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Monsoon Rain Prediction for Vidarbha in the Year 2026

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Abstract - The present study uses 32 years of historical monsoon rainfall data for Vidarbha to predict the rainfall for the coming year. Four computational approaches are employed: the Time Series method, the Root Mean Squared (RMS) method, the Artificial Neural Network (ANN) method, and the Fast Fourier Transform (FFT) method. For each method, rainfall values are computed and then averaged. This average is calling Sharan's method of average. After this, other average is computed, where the average of Sharan's and LP Neuro methods prediction are averaged and it's use as predication of coming year. The results are presented as graphs for each of the monsoon months, and a summary of the predicted values is provided in tabular form in table 1 and 2.

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

I. INTRODUCTION AND LITERATURE SURVEY

Today the world is experiencing significant climate change, which manifests as extreme rainfall events, drought, land erosion, severe storms, and forest fires [1-4]. These phenomena aggravate water shortages in many regions [5-26].

In India, about 87% of the total surface freshwater is stored in lakes, 2% in rivers, and the remaining 11% in swamps. However, not all this freshwater is accessible; only about 1% is available for drinking. The lack of reliable rainfall also affects hydropower generation [27].

Farmers in Vidarbha need early and reliable information about the expected rainfall to plan cropping patterns for the following year. They typically purchase seeds, fertilizers, and other inputs at high interest rates. When crops fail, many farmers are unable to repay their loans, and this has been linked to farmer suicides in the region.

The present research provides rainfall predictions roughly seven months in advance, so that farmers can plan their crops accordingly. In contrast, the India Meteorological Department (IMD) generally issues its monsoon forecast in April, which is not sufficiently early for planning seed purchases, usually undertaken in June.

Beyond agriculture, advance rainfall prediction is also important for flood management. When there is excessive rainfall in a river basin, many reservoirs approach full capacity. To avoid sudden and potentially dangerous releases of water, forecasts such as those developed in this work can help authorities decide on safe, pre-planned release schedules.

Further literature on water availability can be found in [28-34], while rainfall data made available by IMD are documented in [35]. References [36-39] describe the Time Series, FFT, LP Neuro and ANN methods that are employed in the present study.

II. METHODOLOGY

In this research, rainfall is predicted using five methods: (1) the Time Series method, (2) the Fast Fourier Transform (FFT) method, (3) the Artificial Neural Network (ANN) method, (4) the Root Mean Square (RMS) method and (5) LP Neuro. The essential features of these methods, as implemented in this study, are outlined below.

In the Time Series method, the rainfall data for June, July, August, and September are treated as four separate seasons. For each month, the overall trend is obtained by linear regression on the 32-year historical record. The predicted rainfall for the coming year for that month is then calculated by extrapolating this trend.

In the RMS method, regression analysis is again carried out separately for June, July, August, and September. For each month, the regression line is extended to obtain the predicted rainfall, and an RMS-based measure is used to represent the fitted values.

The LP-Neuro Method (Linear-Programming Neural Network Method) is a hybrid computational approach that combines the learning capability of neural networks with the optimization strength of linear programming (LP). It was first introduced by Balasubramanian and Sharan (1996) in the Journal of Dynamic Systems, Measurement, and Control (ASME Transactions) as a framework for solving engineering problems involving complex, nonlinear, and constrained data relationships. Although the present work focuses on the four methods listed above, the LP-Neuro method is mentioned here because of its demonstrated effectiveness in related prediction problems [39].

In the ANN method, the network is trained using 32-year batches of historical rainfall data, one year at a time, going back to 1878. For each batch, 32 consecutive years of data are used as input, and the rainfall in the 33rd year is used as the corresponding output. This process is repeated by sliding the 32-year window through the historical record until the most recent data are included. After the network has been trained in this way, it is used to predict the rainfall for the next year.

The ANN model is based on a linear relationship between input and output vectors:

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

where {O} and {I} are the output and input vectors of sizes m×1 and n×1, respectively, and [W] is the m×n weight matrix. Using several inputs–output vector pairs, the network training process determines the appropriate weight matrix [W]. Once [W] has been obtained, a new input vector {I} representing the most recent 32 years of rainfall is supplied, and the corresponding output vector {O} provides the forecast of rainfall for the coming year.

