

Monsoon Rain Prediction for Drought Prone Jharkhand for The Year 2024

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Abstract - Jharkhand frequently faces drought like situation quite often. Therefore, it requires careful planning before planting of crops. The planting of crops involves sufficient capital for the poor farmers who borrow money either from the banks or from private money lenders at much higher rates. Since the amount is heavy for the farmers, the crop failure can lead to farmer's suicide. Therefore, information about the future rain is very important. The earlier the information is available the better it will be for planning. This research is being carried out with this point in mind. In this research the data is collected over 32 years and based on these - three methods are used for prediction. The predicted value is the average of the three method results. The methods are: (1) the Fast Fourier Transform (FFT) method, (2) the Time Series method, and (3) the Root Mean Square (RMS) method using linear regression analysis, and the Artificial Neural Network (ANN) method.

KEYWORDS: Monsoon rain prediction, annual rainfall, rainfall frequency spectrum, El Nino and La Nina influence on rainfall, drought and famine, crop failure

I. INTRODUCTION AND OBJECTIVE OF RESEARCH

Figure 1 shows the map of Jharkhand. It is a rocky area and storing water is difficult. Being rocky, drilling is difficult. This place suffers from lack of rain quite often. Many efforts have been made in the past for making arrangements for irrigation. Digging canals is difficult and costly. So is making reservoirs for storing water. Due to these factors and deficient rain - quite often the crop failures happen [1-6].

The crop failure results in decreased purchasing power for the farmers who are really dependent on monsoon rains. In India, about 68% of the agriculture land is dependent on monsoon rain for irrigation. The lack of rain causes slowing down of the economy of India [7].

It becomes problematic when a country's water reserve becomes below 1,000 cubic meters per person per year; the country then faces water shortage [8]. About 700 million people in 43 countries were living below the 1,700 cubic meters per person threshold. Water stress has increased in regions such as China, India, and Sub-Saharan Africa, which has the largest population of the world.

The global warming effects are being felt throughout the world. For example, the state of California in United States of America (USA) went through a six-year drought period. As a result of this, the hydroelectric power stations had to be stopped many times.

The lack of rain not only affects agriculture, but It also affects city supply, and hydropower as been discussed in [9]. The deficient rain conditions change the lifestyle of various places. One problem with Jharkhand is that it doesn't have sufficient number of reservoirs for storage of water.

These days one finds the level of reservoirs to be low and affecting agriculture as well as generation of hydropower [10,11]. Not only Jharkhand but also many other areas of India are suffering from water shortages [12-31].

Many researchers have found this problem to be quite troublesome and their research work can be seen in [32-39]. In this respect rainfall data by Indian Meteorological Department (IMD) can be seen in [40].

The present study has been undertaken to help farmers plan for the crop planting and purchasing of seeds etc. The help comes from forecasting well in advance about 7 months - about the rainfall in the next monsoon. This would also help planning for the hydropower generation as well as the municipalities who have to supply water to the cities.

II. RESULTS AND DISCUSSIONS

III.

Fig. 2 shows the results of calculations using the Time Series method, the Fast Fourier Transform method (FFT), the Root Mean Square (RMS) method, the Artificial Neural Network (ANN) and the actual rainfall record for the month of June. The details about these methods can be seen in [41-43]. In this figure one can see that the actual rainfall varies quite rapidly from year to year whereas the calculated values for the other methods do not show that kind of variation.

In the Table 1 one can see the summary of results. Here, one can see that the FFT method gives the highest value and the RMS method - the lowest. The predicted value is the average of these three methods. One can compare the predicted value with the average of past 32 years. It shows that the predicted value is less than the 32-year average value.

Fig 2 shows various outputs computed by different methods. It shows that the actual rain values differ each year very rapidly.

In Fig. 3, the Time Series method and the RMS method both show a similar declining trend. The actual rainfall curve shows rapid changes from year to year. The FFT method results also vary but not to the same extent as the actual rainfall amounts.

In Fig. 4, the difference between calculated methods is less than the previous figure. The actual rainfall values show variations similar to the ones in the previous figures.

In Fig. 5, the RMS method shows a declining trend whereas the Time Series method shows an increasing trend. The FFT method results fluctuate just like the actual rainfall values. The variation in the actual rainfall is larger as compared to the FFT method.

The total value of rain is shown in Fig. 6. In this figure, the Time Series method shows increasing trend. The difference between all the results is much smaller in this figure. The actual rainfall varies from year to year is just like before.

