# Prediction Of Year 2019 Monsoon Rainfall For Vidarbha, The Area With Acute Water Shortages And Farmers Suicides

**Anand M. Sharan**

*Abstract*— **In this work the prediction of rain is based on (a) Time Series method (b) Fast Fourier Transform method , (c) the average of the two methods , and (d) modification of the average method by including a random factor. This factor which is less than one modifies the average value. In these methods, historical rain data of Vidarbha from 1987 to 2018 are selected for projection. These methods take into account the trends in rain pattern also.**

**The forecast is being made in month of February much before the Monsoon season starts in June. This forecast makes known that there will be more rainfall than the 32 year average. This early forecast can be useful to the farmers for planting crops, and city governments for making arrangements for water supply.**

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

## I. INTRODUCTION

Recent report to Maharashtra indicates that there has been an acute shortage of rain [1]. The city of Nagpur will undergo severe water crisis. The city of Nagpur will allow only 50% of its raw water to be used for domestic purposes. Five districts in Amravati division in Vidarbha are facing shortage of water due to the drop in the water stock that fell last year. The average water stock in the reservoirs in five districts has dropped to 19.71% [2] . This has resulted in the reservoirs running dry faster than their annual rate. The drop in the water level has led to a rise in the number of water tankers being used for supply of potable water. Some of the districts in Marathwada too have been facing shortage of drinking water. Despite satisfactory rainfall last year in Marathwada, Aurangabad district has 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 ($km^3$). However, 97.5% of this water being sea water, it is salty. Fresh water availability is only 35 m km3. 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 " [3]. Other references applicable for this region are available in public domain [4-18].Water shortage also affects the hydropower generation [19].

**Anand M. Sharan,** Professor, Mechanical Engineering Department,Faculty Of Engineering, Memorial University Of Newfoundland, St. John's, Newfoundland, Canada A1b 3x5,
Fax: (709) 864 - 4042

In the light of the above, it is desirable that we come up with an accurate model 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 to be prepared from before about the amount of rainfall in the Monsoon season (total new water). This way, the farmers can decide what to plant and how much to plant? The farmers are under heavy loans and a drought breaks their backs. In case of advance knowledge about a drought -it will help farmers in avoiding loans. Similarly, in many cases, one can have idea about floods if the predicted rainfall is to be heavy resulting in opening up of many flood-gates in dams in quick succession in a river basin.

One can refer to work of some scientists working in this area [20-23]. The rainfall predictions by IMD can be seen in [24]. References 25, and 26 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. As monsoon approaches from day south-west Indian encounters Western Ghats mountain range on the west coast of India. So Vidarbha comes in the of the monsoon's shadows. However it gets the rain from the southern side where another set of mountain ranges called the Eastern Ghats but 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 least-squares analysis and Fast Fourier Transform. 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. The least-squares analysis results are represented by because time is the actual variable along the x-axis. The fast Fourier transforms reserves approach the actual rainfall amounts. The take the mean path. The FFT results predict 14.4 cm of rain for the year 2019. On the other Time series results indicate 24.1 cms. Other details of the results are shown in Table 1.

Figure 3 shows the results for the month of July. It also shows the actual rainfall and those calculated by FFT and time series methods. This will also shows the actual rainfall differing from year to year by large amounts. The FFT method predicts 23.6 cms whereas the Time Series -33.8 cms.

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 in the later period it appears to converge towards the mean value. The results of the FFT and with Time Series methods also converge. The values respectively are 32.7, and 31.8 cms.

The rainfall amounts for September are shown in Figure 5. The Time Series method shows higher values. The FFT method and the actual rainfall plots show better results. The predicted values for the Time Series method and the FFT method are 28.8 and 16.9 cms respectively. The rainfall tapers of in this month.

Figure 6 shows the total rain values for the months of June to September. In this figure in Time Series method does represent the path along the mean values. The predicted values by the Time Series method and the FFT method are 118.6 and 82.8 cms respectively and are quite different.

In the Figure 7, the magnitudes of the various frequencies are shown. It shows the wide variation in the magnitude of the spectrum. It will see numbers 1 and 3 as well as 13 and 14 are very high. As a matter of fact all the frequencies including number 12 are quite significant. Similarly, the first and the third frequencies are also quite significant. The high magnitudes of the last four frequencies shows rapid change in the total rainfall.

Table 1 shows the summary of the rainfall. Here, the Time Series method yields values much higher than the 32 year average values (last row). Next shown are the Fast Fourier Transform results. These results are lower than the Time Series results. The third row shows the average values obtained by averaging the Time Series results and the Fast Fourier Transform results. These average values are close to the 32 year average results. In the fourth row, the results obtained by modifying the average results due to the randomness factor and this is called the Predicted Results.

For prediction, a set of random numbers, r, between 0 and 1 were generated. These were used in the formula for Predicted Value as:

Predicted Value = Average Value + (0.2 x Average Value) (r-0.5)

The random number generated was equal to 0.82. Using this random number, the calculated values are shown in Table 1. The predicted values for the month of June and July are close to the 32 year average of the actual values. The numbers for the months of August September and the total value will be greater in the predicted value.

## III. CONCLUSIONS

1. Looking at the Table 1 one can say that the rain amounts will be greater in all months, and hence the total value considering the 32 year average.
2. The Time Series method gives far higher values for the rainfall.
3. The FFT method gives lower values in all the months except in August.
4. Based on the review of the situation of water supply, it is imperative that the governments (all levels), take immediate steps to improve the water situation in the area.

## REFERENCES


[1] NMC likely to get only 50% of raw drinking water demand ,2018, http://timesofindia.indiatimes.com/articleshow/63649420.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

[2] Water crisis looms in Vidarbha and Marathwada as summer arrives,2018, https://www.hindustantimes.com/.../water-crisis...vidarbha.../story-NHSMc1JqRMbmD...