III. RESULTS AND DISCUSSIONS

In Fig. 1, one sees the location of Vidarbha. The monsoon approaches from the south- western side where the mountain ranges called the Western Ghats obstruct the pattern of the monsoon clouds thereby introducing uncertainty in the rain pattern.

In Fig. 2, actual rainfall has abrupt changes. The RMS and the Time Series method have straight line relationship with increasing trend.

Fig. 3 shows the results for the month of July. It also shows that the actual rainfall values change very drastically. The RMS method and the Time Series method have a straight-line relationship. The results of the ANN Method and the FFT method do not follow closely to each other.

Fig. 4 results are like Fig 3 where the actual rainfall has sharp variations. Fig 4 results are slightly less than those of Fig. 3.

The Fig 5 shows the rainfall for the month of September. Here, their amounts are less than the ones in July and August.

Total amount of rainfall 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. The figure shows that the frequency numbers 1, 3, 12, and 13 have magnitudes greater than 4 centimetres. The presence of many frequencies results in complicated rainfall distribution.

Table 1 shows the average of past 32 years. The predicted rain amount for the year 2026 is the average of four methods. This predicted amount is greater than the average of past 32 years.

In table 2, predicted value also is less than 32 years average value. LP neuro method is slightly lower than Saran's method.

IV. CONCLUSIONS

1. Table 1 shows that this year the rain will be slightly less 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.
4. The actual rainfall values show abrupt changes.
5. LP neuro value is lower than Saran's method value.

