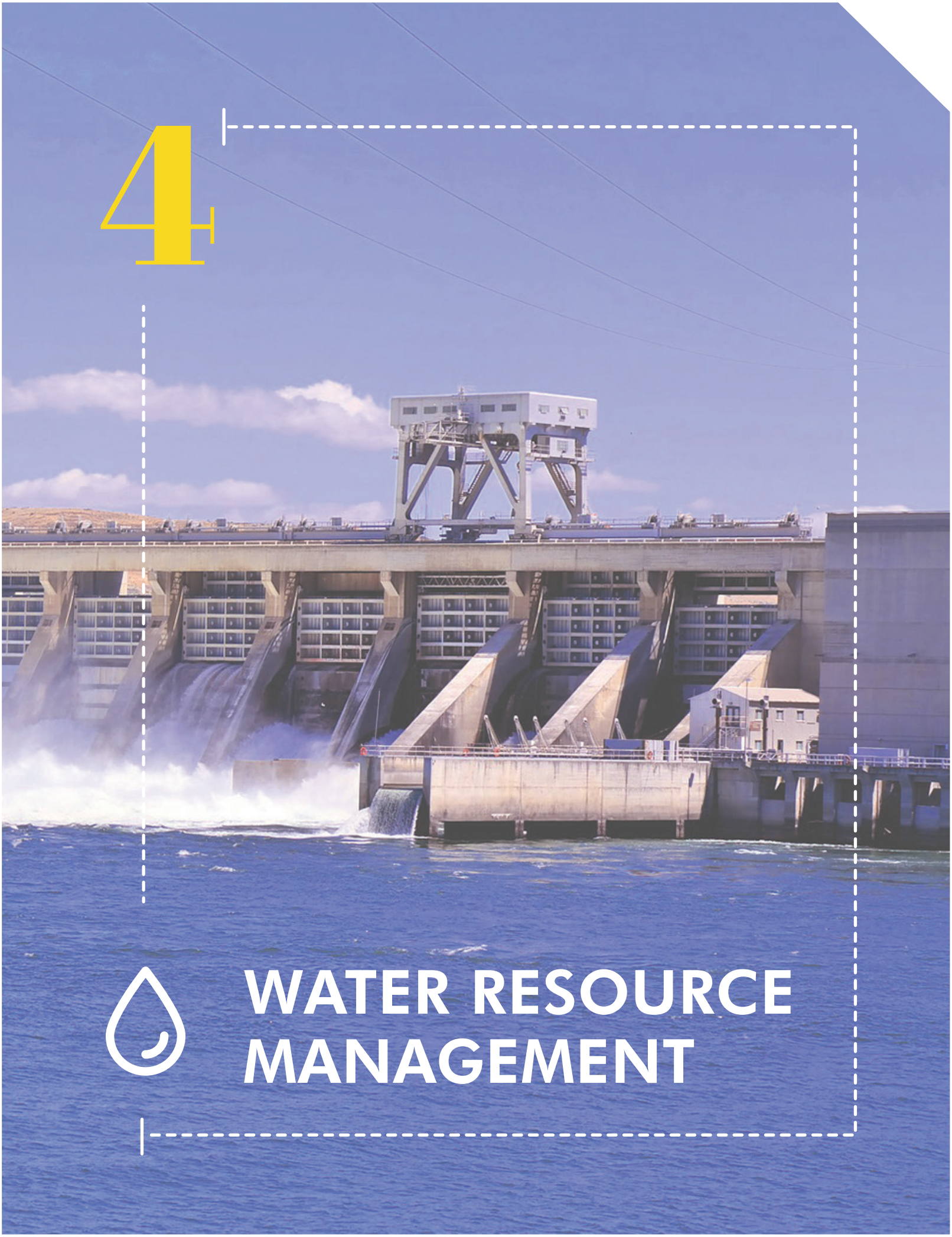
4



WATER RESOURCE MANAGEMENT

22

UTILIZATION OF MANGALURU CITY SEWAGE WASTEWATER FOR INDUSTRIAL PURPOSE

Project Highlights

- Reuse of wastewater for the Industrial purpose
- Reduction in the cost of Operation and Maintenance from the side of ULB for the Sewage Treatment Plant and the connected wet wells
- Adoption of separate Special Purpose Vehicle (SPV) for Monitoring and Supervising the activities Wastewater Utilization