Fig. 7 shows the amplitude versus frequency number. In this figure the frequency numbers 1, 3, 5, 6, 8, 9 and 10 have amplitudes greater than 4 centimeters. All other frequency numbers exhibit their amplitudes less than 4. This shows that there are sufficient number of frequencies whose amplitudes are significant.

III. CONCLUSIONS

In this work, the calculations of the rainfall were carried out using the Time Series method, the FFT method, and the RMS method, and the ANN method. The Time Series method, and the RMS method show a uniform variation in all calculations. The FFT method results show fluctuations but not as much as those in the case of the actual rainfall. The ANN method results were the lowest in all the figures.

Based on this study one can conclude the following:

1. There is sharp variations in the actual rainfall values from year-to-year.
2. The Time Series method and the RMS method results show linear variation due to linear regression. However, the slopes of these curves did show opposite variation in many of the curves.
3. The FFT method results are sum of various harmonics, and they fluctuate fair bit from year to year. The total variation in this method is less than that of the actual rain values.
4. This year - overall there will be less rain amount than the 32-year average as shown in Table 1.
5. The ANN method yields the least result.

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TABLE 1: RAIN FORECAST IN CENTIMETERS FOR JHARKHAND DURING 2024 MONSOON MONTHS

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
TIME SERIES	2024	13.0	22.6	26.9	32.4	95.0	
FFT	2024	12.5	21.5	22.7	33.4	90.3	
RMS	2024	10.7	28.4	26.0	19.2	84.3	
ANN	2024	6.0	26.0	23.3	24.3	79.7	
PREDICTED AVERAGE	2024	10.6	24.6	24.7	27.3	87.3	This year the predicted value is less than the 32 – year average shown below
32 YEAR AVERAGE	2024	18.7	31.4	29.7	21.7	101.4	

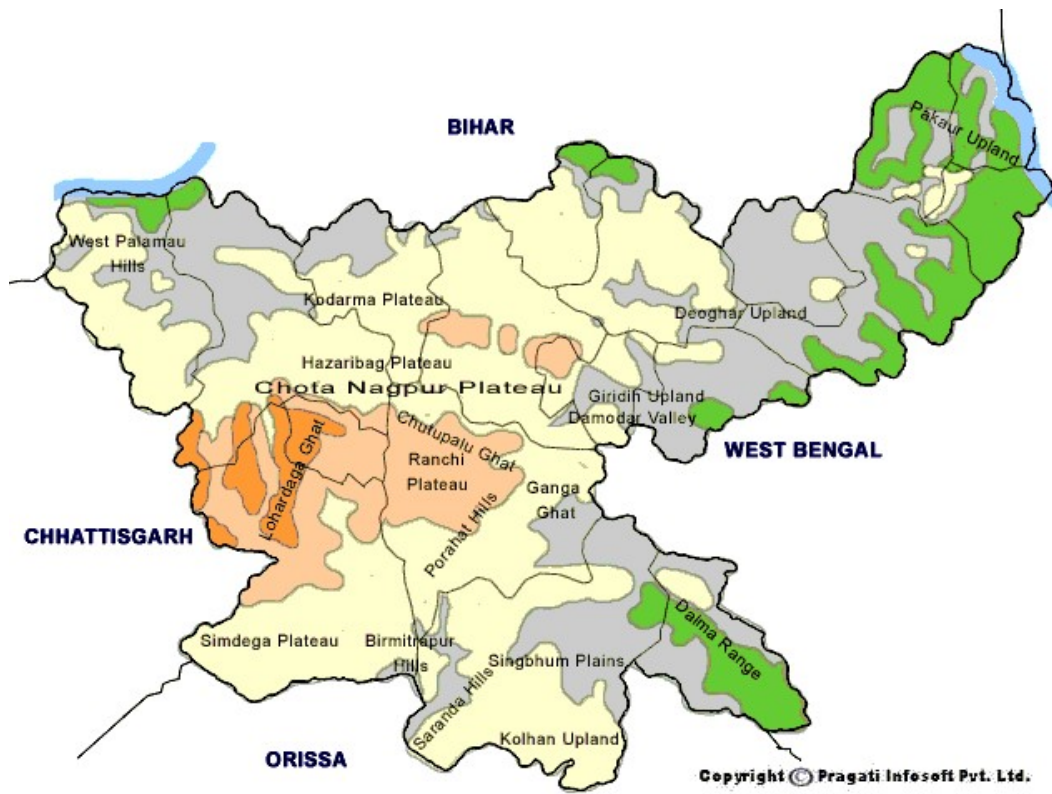


FIG 1 PHYSICAL MAP OF JHARKHAND, INDIA