REFERENCES

[1] The percentage of irrigated land in India is about, https://www.vedantu.com/question-answer/the-percentage-of-irrigated-land-in-india-is-class-10-social-science-cbse-5fc86b12fc3d9653700e8cd1Climate change is remaking South Asia's monsoon , https://www.economist.com/asia/2021/06/19/climate-change-is-remaking-south-asias-monsoon
[2] A drink of clean water, https://www.compassion.ca/blog/a-drink-of-clean-water/?utm_source=google&utm_medium=paid-search&utm_campaign=&utm_term=water%20crisis%20in%20india&appeal=AdWords&gclid=CjwKCAiAvOeQBhBkEiwAxutUVGq8AavDjnNVQ40Y7nspEVMF7USwEgNl4V4IlyBZEm_3pZHVp32R-hoCdiIQAvD_BwE
[3] Water Scarcity in India: A Human Crisis I India Loud & Clear I EP 7 , https://www.videovolunteers.org/water-scarcity-in-india-a-human-crisis-i-india-loud-clear-i-ep-7/?gclid=CjwKCAiAvOeQBhBkEiwAxutUVBOSCMfysLVwJi8VmTyzlYFGRyW7YkISyG5C-n6jQenI51VWPTKIghoCJSgQAvD_BwE
[4] India's water crisis: It is most acute for women - down to earth, https://www.downtoearth.org.in/blog/water/india-s-water-crisis-it-is-most-acute-for-women-78472
[5] Dependence Of Indian agriculture on monsoon, https://www.skymetweather.com/content/agriculture-and-economy/dependency-of-indian-agriculture-on-monsoon/
[6] Climate change is remaking South Asia's monsoon , https://www.economist.com/asia/2021/06/19/climate-change-is-remaking-south-asias-monsoon
[7] A drink of clean water, https://www.compassion.ca/blog/a-drink-of-clean-water/?utm_source=google&utm_medium=paid-search&utm_campaign=&utm_term=water%20crisis%20in%20india&appeal=AdWords&gclid=CjwKCAiAvOeQBhBkEiwAxutUVGq8AavDjnNVQ40Y7nspEVMF7USwEgNl4V4IlyBZEm_3pZHVp32R-hoCdiIQAvD_BwE
[8] Water Scarcity in India: A Human Crisis I India Loud & Clear I EP 7 , https://www.videovolunteers.org/water-scarcity-in-india-a-human-crisis-i-india-loud-clear-i-ep-7/?gclid=CjwKCAiAvOeQBhBkEiwAxutUVBOSCMfysLVwJi8VmTyzlYFGRyW7YkISyG5C-n6jQenI51VWPTKIghoCJSgQAvD_BwE
[9] Groundwater scarcity looms over 145 villages in Maharashtra: GSDA, 2021, https://indianexpress.com/article/india/groundwater-scarcity-looms-over-145-villages-in-maharashtra-gsda-7157890/
[10] India's water crisis: It is most acute for women - Down To Earth, https://www.downtoearth.org.in/blog/water/india-s-water-crisis-it-is-most-acute-for-women-78472
[11] Water Scarcity in India, https://www.circleofblue.org/in
[12] Southwest Monsoon 2020: Good rains now bring bad news, https://www.downtoearth.org.in/news/climate-change/southwest-Monsoon-2020-good-rains-now-bring-bad-news-71959
[13] Heavy rains lash Maharashtra, north India reels under sultry weather, https://indianexpress.com/article/cities/mumbai/mumbai-rains-Monsoon-maharashtra-north-india-weather-6490378/
[14] 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
[15] Water crisis looms in Vidarbha and Marathwada as summer arrives, 2018, https://www.hindustantimes.com/.../water-crisis...vidarbha.../story-NHSMc1JqRMbmD...
[16] Water Scarcity and Security in India, https://www.indiawaterportal.org/sites/indiawaterportal.org/files/waterscarcityandsecurityinindia_nghegde_baif_isc_2012.pdf
[17] Farmer's Suicide in Vidarbha: Everybody's Concern, http://medind.nic.in/jaw/t09/i2/jawt09i2piii.pdf
[18] Farmers' Suicides in the Vidarbha Region of Maharashtra, India a Qualitative Exploration of Their Causes, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291283/
[19] Four more Maharashtra farmers commit suicide, http://www.thehindu.com/news/national/four-more-maharashtra-farmers-commit-suicide/article6655587.ec
[20] 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
[21] .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
[22] India is already facing a water crisis—and it is only going to get worse, https://thediplomat.com/2014/04/indias-worsening-water-crisis/
[23] India's escalating water crisis -, https://www.livemint.com › Politics › Policy
[24] India's potable water crisis is set to worsen, https://www.livemint.com › Politics › Policy
[25] India's fast-growing cities face water crisis - Phys.org https://phys.org › Eart› Environment
[26] India drought: '330 million people affected', http://www.bbc.com/news/world-asia-india-36089377
[27] 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/
[28] The Thirst for Power: Hydroelectricity in a Water Crisis World, http://www.brinknews.com/the-thirst-for-power-hydroelectricity-in-a-water-crisis-world/
[29] P. Singh, and B. Borah , Indian summer Monsoon rainfall prediction using artificial neural network, Stoch Environ Res Risk Assess Vol 27:pp. 1585–1599, 2013.
[30] S. Gadgil and J. Srinivasan Monsoon Prediction: Are Dynamical Models Getting Better Than Statistical Models?, J Current Science VOL. 103, NO. 3, 10 August, 2012.
[31] T. Delsole, and J. Shukla, J. Climate Models Produce Skillful Predictions of Indian Summer Monsoon Rainfall. Geophys. Res. Lett Volume 39, Issue 9, May ,2012.
[32] T.P. Singh, V. Kumbhar,S. Das,M.M. Deshpande, K. Dhoka, Comparison of TRMM Multi-Satellite Precipitation Analysis (TMPA) Estimation with Ground-Based Precipitation Data over Maharashtra, India , Environment, Development and Sustainability, 22 (6), pp. 5539-5552. 2020.
[33] U. Saha, , T. Singh, P. Sharma, M.D. Gupta,V.S. Prasad, Deciphering the Extreme Rainfall Scenario over Indian landmass Using Satellite Observations, Reanalysis and Model Forecast: Case Studies , Atmospheric Research, 240, art. no. 104943, 2020,
[34] E. Khosla, R. Dharavath, R. Priya, Crop Yield Prediction Using Aggregated Rainfall-Based Modular Artificial Neural Networks and Ssupport Vector Regression, Environment, Development and Sustainability, 22 (6), pp. 5687-5708, 2020.