Background

Mangaluru, Karnataka

2011

(Not to scale)

Mangalore is the chief port city of the Karnataka state located about 352 kilometers (220 mi) west of the state capital, Bengaluru between the Arabian Sea and the Western Ghat mountain ranges. It is the administrative headquarters of the Dakshina Kannada District and accessible via all forms of transport - Air, Road, Rail and Sea, thus, making it a unique location for commercial investments & activities. Mangalore's economy is dominated by the Industrial, Commercial, Agricultural processing and port-related activities. One of the largest SEZs in India, the MSEZ is in Mangalore. In view of this, Mangaluru City is receiving water from the 'River Netravati'. Since MSEZ has been established the demand for the supply of water was increased for the Industrial purposes, under the strong political will and administrative leadership of the Commissioner discussion was carried out with the MSEZ officials to take over the sewage wastewater produced within Mangaluru City Limits after secondary treatment of the wastewater.

Hence, a Special Purpose Vehicle (SPV) has been formed for operation and maintenance of the sewerage treatment plants and connected wet wells.

Project Objectives

I. To utilize the wastewater, which was discharged to the sea after secondary treatment
II. To reduces the stress on the existing water resources by Recycling and reuse of wastewater
III. To reuse in diverse avenues such as non-potable domestic use; horticulture, agricultural, power plants, industries and others

Key Stakeholders

Mangaluru City Corporation

Approach

- Formation of Special Purpose Vehicle (SPV) for the implementation of the project
- Agreement between MCC & MSEZ Ltd.
- Approval from Government of Karnataka
- Operation and Maintenance of STPs and Connected Wet wells
- Cost Sharing of O&M by Mangalore SEZ Ltd (MSEZL) and Mangaluru City Corporation (MCC)
- Establishment of Sewage Treatment Plants and Wets within MCC Limits
- 4 STPs: Kavoor (43.5 MLD/9.5 MGD), Bajal (20 MLD/4.40 MGD), Surathkal (16.5 MLD/3.63 MGD) & Pachanady (8.75 MLD/1.92 MGD)
- 22 No's of wet wells connected to their respective STPs

Financial Structure

The initiative is funded under the Smart Cities Mission

Achievements

Benefits and Co-benefits:

- Operation and Maintenance of three Sewage Treatment Plants (Kavoor, Surathkal and B[illegible]d connected wet wells/ Pumping station from Wet wells to STP) in Mangaluru.
- Reduction in dependency on natural water resources.
- Reduction of Financial burden on Mangaluru City Corporation for O&M of STP.
- Avoiding disposal of Secondary treated sewage in natural river body thereby Minimization of pollution loads on Fresh water sources & improving Environmental quality.
- Employment Generation



Success Factors

- Technical innovations for effective implementation of the project
- PPP type of arrangement for the implementation of the project

Limitations and Future Prospects

The project faced following challenges:

- Only 3 STPs have been tied up with MSEZ and the secondary treated wastewater is further treated to tertiary level and being reused for industrial purpose
- The 4th STP having a capacity of 8.75 MLD treatment facility, the wastewater after secondary treatment is being let to the river. Hence, the wastewater needs to be utilized such as non-potable domestic use; horticulture, agricultural, power plants, industries and others. Tertiary treatment plant needs to be setup for future to reuse the wastewater
- The uncovered area within the MCC limits needs to be covered using underground drainage system facility hence the wastewater is completely collected, recycled and reused. Thereby completely minimizing the pollution load on fresh water sources & improving Environmental quality

Source: Case received from the city

For more Information

https://blogs.adb.org/blog/mangalore-shows-way-wastewater-management-india
https://www.genexutility.com/mangalore-model-wastewater-management-karnataka
https://development.asia/insight/one-way-dispose-wastewater-turn-it-profit

