

Resource Conservation: Water Sustainability

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Abstract— “Sustainability can’t be like some sort of a moral sacrifice or a political dilemma or a philanthropic cause. It has to be a design challenge.”

Bjarke Ingels, BIG Architects

From tabling the Brundtland Commission report in 1987 to The UN Sustainable development goals 2030, we have come a long way in defining and understanding “sustainability”. The UN SDG’s are a blueprint towards achieving sustainable growth for people and the planet. Earth’s resources are being depleted faster than ever before but technological advances in various spheres have increased our awareness and knowledge towards mitigating its adverse effects. Globally it is vital to get the support of citizens to achieve environmental, social and economic sustainability for all the stakeholders. This is a case study paper and the different aspects of a liveable city like safety, wellbeing, security and infrastructure while being considered as necessary for any city to function effectively, the focus of the paper is on water sustainability. From floods in Kerala to drought in Vidarbha and Chennai running out of potable drinking water – the climate change crisis is hinting that water sustainability by integrating the water cycle is the need of the hour. A city which has taken initiatives to make itself resilient, sustainable and livable is Rotterdam, Denmark. The Dutch model incorporates water in their city planning and involves community participation through waterfront development and community welfare activities. Present paper looks into one such attempt carried out by Navi Mumbai Municipal Corporation, which has incorporated the Dutch Model of water management by constructing holding ponds. Also significance and use of Bio-Swale is explained efficiently. A participatory approach in planning and implementation will help cities become livable and sustainable.

Index Terms— Sustainable Development, Water Sustainability, Community Participation, Water Cycle

I. INTRODUCTION

“There is enough on Earth for everybody's need, but not enough for everybody's greed.”

Mohandas Karamchand Gandhi.

Exploitation of natural resources began the moment man started using tools and fire. As the human population increased on earth, human needs increased and in order to satisfy these ever increasing needs, man started the vicious circle of greed and over exploitation of natural resources, most of the times in the garb of innovation and progress. For the world, sky's the limit and its over-use of natural resources is a matter of grave global concern. Gandhiji's statement rings truer now than ever before.

Even though cities are experiencing an accelerating pace of urbanization there are also efforts to make cities livable for the people, and in a sustainable manner. “Sustainability” as defined by the Brundtland Commission is the action word which is being adopted with greater urgency by cities and governments.

In 2015 The United Nations adopted the Agenda of Sustainable Development Goals [1] by setting 17 global goals for the year 2030. This was adopted by all UN member nations with the intention of achieving overall development and a sustainable future for all.

India played a key role in the formulation of the SDGs and it is also reflected in the country's National Development Agenda. The Government of India's Smart Cities Mission [2] is an urban renewal program to develop 100 smart cities across the country to make them citizen friendly and

sustainable. While recognizing the Smart City Mission, the UN SDG's, and the parameters of a livable city - safety and security, societal wellbeing, energy, water, waste management etc., this paper looks at measures of water sustainability which can be taken at a city level to promote livability and sustainability.

II. WATER AS A RESOURCE

Jal hi jeevan hai ...

The Earth's water is 3% fresh water, 69% as icecaps and glaciers and 30% as groundwater, while all lakes, rivers and swamps combined only account for a small fraction, 0.3% of the Earth's total freshwater reserves.

Water is essential to life and a source of livelihood for many. Several parts of India face severe water crisis and the situation is worsening year after year. As was seen in the summer of 2019, the metro city of Chennai ran out of potable drinking water. It is believed that India's water crisis is due to the lack of coordinated efforts and planning by both central and state governments. 85 percent of India's rural domestic water requirements, 50 percent of urban water requirements and more than 50 percent of its irrigation requirements are dependent on ground water resources [2]. Due to rapid industrialization, construction activities and effects of climate change, the water crisis has deepened over the years. The rational use of water and supplying citizens with clean

water is the urgent need of the hour. The 2012 Draft National Water Policy looks at the question of the right to water for everyone.[2]

III. WATER CYCLE

Water in all its forms interacts with each other as it passes through its different stages from ocean to land and back under the influence of gravity and solar radiation. All forms of water gets renewed at different time periods but waters of glaciers, oceans and large lakes take years to renew. When there is uncontrolled consumption of such slow regenerating resources it becomes non-renewable resource and consequently the natural cycle also gets disrupted.

