SOLUTION TO CHENNAI WATER CRISIS

PROJECT REPORT

Submitted for the course: Technical Answers for Real World Problems [CLE3999]

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CERTIFICATE

This isto certify that the project workentitled **"SOLUTION TO CHENNAI WATER CRISIS "** that is being submitted by **"VIBUDH TIWARI, ILA HARI, MALAVIKA ANIL, SHASHANK GOSWAMI, RAHUL SASIKUMAR, LALIT DONGARE, ABBAS JAHANGIR and IVSEN KARKI"** for **Technical Answers for Real life Problems (CLE3999)** is a record of bonafide work done under my supervision. The contents of this project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Place: Vellore

Date: 09-04-2019

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ABSTRACT

This study attempts to know the reasons behind the Chennai water crisis and to suggest new innovative ideas to prevent the same from occurring in other places. The 2019 crisis is a wake-up call for Chennai and other cities in India. With cities being the powerhouse of the economy, much more is required to make them sustainable and liveable. Government mismanagement and unplanned construction has also been a factor to blame for the crisis. A lack of rainwater and groundwater has left four of the reservoirs that supply the city completely dry.

INTRODUCTION

The 2019 Chennai water crisis is an ongoing water crisis occurring in India, most notably in the city of Chennai in Tamil Nadu. On 19 June 2019, Chennai city officials declared that "Day Zero", or the day when almost no water is left, had been reached, as all the four main reservoirs supplying water to the city had run dry. Chennai's aspirations to grow into a global economic hub appear considerably weakened as it struggles to find water. The shadow of drought from 2018 has stretched into the torrid summer this year, evaporating not just the city's reservoirs, but the prosperity of its residents who are forced to hunt for tankers, pay bribes and spend hours even at night waiting for trucks to dispense some water. Millions of people are without consistent access to water.

A lack of rainwater and groundwater has left four of the reservoirs that supply the city completely dry. The inability to meet demand for water has forced businesses like hotels and restaurants to close. Water tankers from areas of Tamil Nadu unaffected by drought have been bringing water into some areas of the city. However, government tankers can take up to a month to appear after requested, so some families, wealthy residents, and business owners have opted to pay for costly private water tankers. The poor who live in slums do not have this option; a family in Chennai's slums may receive as little as 30 litres (7.9 US gallons) of water every day compared to an average American household which uses 1,150 litres (300 US gallons) of water a day. Many fights over water have also broken out as a result of the conflict. In one such conflict that occurred on 15 June 2019, a woman was stabbed and the perpetrator was turned in to the police

OBJECTIVES

- Study in detail about the reasons that lead to the major crisis of water in and around Chennai.
- Study the present water condition in the area.
- Analyse the geographic location of the city and suggest measures to harvest water from various sources.
- Come up with feasible ideas to make use of water available in an efficient manner.
- According to studies, various parts of India are going to face the same fate in future if water is not managed properly. Suggest ways to prevent this from happening.

METHODOLOGY

1. Studying the reason why it occurred in the first place through:
   - Local & official interaction
     | Discussion with officials of Chennai Metro Water board |
   - Already published articles / reports.

2. Study the present condition through:
   - Ground survey
     Talk to those who have been affected by this
   - Photography / videography
     Record the current situation
   - Understand govt. policies/schemes to come out of it

3. Analyse the geographic location of the city and suggest measures to harvest water from various sources:
   - Study different reservoir: team will be divided in 4 parts to study 4 different reservoir of Chennai city
   - Geotag high affected areas
   - Geotag water sources in-and-around Chennai

4. Come up with feasible ideas to make use of water available in an efficient manner
   - Suggest innovative ideas based on previous studies
5. Suggest innovative ways to prevent water crisis from happening in other cities

- Data collection
  Study from various reports and journals about the cities which are prone to water crisis
- Put forward ideas and schemes based on the study

