Global Journal of Researches in Engineering: E
Civil And Structural Engineering
Volume 22 Issue 1 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Blue Covenant: Strategies for Managing Water Stress in Dwarka, New Delhi, India

By Angel Steffy Thomas

Abstract- Water is an indispensable resource available on earth for all living beings. A decline in the quality and quantity of water is now a global issue of concern. Due to the increasing demand controversy can be seen over command and sharing over water. Hence water stress is a complex issue which deserves urgent global attention and actions. Water stress refers to the ability, or lack thereof, to meet human and ecological demand for water. Therefore, this research aims to understand the reasons for water stress through different summits, policies and case studies. The main focus of this research is to frame strategies for waster stress management in Dwarka, Delhi, India. It is also known for being the largest sub-city in Asia with a potential for further development. Dwarka is already facing water stress and further development will only add to the tension on water supply and its availability in future. In-depth research is done on the existing water infrastructure and the potential to reduce water stress in Dwarka. Based on these studies strategies and proposals were formed to effectively reduce water stress in Dwarka. This study will help in planning for an area concerning the available resources. The outcome of this study is to practice different short and long term goals which can be followed to reduce the intensity of water stress and less dependency on the available resources.

GJRE-E Classification: DDC Code: 333.91 LCC Code: TD345

Strictly as per the compliance and regulations of:

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I. Introduction

India is in the grips of an unprecedented water stress with majority of its western areas under drought-like conditions. Taps are running dry in both rural and urban parts of the country. According to Composite water management index (CWMI) a report by NITI Ayog which claims that 21 Indian cities will run out of groundwater by 2020. Meanwhile, in the national capital Delhi, which recently saw mercury rise above 48*C. Apart from recent heatwave, depleting groundwater levels are among the reasons for the diminishing supply in these areas. Since Dwarka being Asia's largest sub-city and largest residential suburb which has a total of 1718 residential enclaves. Hence a detailed water stress management strategies is necessary for Dwarka, Delhi. The outcome of this study is to practice different short and long term goals which can be followed to reduce the intensity of water stress in Dwarka, Delhi.

Author: *Architect and Urban Planner, New Delhi, India.*
e-mail: angelthomas0812@gmail.com

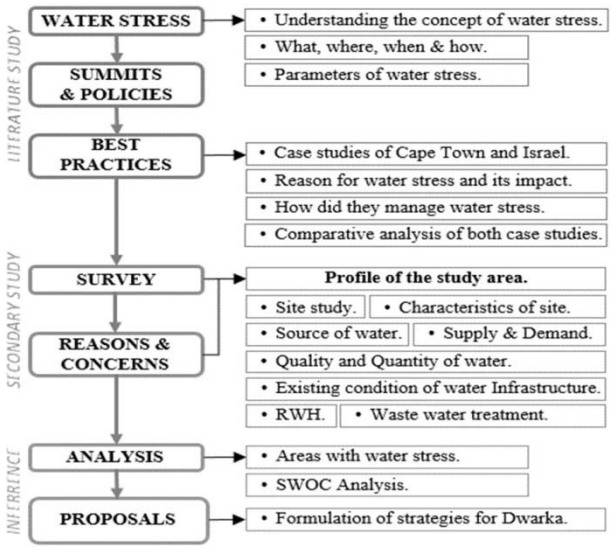


Fig. 1: Methodology

II. Water Scarcity and its Factors

a) Physical Factors

Geology which includes location of water storage, aquifers and ground water. **Climate** which includes change in rainfall, snowfall and rates of evaporation and **Water bodies** which includes change of water course, can dry up, pollution of water bodies.

b) Human Factors

Pollution of water supplies by discharge of untreated raw sewage from industries and households, agriculture runoffs, **Human littering. Overuse of Water.**

c) Economic Factors

Population which includes increase in population, demand and supply. **Urbanization** as it has an impact on the physical environment.