[3] Water Scarcity and Security in India, https://www.indiawaterportal.org/sites/indiawaterportal.org/files/waterscarcityandsecurityinindia_nghegde_baif_isc_2012.pdf

[4] Farmer's Suicide in Vidarbha : Everybody's Concern , http://medind.nic.in/jaw/t09/i2/jawt09i2piii.pdf

[5] Farmers' Suicides in the Vidarbha Region of Maharashtra, India a Qualitative Exploration of Their Causes, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291283/

[6] Four more Maharashtra farmers commit suicide, http://www.thehindu.com/news/national/four-more-maharashtra-farmers-commit-suicide/article6655587.ec

[7] Three Farmers Commit Suicide in Draught-Hit Marathwada Region, http://zeenews.india.com/news/maharashtra/three-farmers-commit-suicide-in-draught-hit-marathwada-region_1508366.html

[8] Three Farmers Commit Suicide in Draught-Hit Marathwada Region, http://zeenews.india.com/news/maharashtra/three-farmers-commit-suicide-in-draught-hit-marathwada-region_1508366.html

[9] India is already facing a water crisis—and it is only going to get worse, https://thediplomat.com/2014/04/indias-worsening-water-crisis/

[10] In Gujarat's water crisis, key question: why is Narmada's level low this year?, http://indianexpress.com/article/explained/in-gujarats-water-crisis-key-question-why-is-narmadas-level-low-this-year-5113688/

[11] Water shortage in Gujarat's Morbi forces people to dig holes in the ground, http://indianexpress.com/photos/india-news/gujarat-morbi-water-crisis-narmada-river-5119373/

[12] Gujarat staring at water crisis this summer, http://indianexpress.com/article/india/gujarat-staring-at-water-crisis-this-summer-5042137/

[13] Water scarcity threat to India and South Africa - Climate News Networhttps://climatenewsnetwork.net/23742-2/

[14] India's escalating water crisis -, https://www.livemint.com › Politics › Policy

[15] India's potable water crisis is set to worsen , https://www.livemint.com › Politics › Policy

[16] India's fast-growing cities face water crisis - Phys.org https://phys.org › Earth › Environment

[17] India drought: '330 million people affected', http://www.bbc.com/news/world-asia-india-36089377

[18] Drought years may become more frequent in India, says study, http://indianexpress.com/article/india/india-news-india/maharashtra-gujarat-drought-waterless-monsoon-crisis-years-may-become-more-frequent-in-india-says-study-2826500/

[19] The Thirst for Power: Hydroelectricity in a Water Crisis World, http://www.brinknews.com/the-thirst-for-power-hydroelectricity-in-a-water-crisis-world/

[20] Singh, P, and Borah, B., 2013, "Indian summer monsoon rainfall prediction using artificial neural network", Stoch Environ Res Risk Assess Vol 27:pp. 1585–1599

[21] Gadgil, S and Srinivasan, J (2012). "Monsoon Prediction: Are Dynamical Models Getting Better Than Statistical Models?", J Current Science VOL. 103, NO. 3, 10 August

[22] Delsole, T. and Shukla, J. (2012). Climate Models Produce Skillful Predictions of Indian Summer Monsoon Rainfall. Geophys. Res. Lett Volume 39, Issue 9, May

[23] Prediction of Rain in Bihar, India Based on Historical Bihar's Rain Data. http://www.engr.mun.ca/~asharan/RAINBIHAR/RAIN_BIHAR_V12.pd

[24] Rainfall Projections. http://www.imdpune.gov.in/endofseasonreport2013.pdf

[25] Excel - Time Series Forecasting. http://www.youtube.com/watch?v=gHdYEZA50KE

[26] Frequency Domain Using Excel. http://online.sfsu.edu/jtai/downloads/ENGR%20302/Excel.FFT.pdf

TABLE 1: RAIN FORECAST IN CENTIMETERS FOR VIDARBHA DURING 2018 MONSOON MONTHS

| METHOD | YEAR | JUN | JUL | AUG. | SEPTEMBER | TOTAL | COMMENTS |
|---|---|---|---|---|---|---|---|
| TIME SERIES | 2019 | 24.1 | 33.8 | 31.8 | 28.8 | 118.6 | |
| FAST FOURIER TRANSFORM (FFT) | 2019 | 14.4 | 23.6 | 32.7 | 16.9 | 82.8 | |
| AVERAGE OF TIME SERIES AND FFT METHODS | 2019 | 19.3 | 28.7 | 32.3 | 22.9 | 100.7 | |
| PREDICTED AMOUNT | 2019 | 20.5 | 30.5 | 34.3 | 24.3 | 107.1 | More than the 32 Year Average Value |
| 32 YEAR AVERAGE | | 19.3 | 30.6 | 28.8 | 15.8 | 94.5 | |

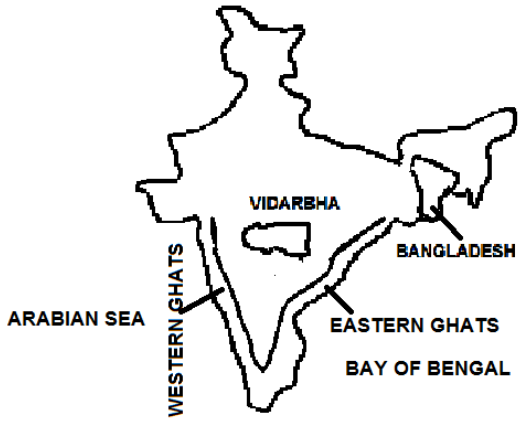


**FIG. 1 LOCATION OF VIDARBHA BETWEEN EASTERN AND WESTERN GHATS**