REASONS

a) Submission of detailed report on government response

- The Madras High Court criticised the Tamil Nadu state government led by the AIADMK for serious mismanagement of water resources in Tamil Nadu. The government of Tamil Nadu submitted a detailed report about the water situation. In the report submitted by the Chennai Metrowater Supply and Sewerage Board (CMWSSB), it stated that since Northeast Monsoon failed in 2017 drying up the lakes, the water supply to the city was reduced from 830 MLD to 525 MLD from June 1, 2017. The state government responded that the present water crisis happened due to monsoon failure and that steps are being taken to set up 270 purification centres which will supply 270 MLD of water.
- Arguing for government of Tamil Nadu, the Advocate General also said that Cholavaram lake has been desilted at a cost of Rs 38 lakh and that as soon as the third desalination unit starts operation, Chennai need not depend on monsoon for its water needs.
- Following this, the judges ordered Public Works Department to collect information from all the districts about the orders issued to rid water bodies of encroachments and desilt them and posted the case for June 27.

b) Impact of rainfall

- Chennai has historically relied on annual monsoon rains to replenish its water reservoirs since the rivers are polluted with sewage. Two years of deficient monsoon rainfall, particularly in late 2017 and throughout much of 2018 had led to this crisis.
- The 2018 northeast monsoon season was one of the driest ever recorded in Chennai, as only 343.7 mm of rain had fallen compared to an average of 757.6 mm, which was a 55% rainfall deficit. Additionally, the entire state of Tamil Nadu had recorded a 23% rainfall deficit in that season.
- NASA's Earth Observatory released the "before" (May 31, 2018) and "after" (June 19, 2019) satellite images of Puzhal Lake. It is a rain-fed lake in the southern state of Tamil Nadu and is one of four reservoirs that serve the city of Chennai. The satellite images are from the Operational Land Imager on Landsat 8. As of June 21st, the four reservoirs were at 0.2 percent capacity

according to the NASA Earth Observatory website. Lack of forest cover : urbanization and increasing construction significantly reduces forest cover and thereby reducing the amount of rain received.

c) Pollution of lakes in and around Chennai
   - Dense green waters lap the shores of the Ambattur Lake in Chennai. Spread across 400 acres, the lake is a major source of water for the city of Chennai. But activists now allege that Ambattur Lake is polluted, with sewage and waste being dumped into the waterbody.
   - Arappor Iyakkam, a non-government organization which works for social causes, conducted a survey and found that sewage from residential areas flows directly into the lake, polluting it.

d) Unplanned urban development & lack of sufficient government schemes
   - Unplanned infrastructural development and lack of government regulation. Implementation of existing rules under expert supervision in this sector is resulting in depleting ground water levels. Such infrastructural growth is also hampering the groundwater replenishing process.
   - No political Will
     There has been no political will to address the problem comprehensively. Politicians rely on the monsoon and when it is late, as it is this year, and when the rainfall is inadequate, as it has been for several years, there are no policies in place to compensate for the shortfall.
   - Chennai City Population Growth
     Chennai's population has increased from 500,000 to more than 10 million over the last century. Its economy and appetite for water-intensive industry, products and agriculture have grown in-step with population. According to WRI's Aqueduct Water Risk Atlas, Chennai faces extremely high baseline water stress, meaning that on average more than 80% of the available water supply is used up every year by agriculture, industries and consumers. Government has done nearly nothing to avoid a water crisis due to this in future.
   - Water Bodies not Preserved
     The restoration and proper maintenance of reservoirs and lakes and tanks in the city has been in the picture for the past two decades. There have been poor efforts to desilt and restore the water bodies. As for the restoration of water bodies, in its latest submission to the Madras High Court on the water scarcity, Chief Engineer of the Chennai Metro Water Supply and Sewerage Board submitted that only five water bodies of the 210 in the city have been restored.

- Government occupied the areas
  Government occupied the areas in and around the lakes for construction activities. Construction around lake leads to pollution and eventually made it difficult to use the water from these lakes. One such construction was done on the Nungambakkam Lake during the 1970s to build a monument called Valluvar Kottam dedicated to Thiruvalluvar.