[35] Prediction of Rain in Bihar, India Based on Historical Bihar's Rain Data. http://www.engr.mun.ca/~asharan/RAINBIHAR/RAIN_BIHAR_V12.pd
[36] Rainfall Projections. http://www.imdpune.gov.in/endofseasonreport2013.pdf
[37] Sharan AM and Balasubramanian R. "Design Of Four-Bar Mechanism By Neural Network Methods". International Journal of Modelling and Simulation 19.1 (1999):
[38] "Excel - Time Series Forecasting". https://www.youtube.com/watch?v=gHdYEZA50KE
[39] Frequency Domain Using Excel, http://online.sfsu.edu/jtai/downloads/ENGR%20302/Excel.FFT.pdf
[40] Balasubramanian, R and Sharan, A. M., 1996, "LP-Neuro Method – A New Approach for Solving Neural Network Problems", Journal of Dynamic Systems, Measurement, and Control, ASME Transactions, Vol. 118, pp. 784–785.

TABLE 1: RAIN FORECAST IN CENTIMETERS FOR VIDARBHA DURING MONSOON MONTHS 2026

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
TIME SERIES	2026	31.19	26.87	25.39	28.25	110.89
FFT	2026	20.31721578	2022.00	27.16	24.65	21.08
ANN	2026	13.57	34.02	46.35	19.80	113.75
RMS (interpolated/extrapolated)	2026	19.32	40.98	9.50	17.64	96.46
PREDICTED AMOUNT BY SHARAN'	2026	nan	530.97	27.10	22.59	85.54
32 YEAR AVERAGE		18.10	33.10	26.52	18.75	96.56

