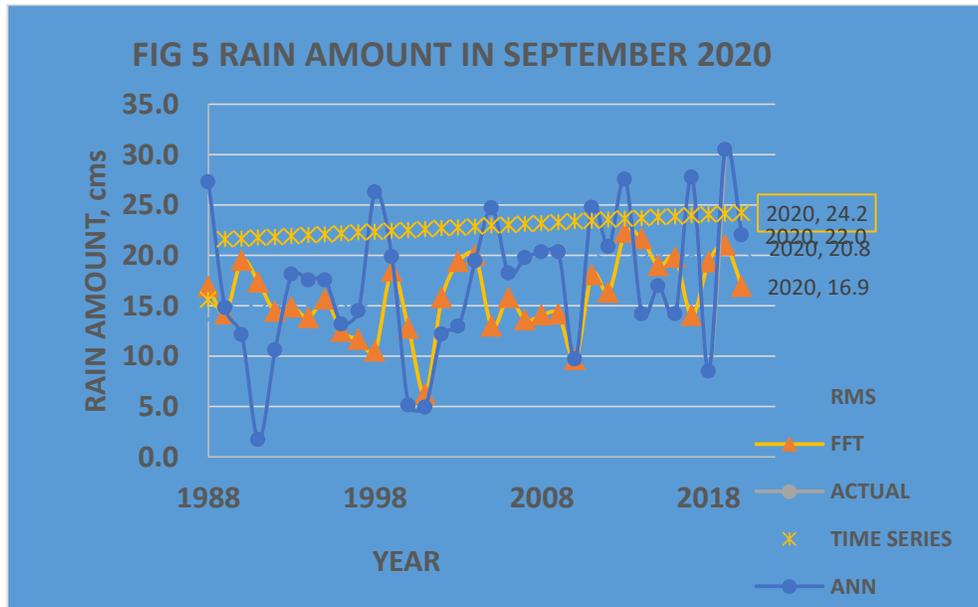
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