23

SUSTAINABLE WATER MANAGEMENT THROUGH NON-REVENUE WATER CELL IN SURAT

Project Highlights

- Development of a dedicated cell, i.e., NRW cell to manage issue of non-revenue water
- Significant decline in the leakage per km length of pipeline as well as the complaints associated with water supply leakages

Background

Surat is the second largest city in Gujarat and is known as the commercial capital of the state. Surat Municipal Corporation (SMC) manages the water supply and sewerage system of the city. River Tapi is the major source of water supply and the city has piped water supply network since 1898. The growing population of the city has led the authorities to invest in the water supply system and it has implemented a new WATER SUPPLY Master Plan in 2015, which expects to cover the entire city and meet water demands up to the year 2041. The NRW has been reported to be at 20.4% under the SLB framework, hence is a serious cause of concern. Considering this, in order to enhance the water supply services of Surat, SMC constituted an NRW cell in 2007 with the mandate to plan, develop, implement and monitor an action plan for reduction of NRW.

Surat, Gujarat

2007

(Not to scale)

Project Objectives

The NRW cell was formed with the objective of undertaking a thorough estimate of NRW levels and then progressively improving and maintaining overall NRW level at 20%. The NRW cell had six major objectives:

I. Efficiency enhancement in transmission and distribution network
II. Achieving equity in distribution
III. Achieving financial recovery
IV. Creating awareness for water conservation
V. Conducting periodic water audit
VI. Implementation of efficiency and equity measures as per requirement

Key Stakeholders

Surat Municipal Corporation (SMC)

Approach

The NRW cell was mandated with taking an integrated perspective in evaluating the efficacy of the initiatives and to ensure streamlined implementation. The following steps were taken by the cell:

- Identified leakage mapping as a priority initiative and involved identification of leakages based on current and historical complaints from citizens/areas and ground level assessment by SMC's Hydraulic department

- Thorough discussions with leakage team and fitters in various areas to identify the frequent leakage points
  - Leakage repairs were done at three levels based on the size of the pipes, i.e.,
  - Leakages in pipe sizes > 750mm: by outsourcing by AMC to private operators
  - Leakage in pipe sizes 550-750mm: by AMC
  - Leakages in pipe sizes < 550 mm: by zonal offices
- Leakage repairs

Financial Structure

The initiative has been majorly funded by SMC

Achievements

Benefits and Co-Benefits

The initiative yielded numerous impactful results:

- Reduction in leakage per km length of the pipeline: Ratio of the number of leakages per km length of the pipeline has drastically declined over the years
- Reduction in number of complaints: The number of leakages were reduced by 30% annually in all zones
- Effective and better tracking of complaints: Daily reporting of the leakage repairs is done by all the zones to the head office of SMC
- Leak Repairs and water savings: Identification and repair of over 185 frequent leakage points and over 110 contamination points post creation of the NRW cell. It also estimated saving to the extent of 708 ML of potable water translating to a net savings in water costs and road reinstatement cost of Rs. 212 Lakh annually

Limitations and Challenges

Presence of large number, i.e. ~60% of migrant population in the city making it difficult to spread awareness about the key challenges associated with floods

Future Prospects

SMC aims to extend this initiative at a full swing covering all the regions of the city.

Source:

1. https://pearl.niua.org/sites/default/files/books/GP-IN2_WATSAN.pdf
2. https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf

24

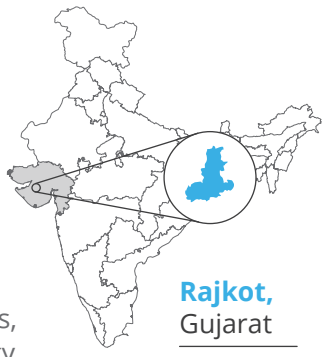
RENEWABLE ENERGY DEPLOYMENT AT AJI WATER TREATMENT PLANT IN RAJKOT

Project Highlights

- Installation of 145kWp grid connected solar PV system at Aji water treatment plant
- Compensation of 18% of the electricity demands of the water treatment plant by renewable source