III. World Summits on Water Conservation and Policies

a) World Water Summits I

It was held in New on 21-23 August 2018. It focused on Nature for Water- Solution to the Water Challenges. It will synergies between water security and economic prosperity, finance and technology to deliver clean and safe water solutions for both industries and utilities.

b) World Water Summits II

It was held in Geneva on 7-8 February 2018. It focused on Leaving No One Behind. It provides a dynamic platform for bringing real projects and funders together in an engaging manner.

c) World Water Summits III

It was held in New Delhi on 24-26 August 2019. It focused on water management locally and globally. It will initiate an interaction between water security, economic prosperity, finance and technology to deliver water solutions for both industries and utilities.

d) Salient Features of National Water Policy (2012)

Emphasis on the need for a national water framework law. Water, after meeting the basic needs for safe drinking water and sanitation, food security, agriculture and high priority allocation for minimum eco system needs, be treated as economic good to promote its conservation and efficient use. Ecological needs of the river should be determined portion of river flows should be kept aside to meet ecological needs. Adaptation strategies in view of climate change for designing and management of water resources structures. Setting up of Water Regulatory Authority. Removal of large disparity in stipulations for water supply. Water resources projects and services should be managed with community participation.

IV. Case Studies: Cape Town and Israel

Cape Town is a port city on South Africa's southwest coast, on a peninsula beneath the Imposing Table Mountain. It is the legislative capital of South Africa. The city is known for its harbor. In 2015, the City of Cape Town won a prestigious international award recognizing their efforts at Water Conservation & Demand Management (WCWDM). It successfully reduced water use by more than 50% during drought from 2015 to 2018. 2019 was a recovery year after having successfully emerged from severe and unprecedented drought. Israel belongs to the Asian continent. Israel was once battling its worst drought but now is one of the water exporting countries due to technological advancements and water conservation measures. Despite being 60% desert and lacking perennial sources of water. Israel become world's leader in water conservation, reuse and recycling approximately 80% of its water.

Table I: Comparative analysis between two case studies: Cape Town and Israel

Parameter	Cape town	Israel	Remarks
Topography	Desert condition.	Rough mountain ranges and semi desert fringes	It helps to understand the spatial organization of activities & land use.
Population Growth	2011 = 19.90% rise, 2018 = 15.28% rise. The population is increasing.	2011 = 29.31% rise, 2018 = 18.44% rise. The population is increasing.	The impacts of the increasing number of people, their daily activities and the rising demands for resources eventually affects the environment.
Climate	Mediterranean Climate.	Mediterranean Climate.	Study of climate reveals change in climate. It helps in determining how climate is likely to change in the coming years.
Sources of Water	Less water resources. Relies more on reuse & recycle of water	Completely relies on dams.	Alternate source should be introduced instead of relying on the existing primary resources.
Water usage	Agriculture is the largest user of water resource.	Agriculture is the largest user of water resource.	Water is a central component in a sustainable and healthy built environment and planning for efficient water use is essential.
Water Quality	Varies from very low to high salinity water.	Achieved awards for excellent water quality.	Monitoring water quality helps determine the progress in cleaning of waterways. It helps to reveal the composition and health of water resources over months and years.
Reason for Stress	Domestic practices, Urbanization, Climate change, Industrial and Agricultural practices.	Urbanization, Climate change – anaemic rainfall, Increased water demand.	In the urban areas due to urbanization, climate change and human practices, it affects the availability of water.

V. Analysis from Case Study

Water scarcity was the major concern for both Cape Town and Israel and the major factor that induced water scarcity was climate change and their lack of availability of fresh water. Decrease in annual rainfall led to huge water stress. But both Cape Town and Israel successfully overcame the major concern with small and large scale measures. Every small action taken to conserve water can make a difference. These small changes in attitude towards water and efficient usage of water made Israel an example globally on how water can be conserved.