TABLE 2 OVERALL RAIN PREDICTION

METHOD	VALUE (CMS)
SHARAN'S METHOD	84.5
LP NEURO METHOD	83.2
AVERAGE	83.6

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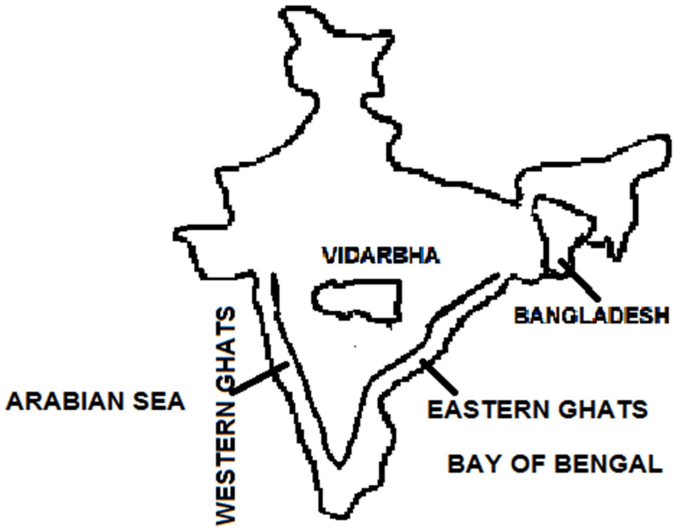
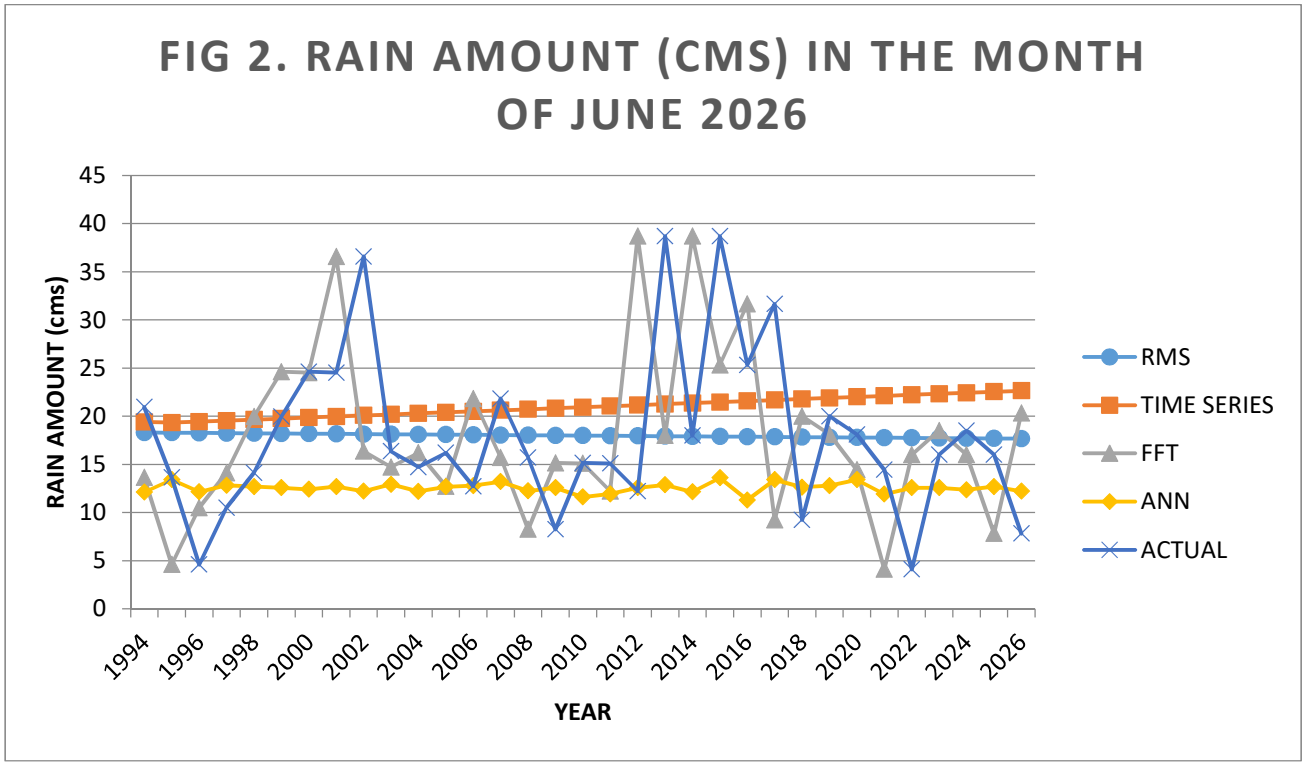