Background

Rajkot is part of Swiss Agency for Development and Cooperation's (SDC) Capacity Building for Low Carbon and Climate Resilient City Development project (CapaCITIES) project, which aims to enhance capacities of Indian partner cites (Rajkot, Coimbatote, Siliguri, and Udaipur) in planning and implementing climate mitigation and adaptation measures along with increasing awareness on low carbon and climate resilient city development. Water supply accounting for 61% of the total municipal electricity consumption (2015-2016) is the most energy intensive municipal service of the city. This depicts immense potential of reducing energy consumption of the water supply sector through renewable energy alternatives. In view of this, RMC implemented a pilot project with energy efficiency and renewable energy measures in one of the water treatment plants, i.e., Aji water Treatment Plant.



Rajkot, Gujarat

2015-2016

(Not to scale)

Project Objectives

I. To reduce conventional electricity consumption by introducing Energy Efficiency (EE) in pumping and maximize use of Renewable Energy (RE) through grid-connected solar PV system deployment as per Gujarat Solar Policy 2015

II. To reduce the conventional electricity consumption and related GHG emission from Aji WTP by approx 15 to 18%

III. To understand the potential of scaling up EE and RE integration in the water supply sector of Rajkot based on learnings from the solar PV system deployment at Aji water treatment plant

Key Stakeholders

Rajkot Municipal Corporation (RMC) and ICLEI India

Approach

The following initiatives were undertaken to transform the electricity consumption patterns of the Aji water treatment plant:

- Feasibility study was conducted by ICLEI South Asia to identify feasible location for the project
- Technical specifications were identified for project and contractor was finalized for implementation through technical terms of reference
- The solar PV system was installed based on a co-financing model and the performance of the system is monitored in real time through an online software
- The solar PV system will be operated and maintained by the contractor who set up the plant for a period of 10 years from installation

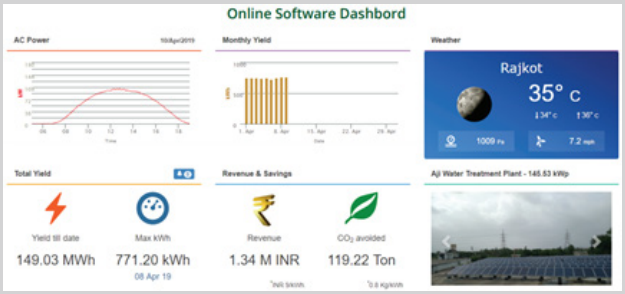
Financial Structure of the initiative

The total cost of the project was estimated to be around INR 8.3 million. The breakup of the funding scheme is: INR 4 million was financed by SDC under the CapaCITIES project (for 70kWp solar PV) and the remaining INR 4.3 million was financed by RMC through the 'SJMMSVY' scheme (for 75kWp solar PV).

Achievements

Benefits and Co-Benefits

- Energy Savings: Plant has generated a total of 224,150 kWh electricity
- Improved facilities for citizens
- Environmental Benefits: reduced 184 tons of CO^2 equivalent GHG emissions since its installation over a period of 12 months



Glimpse of the Solar Rooftop setup at the Aji water treatment plant

Success Factors

- Technical innovations for effective implementation of Solar panels at the water treatment plant

Future Prospects

RMC has already proposed a 250kWp grid connected solar PV at Raiyadhar wastewater treatment plant after the successful implementation of this project and is commissioning a feasibility study to install solar PV systems on other water and drainage pumping stations/ treatment plants. A bankable project based on the RESCO model is also being developed with an aim to install solar PV systems on Ribda and Raiyadhar water treatment plants; and Gavridhar and Madhapar sewage treatment plants. These projects when realized will supplement a significant proportion of the electricity consumed by the municipal services provided by the RMC. Thus, RMC will lead by example in achieving CO_2 abatement through RE integration into their services.

