

Chennai Water Crisis

PROJECT REPORT

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CONTENTS

| | |
|---|---|
| Abstract..... | 2 |
| Dataset and Insights..... | 2 |
| Rainfall | 2 |
| Mean – | 2 |
| Zeros % – The percentage of days rainfall received | 2 |
| Heat Map - | 3 |
| Reservoir level | 3 |
| Mean & Median – | 3 |
| Outliers – | 3 |
| Heat Map - | 4 |
| LSTM..... | 4 |
| Reservoir Level | 4 |
| Rainfall | 5 |
| Reasons | 6 |
| Solution | 7 |

Abstract

The city is facing an acute water shortage. Chennai is entirely dependent on ground water resources to meet its water needs. There are four reservoirs in the city, namely, Red Hills, Cholavaram, Poondi and Chembarambakkam, with a combined capacity of 11,057 mcft. These are the major sources of fresh water for the city. Chennai has been facing acute water shortage due to its lack of rainfall and mismanagement of water resources. This report briefly explains the insights, forecasting model, reasons and solution for this crisis.

Dataset and Insights

Rainfall

Data is available from 01/01/2004 to 03/12/2020.

| COLUMN NAME | DATA TYPE |
|-----------------|-----------|
| DATE | object |
| POONDI | float64 |
| CHOLAVARAM | float64 |
| REDHILLS | float64 |
| CHEMBARAMBAKKAM | float64 |

Mean –

| COLUMN NAME | MEAN VALUE |
|-----------------|------------|
| POONDI | 3.46 |
| CHOLAVARAM | 3.73 |
| REDHILLS | 3.83 |
| CHEMBARAMBAKKAM | 3.97 |

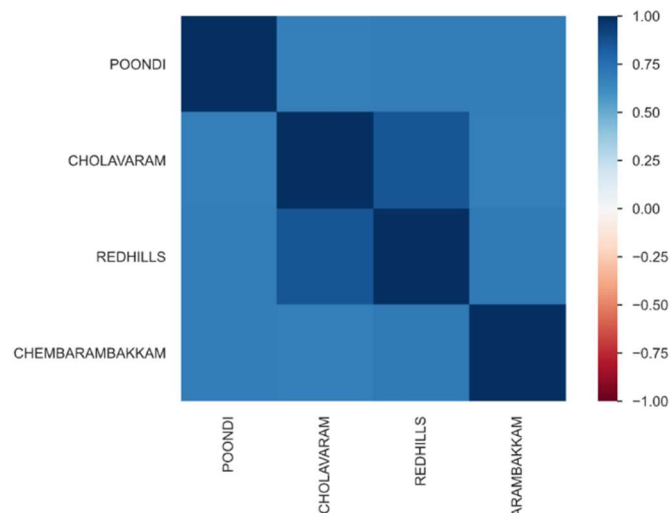
We can infer that the Chembarambakkam received maximum mean rainfall.

Zeros % – The percentage of days rainfall received

| COLUMN NAME | ZERO PERCENTAGE (%) |
|-----------------|---------------------|
| POONDI | 79.65 |
| CHOLAVARAM | 81.88 |
| REDHILLS | 80.60 |
| CHEMBARAMBAKKAM | 81 |

We can infer that Poondi has received rain on a greater number of days.

Heat Map -



This heat map shows the co-relation of rainfall at the different places. Redhills and Cholavaram has highest co-relation (Ignoring same variable correlation)

Reservoir level

Mean & Median –

| COLUMN NAME | MEAN | MEDIAN |
|-----------------|---------|--------|
| POONDI | 1106.74 | 783.15 |
| CHOLAVARAM | 226.4 | 89 |
| REDHILLS | 1592.32 | 1685 |
| CHEMBARAMBAKKAM | 1321.46 | 1264 |