IMPACTS

a) Impacts On Lives Of People
   - The residents are now given minimum piped water and meagre tanker supplies totalling a third of the installed capacity of 1,494 million litres a day, that too mainly from desalination plants, faraway lakes and farm wells, is proof of the neglect of water governance.
   - Millions of people are without consistent access to water.
   - The government tankers can take up to a month to appear after requested, so some families, wealthy residents, and business owners have opted to pay for costly private water tankers. The poor who live in slums do not have this option.
   - Many fights over water have also broken out as a result of the conflict. In one such conflict that occurred on 15 June 2019, a woman was stabbed and the perpetrator was turned in to the police.
   - Residents from prime localities like Triplicane, Alwarpet and Mylapore have started shifting homes in search of water.

b) Impacts On Industries In And Around The City
   - The inability to meet demand for water has forced businesses like hotels and restaurants to close.
   - Companies in the the IT-hub of Old Mahabalipuram Road (OMR) have started asking their employees to work from home. According to reports over 60 per cent of the daily 3 crore litre water distributed in OMR is used by IT companies.
   - Companies like Hyundai, brought back "dry wash" car cleaning service in the service stations, so that customers can get their cars cleaned through an eco-friendly process which can save up to 120 litres of water for each car.
   - Doctors are forced to buy water for surgery.
   - Chennai flood’s effect is largely seen on the real estate sector too. On account of water shortage, many construction players have slowed down their activities and operations. However, this crisis has also provoked those in operations to come up with innovative ways to keep the sector going.

STUDY OF EXISTING GOVERNMENT PLANS

a) Saving water bodies:
    - Hundreds of the city's water bodies, long presumed dead, are being brought back to life. A massive community effort overseen by the city's Corporation is underway, involving tens of organisations and individuals. Only, it didn't come up as a response to the current shortage problem, but the exact opposite of it, the floods. This all started in November of 2015.
    - The Corporation of Greater Chennai identified 210 dead water bodies and did something unprecedented; it put details of them all on its website and called for volunteers. The Corporation would sign the cheque, but the volunteer would do the job, mobilise men and machines, clear the clogs, de-silt the lake and deepen it, de-block the inlet and outlet runnels, cement-up the banks, line the lake with trees and fence it.
    - Tens of organisations, local bodies, corporate's, NGO's, residential associations came forward to do it.
    - Today, the work is mostly over, and the city abounds with shimmering ponds and lakes. Commissioner G Prakash says the rehabilitation of all the 210 water bodies would be over in a few months.
    - And then there are corporates who are doing up lakes in the vicinity of their establishments, as part of their CSR (corporate social responsibility) programmes. The Danish multinational, Danfoss, for example, has done three, and plans more. Car maker Hyundai has done one, in Velakottai village near its plant. Many of these projects are run with corporate funds by the Confederation of Indian Industry, with the aid of consultants.

b) Some NGOs have taken up the job.
    - Notable among them is The Nature Conservancy, a US-based NGO, which is working on the Sembakkam lake, a 100-acre water body that can hold 10 million cubic feet of water—completely choked with water hyacinth. So far, according to the project director, Dr M Nisha Priya, 10,000 tonnes of the weed have been removed and de-silting work is underway.
    - Even when all these get completed, the work would just have begun. If you consider not just the city but also the adjoining areas, which could provide water to the city, there are 3,600 water bodies, according to resilientchennai.com, the website of Resilient Chennai, part of the 100 Resilient Cities project of the Rockfeller Foundation. Deepen them, link them up, they become the city's water reserve.
    - Commissioner Prakash says that 'water bodies' is but one of the prongs of attack.

c) The city, has 6,000 km of roads, and the rains falling on them just runs off. Solution? Water absorption pits. Some 8,000 of them are now in place, Prakash wants to do 15,000 more by the year end, and eventually, 50,000. And, why not get 'large properties', such as college campuses and wedding halls, put in their own absorption pits and trenches? Around 200,000 such properties have been identified, says Prakash.

d) An additional layer of security. The city now has two sea water desalination plants, which cater to 15 per cent of the needs. One more is to come up. Furthermore, the city could get some help through the canal that brings in water from the Krishna river up north, whenever the government of Andhra Pradesh wishes to.
Therefore, in future, floods and droughts will not affect the city.

e) Water wagons: A 220 km train runs from Jolarpettai to Chennai carrying water every day. It costs the government 65 crore per day. The 50 wagon train makes four trips daily to supply 10 ml of water.

f) Offers from other states: Government has accepted Kerala's offer to provide 20 lakh litres of water per day. Also, the Cauvery Water Management Authority also ordered Karnataka to release water to Tamil Nadu. The govt. authorities have decided to approach Andhra Pradesh for seeking its share of water from the Krishna River.