Source: Case received from the city

For more Information

https://capacitiesindia.org/projects-rajkot/
https://timesofindia.indiatimes.com/city/rajkot/rmc-to-set-up-80-mld-plant-at-madhapar/articleshow/57708719.cms
https://www.unescap.org/sites/default/files/IDM_Water_Demand_and_Waste_Water_Management_Rajkot.pdf
https://urban-leds.org/wp-content/uploads/2019/resources/case_studies/ICLEI_UrbanLEDS_case_story_Rajkot_2016.pdf

25

ECO RESTORATION OF KHAM RIVER: AURANGABAD

Project Highlights

- Multifold increase in the biodiversity of the regions along the riverfront
- Improvement in the aesthetic value of the river due to increased levels of green cover
- Disruption of the dumping of MSW in the river leading to decrease in the levels of air, water and soil pollution

Background

Historically Aurangabad city efficiently managed its water supply despite the low rainfall in the region due to the visionary water management practices instituted by its rulers. However, the unmanaged development of the city has taken toll on these traditional water management practices causing serious water crisis in current years. Kham River receives domestic and industrial wastewater from the city and adjoining industrial areas. The polluted water is being used for farming downstream of the city following which the river confluences with the Godavari River; impacting water quality of the Godavari River as well. The non-monsoon flow of Kham river is 40-50 MLD (dry weather) and the reported pollutant levels are well above the permissible limits.

Aurangabad, Maharashta

(Not to scale)

Project Objectives

I. To develop a plan for sustainable restoration of the Kham river

II. To undertake the eco-restoration of the river in such a manner that it can be considered as the pride of the city

Key Stakeholders

Confederation of Indian Industry (CII); Aurangabad Cantonment Board (ACB) and Aurangabad Municipal Corporation (AMC); Green Water Revolution Pvt. Ltd.; Shrishti Eco Research Institute

Approach

The approach taken in eco-restoration of the river was mainly in-situ bioremediation. The design philosophy of the project was to keep it chemical free and maintain zero electricity consumption in the remediation methods.

Some of the solutions adopted were:

- Removal of all unwanted weeds, municipal solid waste like plastic, dead animals carcasses
- Installation of three metal screens with anti-corrosive paints
- Stream – training and bank stabilization along the selected stretch
- Installation of Green Bridges to degrade pollutants. Green Bridge is a horizontal filtration system comprising physical and biological filtration by providing space for growth of floating, submersed and benthic biota. These useful microorganisms form a self-sustaining ecosystem, starting from detritivores, thus improving the self-purification capacity of the stream naturally
- Plantation of species useful in reducing the pollution on both sides of the bank
- Benthic system development in the selected stretch

Achievements

Benefits

- Control of odor and improvement in the aesthetics of the riverfront
- Obstruction of the dumping of Municipal Solid Waste (MSW) in the river is and adoption of filtering of suspended solids and contaminants before discharging in the river
- Facilitation of natural aeration and bio-control of pollutants
- Multifold Increment in biodiversity
- Uninterrupted flow of river with meandering and bank stabilization
- Overall improvement in all the parameters such as DO etc. of the river, thus, enhancing the water quality of the river

(a) Before and (b) After Glimpse of the Kham river after the Restoration Activity

Success Factors

- Discussion with all the stakeholders, IMA and public participation
- Intensive mass awareness and involvement with municipal corporations and other local level government agencies

Limitations and Challenges

- Huge quantity of Municipal Solid Waste, medical waste of hospitals, food waste of hotels etc. was being dumped in the riverbed daily
- Designing the project to take care of the varying inflow was critical
- There were number of broken sewerage chambers discharging wastewater in the river
- Theft of material by localities

Future Prospects

The local authority is making provisions for operation and maintenance of such ecological restoration projects

Source: As received from WRI

For more Information

https://timesofindia.indiatimes.com/city/aurangabad/Green-bridge-technology-to-give-fresh-lease-of-life-to-Kham/articleshow/50295234.cms

26

JAKKUR LAKE REJUVENATION: BENGALURU

Project Highlights

- Improvement in the biodiversity in the surrounding area of the lake, increasing the aesthetic value of the locality
- Increase in employment opportunities and livelihood opportunities to the fishermen
- Increase in the usage of the lake by the local residents for recreational purposes

Background

Jakkur Lake is approximately 160 acres in size and is located in the northern part of Bengaluru near Yelahanka. It receives storm water through three (3) inlet drains starting from Yelahanka, Agrahara and Shivanahalli. Due to urbanization and increase in population, the quantity of the storm water reaching the lake decreased significantly over time and led the drains dry. Instead, the lake started receiving sewage from nearby 12,500 households surrounding the lake.