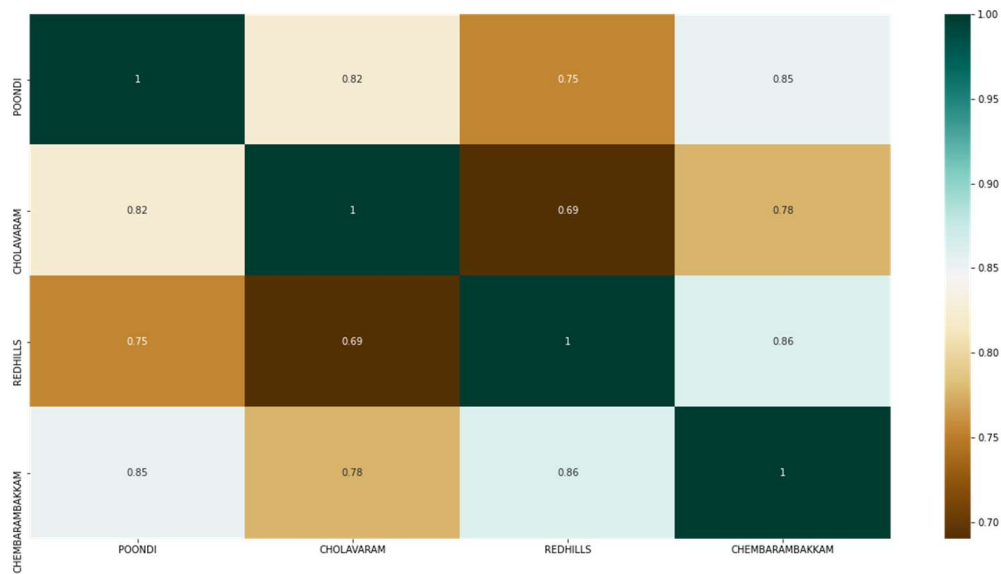
We can infer that the Redhills reservoir has maximum water level.

Outliers –

| COLUMN NAME | OUTLIERS |
|-----------------|----------------------------------|
| POONDI | Fair number |
| CHOLAVARAM | More outliers |
| REDHILLS | Very less outliers |
| CHEMBARAMBAKKAM | Above average number of outliers |

We can infer that Redhills data is more equally distributed.