VI. Formulation of Strategies

The following strategies based on various parameters are derived from the study which can be used globally to conserve water and efficient water usage. The strategies are as follows:-

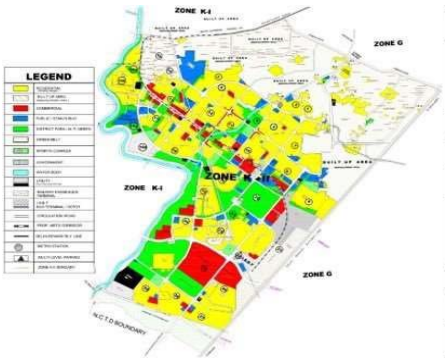
Sources of Water- Water needs to be managed as a community resource held by the state, under public trust doctrine. Periodic inspections of sources of water should be done and strict actions should be taken against the people responsible for the pollution. Regular monitoring of water resources. Traditional systems and source of water supply should be conserved as a build heritage for future generation.

Water Usage- Water should be returned to water cycle with minimum impact on the environment by proper wastewater treatment or directly reused. Community-based water management should be institutionalized and strengthened. Water using activities need to be regulated keeping in mind the local geoclimatic and hydrological situation. Recycle and reusing treated wastewater effluent for various applications, like watering of sports fields, irrigation, for certain industrial uses etc. Integrated Watershed development activities with groundwater perspectives need to be taken comprehensively. Planting of drought-resistant plants (Teff, Sorghum, Sunflower) and watering them at night. Optimizing cropping plants and crop rotation. Methods like aligning cropping pattern with existing natural resources, automated irrigation operation, drip, sprinkler, etc. should be encouraged and incentivized. Water from the industry can be recycled and reused for other applications, such as cooling towers, cleaning, and irrigation, or other uses.

Water supply- Urban water supply and sewage treatment should be integrated and executed simultaneously. Water supply bills should include sewerage charges. An effective management with skilled practitioners who work within and across institutions and among multiple stakeholders collaboratively should introduce measure for efficient water use.

VII. Dwarka

Dwarka is a sub-city and a diplomatic enclave which is located in the South West district of Delhi. Dwarka serves as the administrative headquarters of South West Delhi. It is the largest sub city in Asia which is organized into 29 sectors and mostly has Cooperative Group Housing Societies as residential options. Dwarka has a total area of 13,958.4 acres with a total population of 11,00,000. Dwarka is being developed as a smart city under Delhi Development Authority's 'smart sub city' project. It is the also the largest residential suburb in Asia, with a total of 1718 residential enclaves. Dwarka is relatively flat throughout. It experiences an extreme climate with extreme winters and summers throughout the year. The temperature can be seen increasing from 2015 onwards. The summers are becoming hotter. The winters are becoming less cold. Dwarka Sub city has an area of 5648 ha. Out of this, 1688 ha is designated as built-up. The balance 3960 ha is under planned/regulated development comprising sector 1 to 29. The major land use is residential, which is more that 50% of the total area of Dwarka sub city.



Land use	Area (ha)	%
Residential a) Built-up b) Planned area of sectors	2912.3 1688 (29.89%) 1224.3 (21.67%)	51.56
Recreational	1006.18	17.81
Transportation	777.33	13.76
Public & Semi Public	369.94	6.55
Commercial a)Commercial b)Service Centre	352.13 239.13 113.00	6.24
Utility	138.76	2.46
Govt. Use	91.36	1.62
TOTAL	5648.00	100.0

Source: Zonal Development Plan K-II (Dwarka)