The main source of freshwater is surface runoff and this should be sourced extensively as its capacity to renew itself annually in the hydrological cycle and self-purifying nature is crucial and it will also assist in renewing the water bodies like rivers, reservoirs, lakes and glaciers. ⁽⁶⁾

As seen in history, ancient civilizations developed along waterfronts. Water resource management was an integral part of their culture. India also has a rich history regarding water conservation. Different types of terrains had different harvesting systems. From the *kuls* of Spiti valley to the *johads*, from *ahar pynes* to *surangams* and *ooranis* India has had diverse methods of conservation but the function remained the same – of harvesting and storing rainwater runoffs. We have to look deeper into our traditional water conservation methods to revive our depleted resources.

Today the need for water conservation has become a critical issue worldwide and countries like Australia, UK and the United States have adopted a concept called Water Sensitive Urban Design (WSUD) ⁽⁷⁾ which developed first in the US. The aim was to reuse- recycle the entire water cycle so that the water flow is managed and storm water can be naturally conserved, infiltrated, and purified for potential reuse, thereby reducing flood risks and increasing water availability.

IV. WATER SENSITIVE URBAN DESIGN (WSUD)

Water Sensitive Urban Design (WSUD) is an environmentally sustainable water resource management process which integrates the water cycle management with urban planning by minimising water runoff and ensuring minimum amount of damage is caused due to the run offs. The term WSUD is used in Australia, while in United Kingdom it is called as SUDS – Sustainable Urban Drainage Systems and in USA it's called as LID – Low impact Development.

The significant outcomes of WSUD is

- Demand on potable drinking water is reduced by using recycled or treated water
- Reduced water wastage by using water efficient appliances

- Treating urban storm water to an extent where it can be reused or will be fit to be discharged into surface waters
- To reuse storm water for urban landscaping purposes

● Taking the example of China - due to frequent flooding, China introduced a new urban policy and a new concept called "Sponge Cities" (in the process of implementation in Lingang , Wuhan) where the storm water is naturally conserved, infiltrated, and purified for potential reuse, reducing flood risks and increasing water availability. From the "Sponge Cities" ' of China to the "Water Sustainable Settlements" ' of Africa the aim is to control water flow and thereby control flooding, to purify the urban runoff and to reduce the peak run-off and thereby help in water conservation. ⁽⁸⁾ These practices enhance the natural ecosystems and create aesthetically pleasing space for the citizens, in addition to augmenting the biodiversity of the area.

Similarly in Denmark the heavy rainfall prompted the city to build reservoirs. The earlier approach was to build underground reservoirs, but with citizen participation, and keeping in mind the Danes love for nature, it was decided to build waterparks and streams with green areas and skateboard parks. This gives rise for opportunities to play and exercise. It solves several problems simultaneously. Water storing capacity has increased, recreational zones –have been created - people are getting fit and most importantly people are close to water, they take keen interest in its conservation and therefore ownership is established.

V. NAVI MUMBAI - A STUDY

The twin city to Mumbai – was planned as an extension of Mumbai in 1972 to decentralize Mumbai and make it more sustainable. Navi Mumbai, proposed as an ecologically friendly city is bound by the Parsik hill, and the Sahyadri range on one side, and the Thane creek on the other side thereby forming the catchment area for drainage. The drainage area is divided into ridges and valleys which form the sub-catchment with 18 major Nalla and RCC Storm Water Drains networks to drain off rainwater. Holding ponds (Fig.1 & 2), were constructed to retain excess monsoon run-off, which will be useful during dry seasons. These Holding ponds were also envisaged as recreational zones with activities like pisciculture, boating, and open gyms proposed ⁽⁹⁾ whereby the aesthetic and rejuvenating properties of water were incorporated in the planning process. Navi Mumbai has a separate stormwater and wastewater disposal system possibly the only city in India to have so.