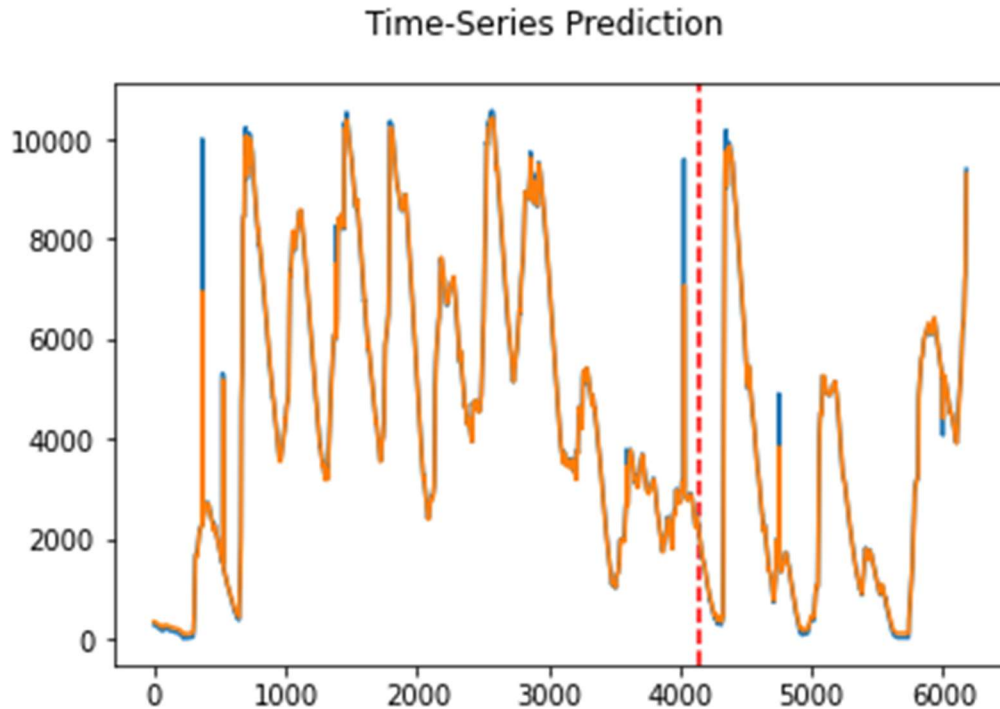
Heat Map -

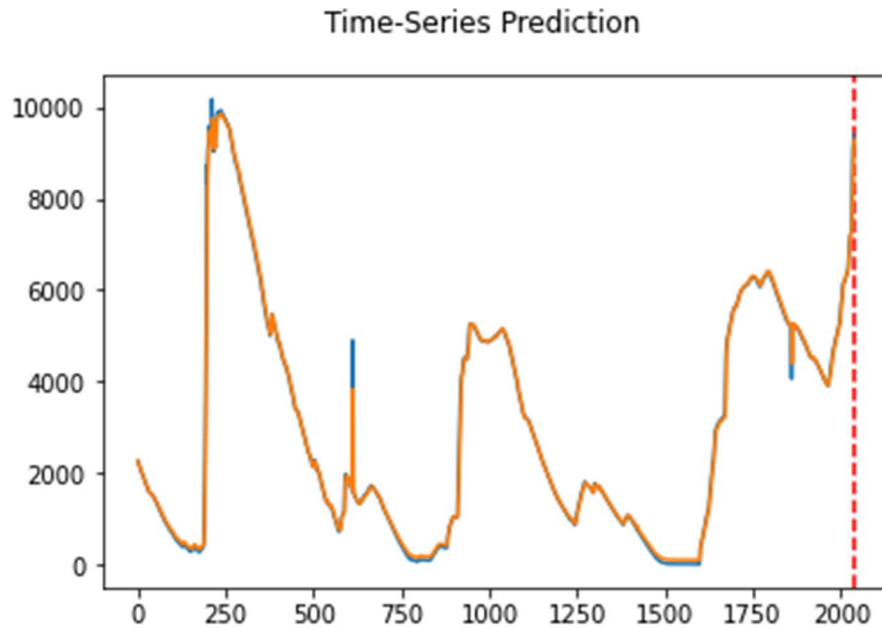


From the heat map we can infer that Poondi is highly correlated with Cholavaram.