Fig. 1: Map showing the Land use map of Dwarka

a) Sources of Water

Dwarka gets its water from Munak Canal in Haryana. The water received from Munak Canal is raw water. Present demand of Dwarka is 121.13 MLD. Water Treatment Plant provides only 20% of water to Dwarka rest is shared with Najafgarh and nearby villages. Delhi Development Authority supplies 15.91 MLD of water. Delhi Jal Board provides 36.36 MLD to Dwarka the rest 145.47 MLD is shared with Najafgarh and nearby villages. Water supplied by Delhi Development Authority + water supplied by Delhi Jal Board = Total water supplied to Dwarka sub-city. 36.36 + 15.91 = 52.27 MLD (Million Gallons per Day). Total water supplied to Dwarka sub-city is 52.27 MLD per day and 1,568.1 MLD per month. Non-revenue water (NRW) is water that has been produced and is lost before it reaches the customer. Losses can be real losses (through leaks, also referred to as physical losses) or apparent losses (for example through theft or metering inaccuracies). According to Delhi Jal Board, the NRW is taken as 15%. Total water supplied /100 x 15% NRW. 52.27 MLD / 100 x 15 = 7.84 MLD 78,40,000 litres/day). The water supplied from Delhi Jal Board to Dwarka has a shortage of 9.10 MLD which is 91,00,000 litres/day. After reducing the NRW the water received by Dwarka is 44.43 MLD of water which is 4,44,30,000 litres/day. The water received by Dwarka have already lost 16.94 MLD of water which is 1,69,40,000 litres/day. Total Demand = 121.13 MLD (12,11,30,000 litres/day), Total Supply = 44.43 MLD (4,44,30,000 litres/day) and Total Shortage = 76.70 MLD (7,67,00,000 litres/day).

b) Ground Water

Apart from receiving water from Munak Canal, Dwarka also depends mainly on groundwater. The water supplied to the 29 sectors is mixed with the groundwater after reaching the societies before supplying it to the individual households. Excess use of ground water has eventually lead to depleted groundwater. Only housing societies and DDA Flats have such rainwater harvesting systems. They have tanks which helps in naturally recharging the ground water. Ground water is saline at deeper depths. The Dwarka contain high concentration of fluoride beyond prescribed maximum permissible limit 1.5mg/l. The groundwater table near the Najafgarh drain has been contaminated with metals such as the cancer-inducing lead, and cadmium apart from other health hazards.

Table II: Comparison of groundwater extraction and its status in 2013 and 2017 and ground water recharge sources and quantity

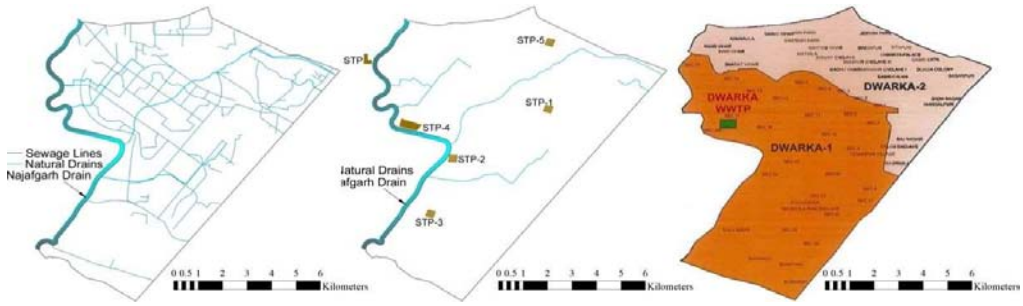
Place	Extraction % in 2013	Status in 2013	Extraction % in 2017	Status in 2017
Dwarka	95.15	Semi - Critical	230.57	Over - Exploited

DWARKA	Monsoon season recharge		Non - Monsoon season recharge		Annual recharge	Total natural discharge	Annual Extractable Ground Water Resources	Current Annual Ground Water Extraction	Net Ground Water Availability for future use
	Rainfall	Other sources	Rainfall	Other sources					
	1435.54	173.7	299.49	472.10	2380.29	238.03	2142.27	4482.64	0.0

Source: Central Ground Water Board, 2017

c) Waste Water and Sewerage

The sewerage network all over Dwarka is sufficient. The water from households and other building goes to small branches of drains which connects to the main sewer line goes to the Sewage Treatment Plant (STP). Residents are charged with 60% of water consumption as sewage charge. The water supplied by the DJB after use goes directly to sewage. The sewerage is estimated at the rate of 80% of the supply.