INNOVATIVE IDEAS TO FIGHT AGAINST WATER SCARCITY

1) Floating Solar Panels
    - The Uttar Pradesh cabinet chaired by Chief Minister Yogi Adityanath has cleared a floating solar power plant on Rihand Dam with an investment of Rs 750 crore. It will be the first water surface floating solar power plant of Uttar Pradesh and biggest in the country.
    - Even though the initial cost of installation of floating solar system is higher than ground-mounted PV systems, its ability in reducing water evaporation in drought stricken areas is highly valuable. Floating solar on water technology is an eco-friendly way towards water conservation and generation of green power.
    - There are many water reservoirs in and around Chennai city. We can install floating solar panels in these water bodies.
2) Inverted umbrella that purifies rainwater, lights up park
    - With the civic polls drawing closer, political parties are betting big on green projects to impress voters. In Santa Cruz, the BJP has collaborated with green tech start-up Think Phi for the Ulta Chaata, a device built to resemble an inverted umbrella that collects and purifies rainwater to make it potable and usable in agriculture.

- Can be used to store up to 40,000 liters of water. The Ulta Chaata, designed to harvest solar energy as well, collects rainwater and puts it through a five-step filtration process.

3) Canal Solar Power PROJECT
    - The Canal Solar Power Project is a project launched in Gujarat, India, to use the 19,000 km long network of Narmada canals across the state for setting up solar panels to generate electricity. It was the first ever such project in India.
    - Setting up solar panels in canals will help decrease evaporation from them as well as generate power.
4) Smart Water Metering Technology
    - Smart water metering technology, enabling residents to monitor their water usage online. Smart meters provide users with more detailed information about how water is being used and in what quantities.
    - It allows household*s* to get a better hold on their water usage each month and encourages residents to install water efficient appliances and other water-saving technologies in their homes. It also helps customers pinpoint leaks that cause increased usage.
5) Improve Agriculture Efficiency
    - Agriculture is the biggest consumer of water resources around the world, and India is no exception. Improvements in irrigation efficiency can increase available water resources for other sectors, including municipal users. Although many of India's farmers, most of whom are small scale, cannot implement high-cost irrigation systems, new financing models can help.
    - City governments could explore and implement policies to invest in and improve rural irrigation systems. If this is implemented then we can conserve hug amount of water from agriculture that goes to waste and can be used in different cities.
6) Open Data
    - Part of the problem is that the government does not provide open and transparent data on water resources and uses, such as the extent of water pipes and how much water flows through them every day. More research and analysis could be done with open data, which could help lead to better solutions. Many experts in the industry and academia would be able to pool their thoughts and ideas if data were made available to them.
7) Desalination Plants
    - At present there are 2 desalination plants in Chennai – Minjur and Nemmeli . Minjur plant started operating on 25th July 2010 and Nemmelli on 22nd February 2013. The construction of a third plant has started.

8) Shade balls
    - They are made of plastic resistant to high temperatures (120-180° C) with a diameter of four inches and weighing 245 grams
    - These shade balls have a diameter of about 4 inches and a unit cost of 36 cents. Given that the spheres are generally uniformly grouped, we can calculate the coverage area cost per acre of reservoir to be US$179,800.
    - Roughly speaking, the capital cost in the first year of a photovoltaic installation per acre is triple that of one shade ball application. But, unlike shade balls, solar panels have a lifetime guarantee from the manufacturer (with up to 80 percent efficiency for about 25 years). Meanwhile, the shade balls have to be replaced every 10 years.
9) Chemically enabled shade balls
    - We can add an adsorbent layer on the ball which will adsorb all the heavy metals present in the water like Mg , Ca, etc.
    - It also will help reducing the cost of water treatment.
    - The increase in price of the shade ball will not go higher than 5 rupees.

METHODS TO PREVENT WATER CRISIS

a) Improved Infrastructure
    - It includes all the infrastructure used to build, pump, transport, divert, store, treat, and deliver safe drinking water, as well the tools and equipment used to build them.
    - These structures include groundwater wells, dams, storage tanks, surface-water intakes, pipes, drinking-water facilities, and aqueducts. With poor water infrastructure inevitably comes water scarcity. This is why it is important for us to improve the quality of our water infrastructure be it natural or artificial.
    - Infrastructure also encompasses natural infrastructure which makes use of landscape management techniques such as conservation, restoration, and sustainable management.
    - These techniques provide basic water services such as flood control, aquifer storage and recharge, and providing a clean and abundant supply of water.
    - Improved infrastructure will not only reduce the amount of clean water being wasted but will also help reduce the number of persons constantly searching for clean water on a daily basis
b) Sustainable water management
    - Improving water infrastructure must be a priority, as water conservation and efficiency are key components of sustainable water management.
    - Solar desalination and smart irrigation systems are great examples of clean technology for water efficiency and control.