LSTM

Reservoir Level

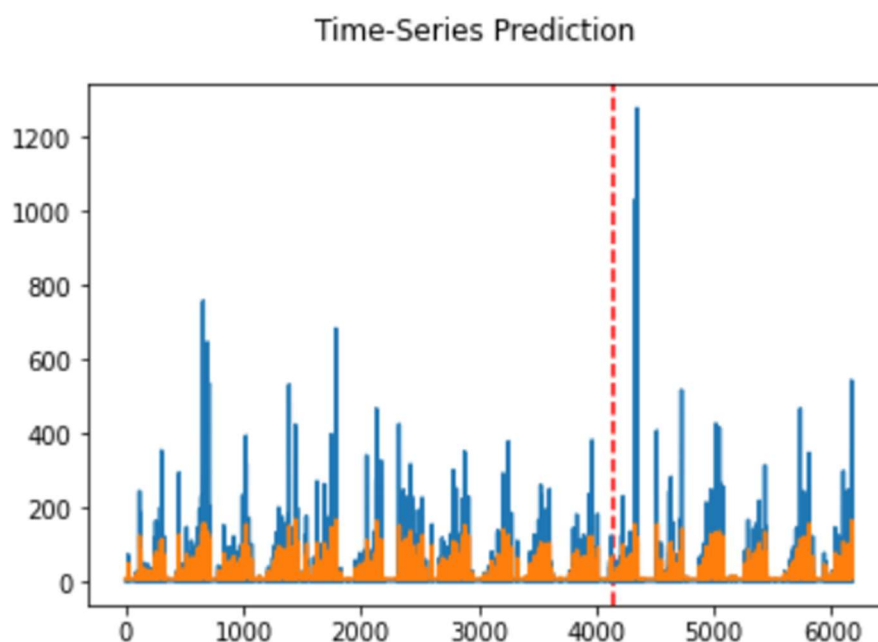


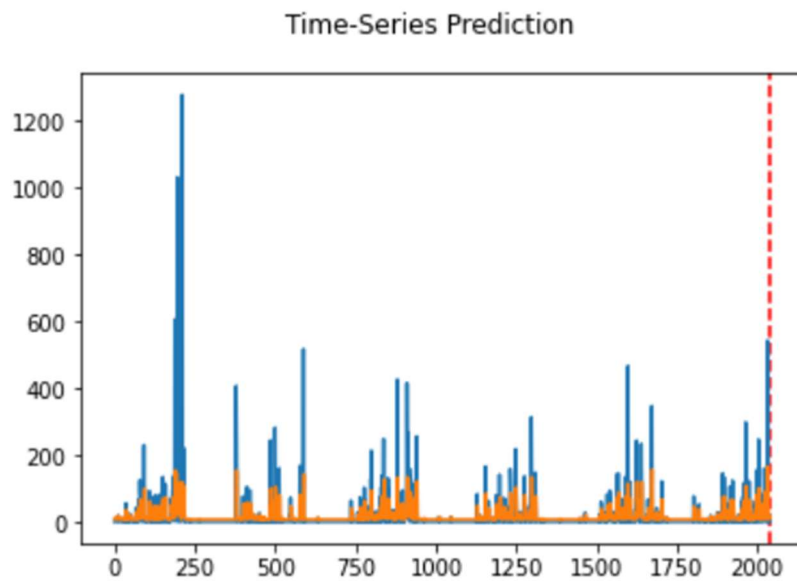


The above images are the LSTM graphs with respect to reservoir levels. The first image is the result of the LSTM model on the training data and the second image is the result of the LSTM model on the test data.

The blue line corresponds to the actual water level in the reservoirs while the orange line corresponds to the LSTM prediction. The orange line in both images, almost superimposes the blue line and hence we can say with confidence that the prediction accuracy of this LSTM model is above 90%.

Rainfall





The above images are the LSTM graphs with respect to rainfall levels. The first image is the result of the LSTM model on the training data and the second image is the result of the LSTM model on the test data.

The blue line corresponds to the actual rainfall level while the orange line corresponds to the LSTM prediction. The accuracy for this LSTM model is around 60 %.

Reasons

From the trend of the reservoir levels over the years, we can say with surety that the reservoir levels have been reducing. This is a bad situation. The rainfall and reservoir levels are correlated. Just by looking at the two datasets – reservoir levels and rainfall, we can make infer a few reasons as to why the water levels in the reservoirs are reducing.

- Failure of North-East Monsoon – Chennai's reservoirs are highly dependent on the North-East monsoon which usually sets in the last week of October. From the reservoir levels dataset, it is quite clear that the reservoir levels are maximum during the North-East monsoon period. The city gets maximum rainfall from the North-East monsoon. So, failure in the North-East monsoon leads to

serious water crisis in the city. The North-East monsoon has not always been consistent in the city. This inconsistency is also one of the main issues with reservoir levels dropping.

- Though Chennai receives most of its rainfall from the North-East monsoon, Chennai does receive some rain during other times of the year as well. We can understand that its poor maintenance of the reservoir and lack of water conservation practices that has caused the reservoirs to dry up rapidly.

Other reasons

- The population of Chennai has risen by 50.68 % from 2004 and is expected to go up by 110.10 % by 2035. This is a scary figure. People use water extensively and with the rise in population and mismanagement of the main water resources, one can only expect water shortage and scarcity.
- The scarcity of water has seen the city's main reservoirs run dry. Borewells are depleted and the groundwater levels have fallen sharply. Tankers have become the primary source of water for the population.

Solution

- Protecting the North-East Monsoon rain water – Chennai receives almost 450 mm of rainfall from the North-East Monsoon. This rain water must be protected and not wasted.
- Better Maintenance of reservoirs – Poor maintenance of reservoirs, have also been one of the reasons for their depletion.
- Improve rainwater harvesting methods – As it is, Chennai receives most of its rainfall in the later part of the year. With poor rain harvesting methods, there is a lot of wastage of rain water leading to increase in dependency on reservoir water. With improvement in rain water harvesting methods, rain water can be conserved and reduce the pressure on reservoirs.