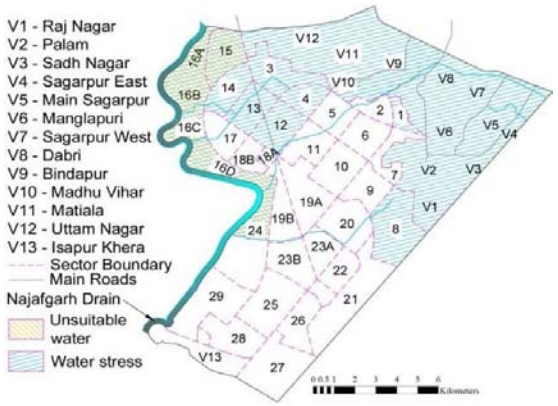


Source: Author, Sewage Master Plan, 2031

Fig. 2: Map showing Sewerage lines, Sewerage Treatment Plants and Drainages zones in Dwarka

VIII. Analysis

Majority of societies in Dwarka mix bore well water into the supply water before supplying it to the individual households. Excess use of ground water has led to depleted groundwater. Only housing societies and DDA Flats have the rainwater harvesting systems. The western side of Dwarka face major water stress due to the Najafgarh Drain flowing near it. The villages face acute water stress due to the shortage of water supply. The western and the northern side of Dwarka face major water stress which is in the villages and in sector 3, 4, 8, 12, 13, 16 and 24. The Najafgarh Drain carries large amount of raw sewage from neighbouring parts of Dwarka. Sewage disposal after treatment is disposed into the Najafgarh drain leading to more water pollution. People living near to Najafgarh drain dispose their household waste and solid waste into the drain making it more polluted. Water supplied by the Delhi Jal Board is also inadequate and does not fulfil the demands of Dwarka.



Source: Author

Fig. 3: Map showing the areas with face water stress

IX. SWOC Analysis

Strength of Dwarka is that well established water distribution network throughout Dwarka. 100% piped connection to all households. The government's scheme of 20,000 litres of water each month free of cost to every household. Weakness of Dwarka is that the availability of water towards Dwarka is not sufficient. Many infrastructures lacks rain water harvesting. Hard water leads to pipe clogging. Frequent repairs of water pipes. No proper sewage water disposal and solid waste management. Opportunities of Dwarka is that implementation of Rain water harvesting tanks in all residential areas. Implementation of waste water treatment at housing society at small level. Challenges of Dwarka is that the existing water bodies are completely polluted with treated and untreated waste. Due to excess boring the ground water in Dwarka is depleting.

X. Strategies and Proposal for Water Stress Management

a) Zone 1: Najafgarh Drain Area – LONG TERM GOALS

1. To restore and revitalize Najafgarh Drain - Najafgarh drain should be cleaned using phytoremediation method which is defined by UNEP (2012) as the use of living green plants for cleaning of contaminants in soils, surface waters, and groundwater.
2. Riverfront development at Najafgarh Drain - Parks on both sides with landscape, hawker zones, event zones and interaction zones. A new STP shall be installed to keep the drain clean. Best example is the Sabarmati river front development.