Figure :1 Proposed Redevelopment Plan of Holding Pond, Vashi Node

These ponds act as a buffer zone between the stormwater drain and the creek, holding the stormwater during rains and releasing it naturally into the sea during the low tide thus preventing flooding of the area⁽¹⁰⁾. This system of stormwater management is called the "Dutch Method", planned on the lines of the Netherland. This method involves controlling the ingress of seawater during high tide and allowing the surface runoff/wastewater/rainwater to flow into the sea during low tide naturally or by pumping with the help of high capacity pumps. Important parts of this Stormwater management system are holding pond, Retaining wall, unidirectional Flap gates, and Stormwater pumping station.⁽¹¹⁾

The capacity of the holding ponds was designed according to the tidal durations. This well-planned system of drainage and holding ponds has helped Navi Mumbai avoid flooding and waterlogging during high tides and during heavy rains. Holding ponds have been constructed in Belapur, Vashi , Vashi gaon, Turbhe , Koparkhairane and Airoli nodes of Navi Mumbai.



Figure :2 Schematic Section of Holding Pond



Figure :3 Existing View and Walkers Track of Holding Pond , Vashi Node

The area around these holding ponds (Fig.3) were developed as promenades, open gyms and walking tracks have been built with boating and other activities. These spaces are being

actively used by the citizens , thus taking care of providing green lungs amidst a bustling city, by creating walking tracks , which takes care of the health and fitness of the citizens as well as increasing the biodiversity of the area as the environment thus created has become conducive for the flora and fauna to thrive.

VI. THE WAY FORWARD

“Start with little things, like getting people to remove the concrete pavement from their gardens, so the soil underneath absorbs rainwater.”

Arnoud Molenaar, Rotterdam Climate Chief

Every city can incorporate these low impact design (LID) stormwater management systems to recharge groundwater , and decrease and capture the run-offs using suitable methods like infiltration trenches, building stormwater runoff reservoirs or holding ponds, creating green infrastructures arrangements, by replacing more surface area of roads/pavements with green patches, by introducing bioswales (Fig.4), by using pervious paver blocks which will allow water to permeate into the ground and recharge groundwater, using green roofs and green walls on buildings and facades in order to control rainwater runoffs that can manage and use rainwater onsite by incorporating rain gardens. Hence by combining the rejuvenating and the aesthetic properties of water in the city planning, the quality of life of its citizens will improve while major issues of flooding, water scarcity, reducing downstream flooding, and the load on sewerage system can be achieved.

Indicative example of incorporating a Bio – Swale in city planning

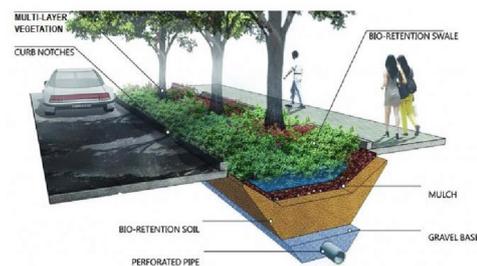


Figure: 4 Schematic diagram of a bio swale near a sidewalk

Bio-swales are gently sloping depressions planted with dense vegetation or grass. The slope allows the stormwater runoff from rooftops, streets, and parking lots to flow efficiently through the system while the vegetation of the swale slows the runoff water, filters it and allows it to permeate into the ground or into a storm drain, thereby improving water quality.[12]

VII. CONCLUSION

"The third world war will be for water"

Rajendra Singh , the waterman of india

This famous quote may turn out to be real if the world doesn't take action soon.

Creating citizen awareness and a participatory approach between the communities and local governing bodies will help galvanizing communities, create a sense of ownership, and help in conserving and sustaining our water bodies. Educating citizens on simple water conservation strategies like treating and reusing greywater by providing rain barrels, and cisterns to each independent household so as to incorporate rainwater harvesting emphasizes the importance of treating every single drop of water. This can be adopted both at an individual level or collectively in housing societies. This will, in the long run, help in making our cities water sustainable. In many cities as a policy Rainwater Harvesting is compulsory for housing societies to get occupancy certificates. Similar incentive-oriented policies, and through stakeholder dialogues the local bodies can implement rules and become a participatory agency in making our cities livable and sustainable. Through resilient planning measures and reinforcing the 3 R's of sustainability we can create a healthy and vibrant city. A city through its planning, citizen and community participation, and political will, will surely achieve livability and sustainability.

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