Bengaluru, Karnataka

(Not to scale)

Project Duration

Initial Restoration by the government was carried out between 2009 and 2011, while the further restoration was conducted by Jal Poshan 2015 onwards

Key Stakeholders

Jal Poshan, Satya Foundation, Biome Environmental Solutions, Ananas, ATREE, BBMP, KSPCB, Fisheries Department, BWSS, Horticulture Department of Bengaluru

Project Objectives

I. To use natural and self-sustainable methods of treating domestic wastewater to rejuvenate Jakkur lake

Approach

In the Jakkur model, the restoration work has integrated conventional grey with green infrastructure. Following step wise approach was adopted:

- The Lake was fenced to remove encroachments and de-silted
- The original 10 MLD secondary STP was upgraded to 15 MLD tertiary treatment STP. The local governing body maintained the legal standards for the STP as the water was fed into the constructed wetland for treatment and later into the lake
- Islands were created and trees were planted along the sides of the lake for creating bird habitation and to maintain natural flora and fauna
- The constructed wetland of 7 acres was created with wetland species such as vetiver, water hyacinth, typhaceae, and alligator weed. They helped in phytoremediation of the lake water
- Separate tank (kalyani) was built for idol immersion during religious/ cultural festivities thereby preventing the pollution the lake water
- Since 2015, through a collaborative and multi-stakeholder engagement model, Jal Poshan brought in various organizations to rejuvenate the lake ecosystem. Some of the key activities included:
    - Sustainable landscaping such as permaculture, community gardens etc.
    - Developing a permanent space for fishing community.
    - Up gradation of existing sedimentation tank

Achievements

Benefits and Co-Benefits

- Jakkur lake restoration project has provided livelihood opportunity to fishermen. On a normal day, they are able to collect at least 100 kilograms of various kinds of fish
- 100,000 liters per day of water is drawn from a step well near the lake for agricultural purposes
- Improved biodiversity in the surrounding area with increased presence of local and migratory birds
- Increased land value of nearby properties

(a) Before and (b) After Glimpse of the Jakkur Lake after the Restoration Activity

Success Factors

- Active participation of local residents for improving the conditions of the lake
- A consensus was reached between the villagers and BBMP that they would draw the water and use it beyond the lake boundary for their activities
- Jal Poshan fulfilled the role of coordinating between all agencies to maintain the lake

Limitations

- Rural-urban conflict due to restrictions placed on activities such as cattle grazing and bathing during the implementation period.
- Lack of awareness about the lake as some urban commons among all beneficiaries
- Continued fund raising to meet the O&M expenses

Future Prospects

This is a successful model of collaborative approach for lake restoration. Institutional mechanisms could be provided to facilitate an easier dialogue between various administrative agencies involved in keeping the lake clean and healthy.

Source: As received from WRI

For more Information

https://www.cseindia.org/jakkur-lake-urban-lake-management-6402
https://swachhindia.ndtv.com/bengaluru-jakkur-lake-tree-plantation-drive-by-citizens-28264/
http://bengaluru.urbanwaters.in/case-study-lake-rejuvenated-for-people-nature-319
https://www.thehindu.com/news/cities/bangalore/348-crore-promised-in-budget-for-developing-59-lakes-over-three-years/article26227094.ece
https://sustainabilitynext.in/case-study/jakkur-lake-rejuvenation-lessons-in-impact-of-strong-community-leadership/

DEEP TUNNEL SEWERAGE SYSTEM - SUSTAINABLE WATER MANAGEMENT: SINGAPORE

Singapore, Southeast Asia

Year of Initiation: 2000

Project Highlights

- **Innovative and Integrated Water Management Approach**
- **Centralized waste water treatment system**
- **DTSS is a superhighway for Singapore's used water management**
- **Massive public education and awareness is a key factor for the success of DTSS**

Background

Deep Tunnel Sewerage System (DTSS) is a massive integrated water management project that caters to the country's long term clean water needs through the collection, treatment, reclamation and disposal of used water from industries, homes and businesses. It is a perfect example that incorporates the concept of integrated land and water management for achieving sustainable environment.