SHORT TERM GOALS

3. To ensure ban on disposal of Sewage into water reservoirs.
4. To ensure proper solid waste management - Proper solid waste management will decrease the disposal of household waste into the Najafgarh Drain.

b) Zone 2: Compact Settlement Area – SHORT TERM GOALS

5. Provision of safe and affordable water for all - Equal water supply to all places as some places get supply once a day whereas other places get supply twice- thrice.
6. Promote Rain water harvesting - According to Delhi Municipal building by- laws Rain Water Harvesting through storing of water runoff including rainwater in all new buildings and reconstructed buildings on plots of 100 sq. m. and above will be mandatory. Proper action should be taken to see that this is practiced everywhere and defaulters are to be levied with fine.
7. Store excess winter water underground - Saving excess water underground for higher demand times has been the practice for New Jersey. The excess winter water to be stored underwater. It helps natural aquifer replenishment and keeps water from evaporating.

c) Zone 3: Organised Settlemet Area – SHORT TERM GOALS

8. Reviving traditional systems and its conservation as build heritage for future generation - Revival of Lodi Era Baoli/ Stepwell in Dwarka sector - 12. It will be a build heritage for the future generation. After restoration it can be used as an alternate source of water and can help in reducing water stress to some extent.
9. Reviving traditional methods of water conservation Construction of Johads with a covered tank can collect rain water and avoid it from getting evaporated. It proved successful in Rajasthan.

LONG TERM GOALS

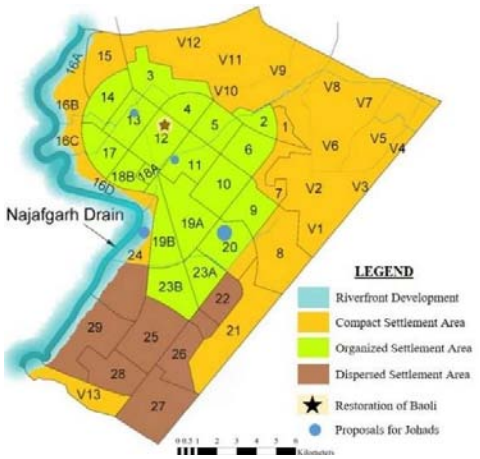
10. Re-route greywater to vegetation - All building having a minimum discharge of 10,000 l. and aboveper day shall incorporate waste water recycling system. Re-route greywater to trees and plants.

d) Zone 4: Disperesed Settlemet Area – SHORT TERM GOALS

11. Provision of Natural STP plants and parks - Greywater from households after getting treated gets collected in underground tank which can be used for watering the plants in parks. The entire plant is underground, with parks above. Best example is Rajokri pilot project.

e) General Strategies and Proposals – LONG TERM GOALS

Quality improvement in water supplies. Ensure all drainage structures to be free flowing. Install water efficient plumbing fixtures and water metering technology. Ensure proper sludge collection, treatment and disposal. Provide incentives for technology and measures that save water. Upgrade waste water treatment plants. Encourage active community participation. Change behavior among citizen to reduce the negative impact on water resources. Creating awareness about efficient water use among students. Improved water management practices that enhance beneficial and efficient use of water.



Source: Author

Fig. 4: Proposal map for all Zones

XI. Conclusion

Dwarka is a sub-city and a major residential hub. Dwarka-Papankala project which was launched in 1988 and is still under development. With further development the population is also increasing so is the demand for water. Increasing demand is leading to water stress due to poor quality and inadequate quantity of water supply and availability. Dwarka relies on surface water and groundwater but with continues decline in ground water level, which makes situation worse. The Najafgarh drain is one of the filthiest water reservoir in overall Delhi which contaminates the ground water. As stated in the above study that Dwarka has shortage of 76.70 MLD (7,67,00,000 litres/day). This clearly states that Dwarka lacks availability of freshwater throughout the year which directly affects the supply. The only best solution to cope with increasing water stress it efficient use of water and efficient water conservation. Hence Dwarka is in acute need of clean water for all and it's possible only with successful reuse and recycle of water and efficient water conservation.

Acknowledgment

Primarily I would like to thank God for helping me to complete this research. I would like to thank my external critics, for devoting their time and expertise to guide and refine my research. I would more over like to thank my family for all the assistance and support they have provided without which, I would not have been able to accomplish everything that I have done. My true mentor throughout this research has been my parents. I dedicate this research work to them.

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