FIG. 1 LOCATION OF VIDARBHA BETWEEN EASTERN AND WESTERN GHATS



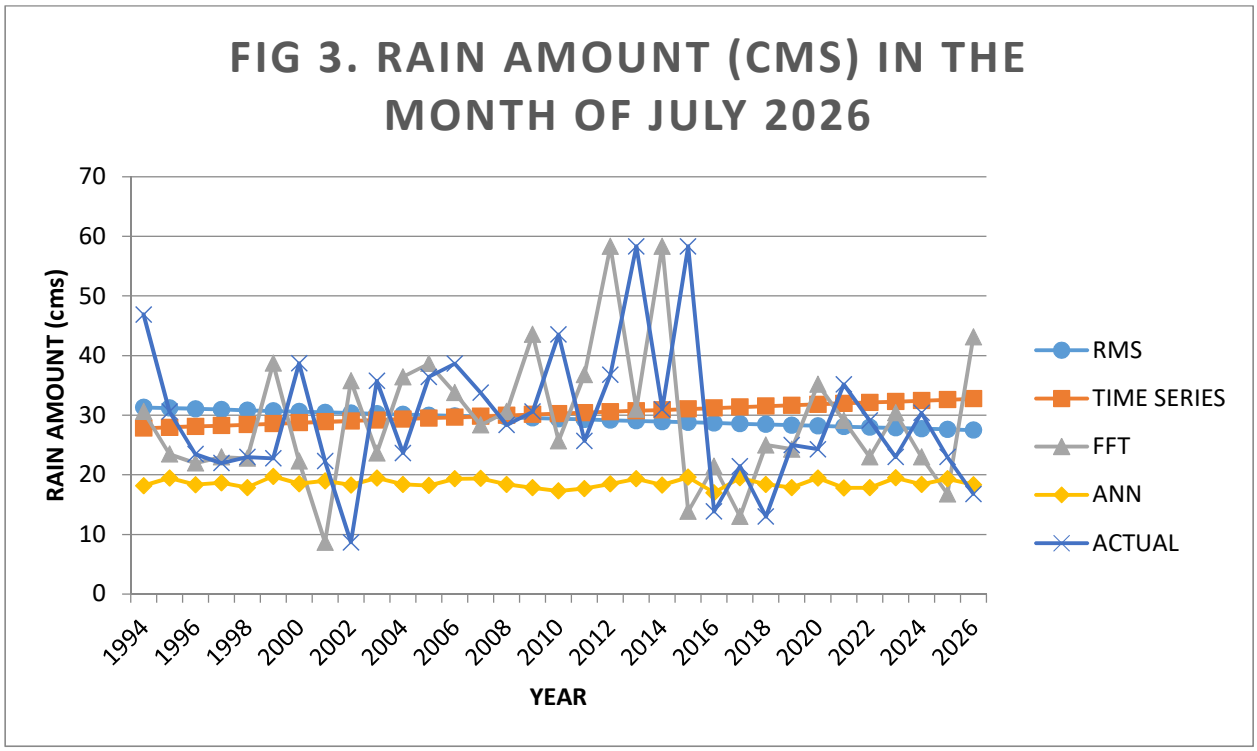


FIG 3. RAIN AMOUNT (CMS) IN THE MONTH OF JULY 2026
RAIN AMOUNT (cms)
70
60
50
40
30
20
10
0
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL

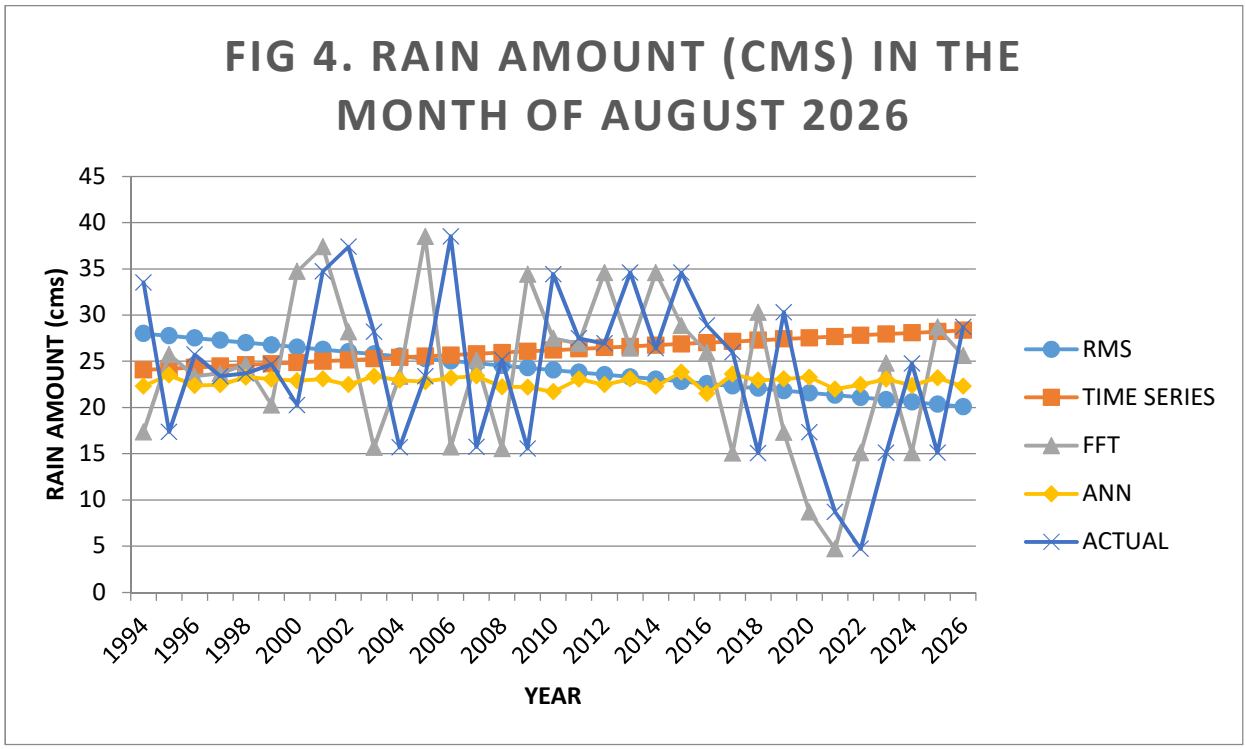


FIG 4. RAIN AMOUNT (CMS) IN THE MONTH OF AUGUST 2026
RAIN AMOUNT (cms)
45
40
35
30
25
20
15
10
5
0
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL

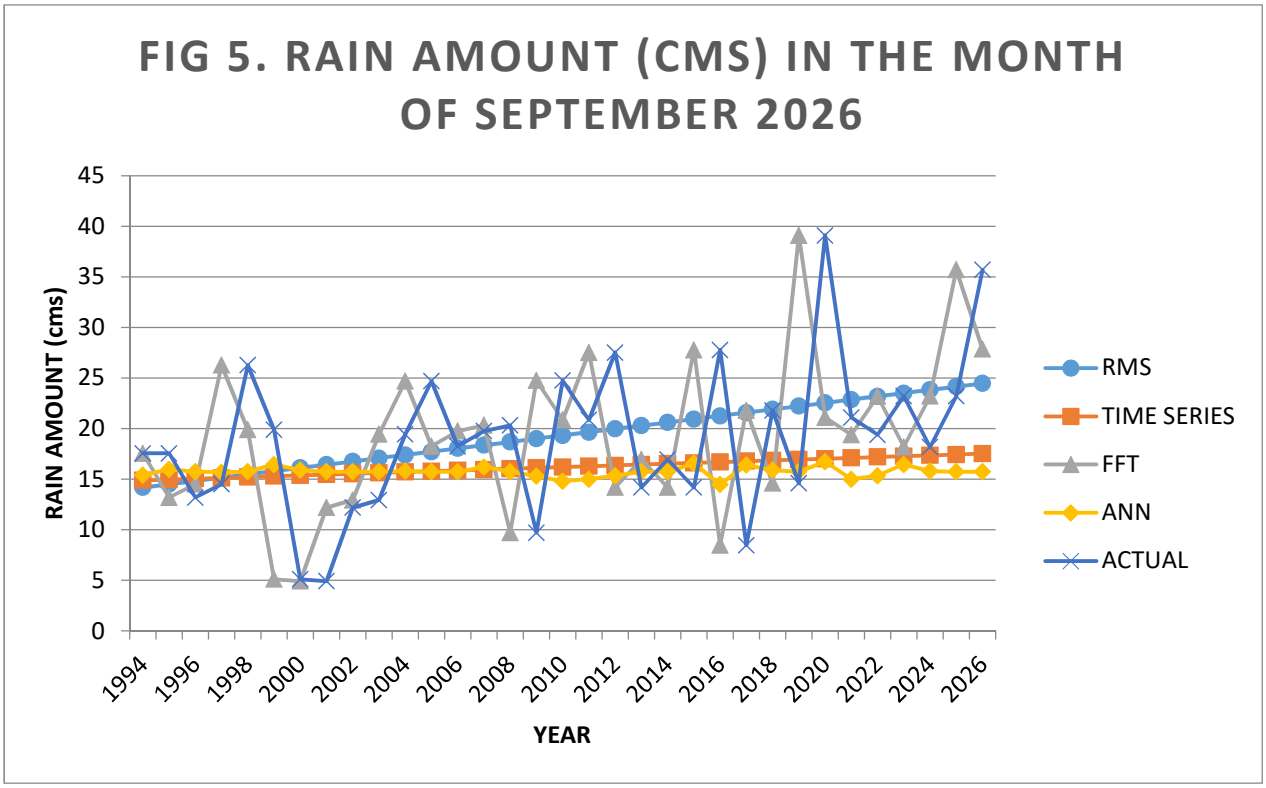


FIG 5. RAIN AMOUNT (CMS) IN THE MONTH OF SEPTEMBER 2026
RAIN AMOUNT (cms)
45
40
35
30
25
20
15
10
5
0
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL

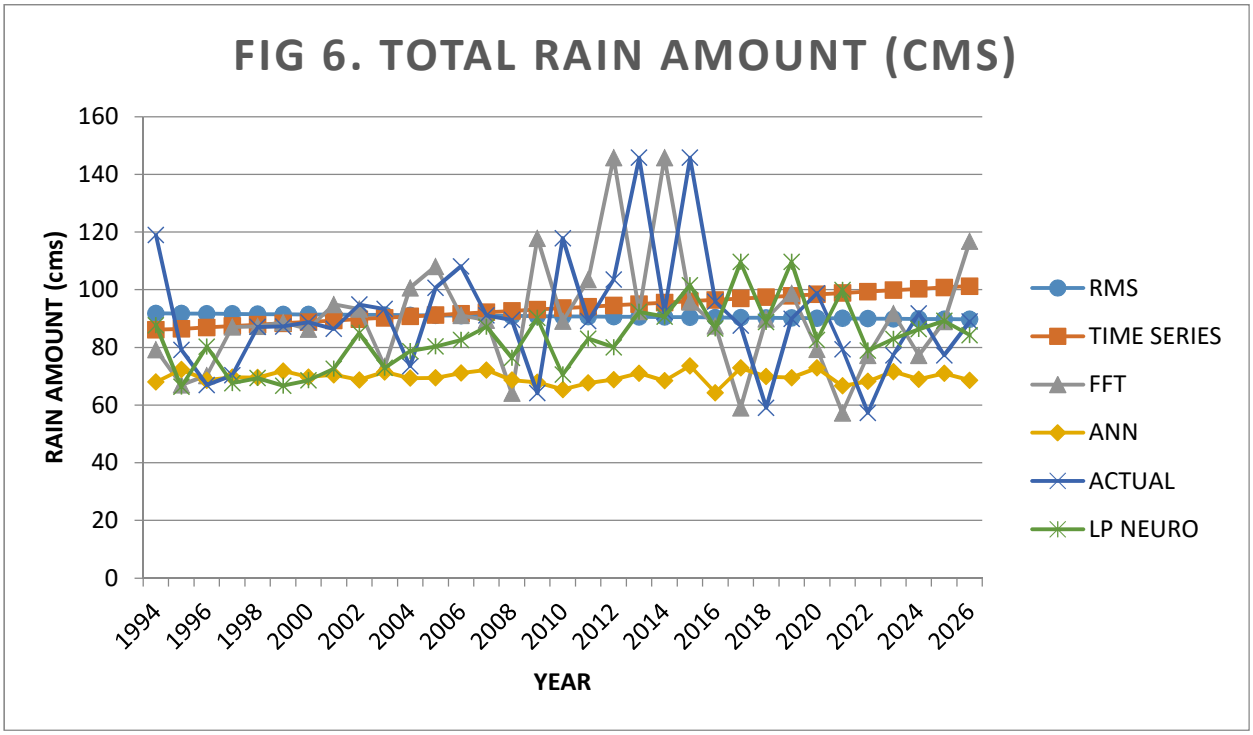


FIG 6. TOTAL RAIN AMOUNT (CMS)
RAIN AMOUNT (cms)
160
140
120
100
80
60
40
20
0
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
YEAR
RMS
TIME SERIES
FFT
ANN
ACTUAL
LP NEURO

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