Project Objectives

The DTSS project aims to improve Singapore's water conveyance and treatment system while reducing the land occupied by the used-water infrastructure on the island by 50%

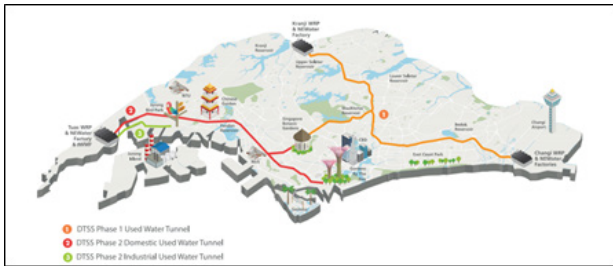
Key Stakeholders

Singapore's National Water Agency, Ministry of Environment and Water Resources, National Environment Agency of Singapore

Project Approach

DTSS project is being developed in two phases and is proposed to be completed by 2022. The key aspects of the project include:

- Construction of two large tunnels, 6.5 m in diameter and 80 km long, located ~ 50 m below the surface to carry the used water to the three centralized water reclamation plants (WRPs)
- WRPs will treat and purify sewage into clean, high-grade reclaimed water, while the effluent will be discharged through deep sea



Financial Structure of "Climate Emission Capping for Buildings" law

- The first phase of the DTSS project was completed with an investment of $2.7 billion and the project is self-financing through retained earnings
- In 2005 Public Utilities Board (PUB) issued the bond for $400 million, while in 2010 PUB received an operating grant of $185 million

Achievements

Benefits

- Reduction in water consumption from 165 liters per person per day in 2003 to 155 liters per person per day in 2009
- Reduction in water losses, i.e., non-revenue water
- Centralized water management system ensuring minimum land utilization
- Development of replicable model for other cities across the world

Co-benefits

- Behavioral changes among residents mediated through tariff structure
- Economic benefits and cost-effective model

Success Factors

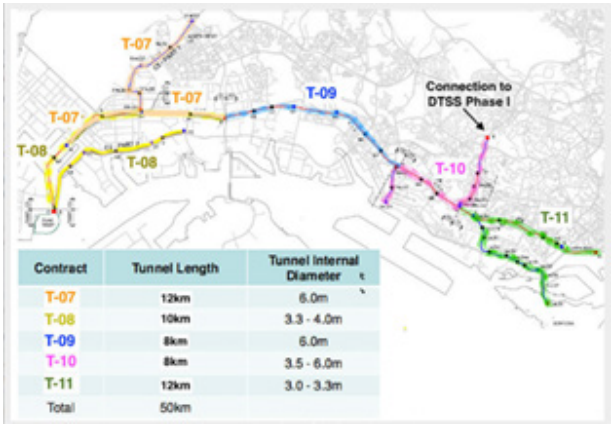
- Effective policy implementation and law enforcements
- Effective Institutional and legislative management
- Effective engineered and technological solutions

Limitations

- Unprecedented costs associated with the centralized water management system

Future Prospects

Phase II of the DTSS project commenced in 2016 and is envisaged to be completed by 2022



Contract	Tunnel Length	Tunnel Internal Diameter
T-07	12km	6.0m
T-08	10km	3.3 - 4.0m
T-09	8km	6.0m
T-10	8km	3.5 - 6.0m
T-11	12km	3.0 - 3.3m
Total	50km	

Source: https://pearl.niua.org/sites/default/files/books/GP-GL2_SANITATION.pdf

For more Information

https://www.aecom.com/sg/projects/deep-tunnel-sewerage-system-phase-2/

https://www.arcadis.com/en/global/what-we-do/our-projects/asia/singapore/deep-tunnel-sewerage-system/