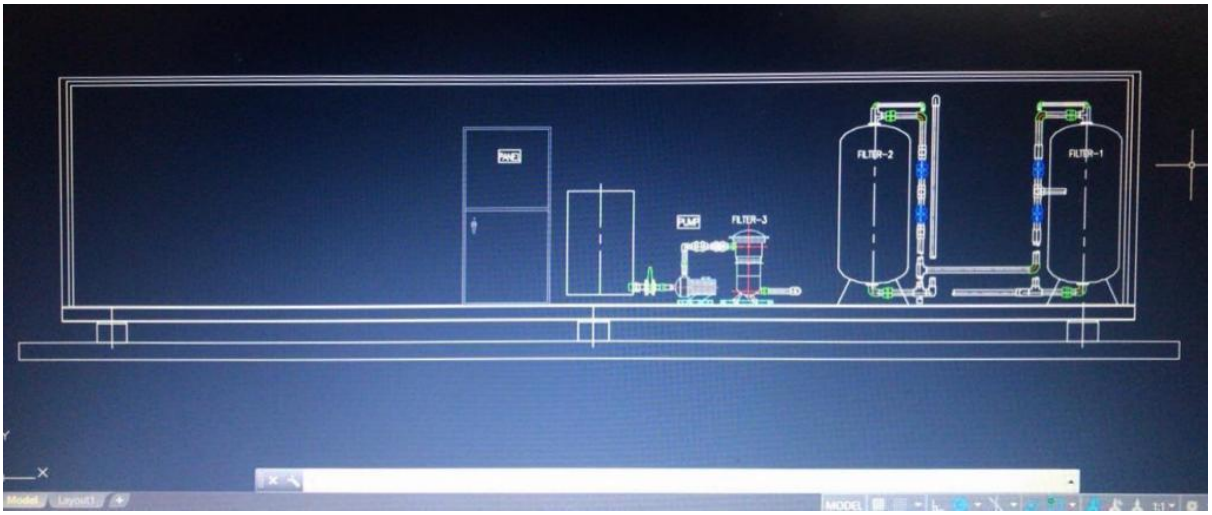
- That obviously applies even more to the agriculture and farming sector - the largest consumer of water.

c) Reclaimed water
   - Rainwater harvesting and recycled wastewater also allows reducing scarcity and easing pressures on groundwater and other natural water bodies.
   - Groundwater recharge, that allows water moving from surface water to groundwater, is a well-known process to prevent water scarcity.

d) Pollution control & better sewage treatment
   - Without proper sanitation, the water becomes full of diseases and unsafe to drink. That is why addressing pollution, measuring and monitoring water quality is essential.
   - Besides, improving the sewage systems in specific areas is another way to prevent water scarcity from becoming any worse.

e) Awareness & Education
   - Education is critical to solve the water crisis. In fact, in order to cope with future water scarcity, it is necessary to radically reform all forms of consumption, from individual use to the supply chains of large companies.

Fig : Desalination plant in 2D



CONCLUSION

Water scarcity is the lack of fresh water resources to meet water demand. It affects every continent and was listed in 2019 by the World Economic Forum as one of the largest global risks in terms of potential impact over the next decade. It is manifested by partial or no satisfaction of expressed demand, economic competition for water quantity or quality, disputes between users, irreversible depletion of groundwater, and negative impacts on the environment. A mere 0.014% of all water on Earth is both fresh and easily accessible. Of the remaining water, 97% is saline and a little less than 3% is hard to access. Technically, there is a sufficient amount of freshwater on a global scale. However, due to unequal distribution (exacerbated by climate change) resulting in some very wet and some very dry geographic locations, plus a sharp rise in global freshwater demand in recent decades driven by industry, humanity is facing a water crisis. Demand is expected to outstrip supply by 40% in 2030, if current trends continue.

From this study we have learnt and analysed the different reasons for water scarcity and the impacts of the same on people and their lives. We have also suggested various solutions to overcome the activities and preventive measures to be taken.