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Urban development impacts on water bodies: A Review in India

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ABSTRACT: Water bodies like rivers and lakes are the foundation on which human civilization have sprung up from. Almost all the major ancient civilizations such as Mesopotamia, Nile Valley, Mohenjo-Daro, and Harappa flourished on the banks of rivers. Modern day urban centres are also built upon the same principles, where the source of water or catchment area is located with close proximity. The reason is because water is one of the basic need which is required by all living beings, without which life cannot be sustained. In this paper, the importance of the urban water bodies will be discussed in relation to impacts of urban growth and development has on this important yet scarce resource. In India, the phenomenon of urbanization in the last few decades leads to rural-urban migration as the growth and developments are concentrated in the urban centres of towns and cities. Urban expansion and development usually in an unplanned or haphazard manner recognition needed for urban water bodies in planning policies and process to help protect, conserve and revitalize this precious resource.

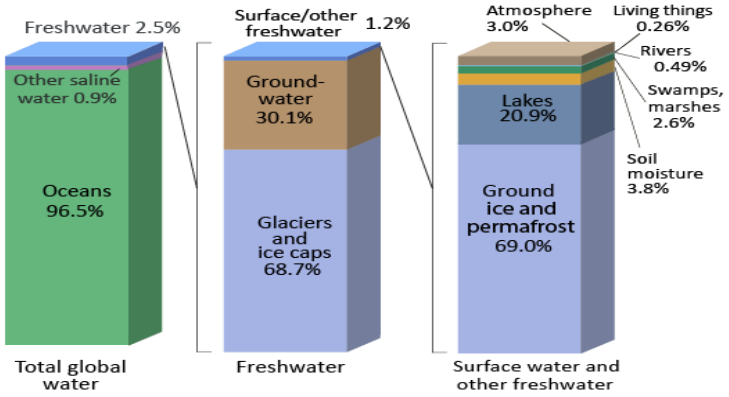
I. INTRODUCTION

Urban development is the social, cultural, economic and physical development of cities, as well as the underlying causes of these processes (Department of Sociology and Human Geography, UIO). The term urban development is used differently depending upon which researcher uses it. Many researchers focus on the physical spatial development, such as architecture and city planning and the social and cultural processes underlying them. Other researchers start with social change, such as inequality or gentrification, in order to explain changes and discuss the social consequences. Water Bodies play multi-functional role in urban area. It can be the source of water for supply, landscaping, irrigation, fishing and eco-tourism, which add values to social benefits. They can also be used to prevent heat island effects and to improve the micro□climate in cities (URDPFI 2014). Inland Water resources of the country are classified as rivers and canals; reservoirs; tanks & ponds; beels, oxbow lakes, derelict water; and brackish water. (Ministry of Water Resources). The European Water Framework Directive (WFD) (EC, 2000) describes bodies of surface water as discrete and significant elements of surface water such as lakes; reservoirs; streams, rivers or canals; part of streams, rivers or canals; transitional water or a stretch of coastal water.

By this definition surface water bodies can take different forms, sizes and shapes due to local physiographic factors. These different types of water are mainly fresh water which sustain various types of flora and fauna. It is not only the aquatic life forms which are dependent on these water bodies but also other living creatures like birds, animals etc. The availability of freshwater is vital not only for the survival of the human race, but also the survival of the ecosystems upon which humans depend (Michael Eduful and David Shively 2015). In the case of cities located in alluvial river plains, surface water bodies may occupy large areas but severe ecological and environmental consequences can arise if they are given insufficient weight in the planning and development processes (Ningrui Du, Henk Ottens, Richard Sliuzas, 2010). Increasing human intervention and interference in the catchment areas (S Koduru and S Dutta, 2013) has also accelerated the sedimentation and siltation process within these water bodies. Water crisis is particularly very severe in highly populated urban areas and it is going to be further aggravated with world becoming urban as pointed out by the World Commission Report on Environment and Sustainability by 2020.

II. OVERVIEW OF WORLD'S WATER BODIES

About 71 percent of the Earth's surface is water-covered, and the oceans hold about 96.5 percent of all Earth's water. Water also exists in the air as water vapor, in rivers and lakes, in icecaps and glaciers, in the ground as soil moisture and in aquifers. The vast majority of water on the Earth's surface, over 96 percent, is saline water in the oceans. The freshwater resources, such as water falling from the skies and moving into streams, rivers, lakes, and groundwater, provide people with the water they need every day to live. The distribution of Fresh Water in the world is as given:



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources.
NOTE: Numbers are rounded, so percent summations may not add to 100.

- In the first bar, notice how only 2.5% of Earth's water is freshwater - the amount needed for life to survive.
- The middle bar shows the breakdown of freshwater. Almost all of it is locked up in ice and in the ground. Only a little more than 1.2% of all freshwater is surface water, which serves most of life's needs.
- The right bar shows the breakdown of surface freshwater. Most of this water is locked up in ice, and another 20.9% is found in lakes. Rivers make up 0.49% of surface freshwater. Although rivers account for only a small amount of freshwater, this is where humans get a large portion of their water from.
  -USGS Water Science School

Today majority of the urban water bodies in urban areas are in a very bad state. The water bodies located in cities and rivers running through the city are degraded in nature in which they are unfit for consumption as we have seen the evident how important it is for planner to consider the water bodies as they consists only around 21% of the total fresh water available globally (Peter H. Gleick 1993). In the future, it is said that water will be a major crisis. Fights, violence and even wars may arise due to this resource. We have seen the recent Cauvery water dispute between the two Indian states of Karnataka and Tamil Nadu, how violence have erupted between the two. More instances may arise if the water bodies are not managed properly. Overexploitation of water resource in urban areas, pollution, floods and other natural disasters are other threats which urban water bodies are facing apart being acute shortage of this scarce resource.

Fig. 1. Cauvery Water Dispute.

III. IMPORTANCE

A lake or pond is the Water Body which holds certain volume of water generally in all seasons of the year and are an intrinsic part of the eco system. Some of the important functions of urban water bodies are as follows:

1.Drinking
2.Washing
3.Urban Agriculture
4.Religious and Cultural purpose
5.Micro-climate
6.Ground water recharge
7.Channelize of water basin which prevent flooding during rainy season
8.Flora and fauna ecosystem
9.Regulate Urban Heat Island effect

Fig. 2. Overview of India's water bodies
Source: State of Indian Urban Water Bodies.

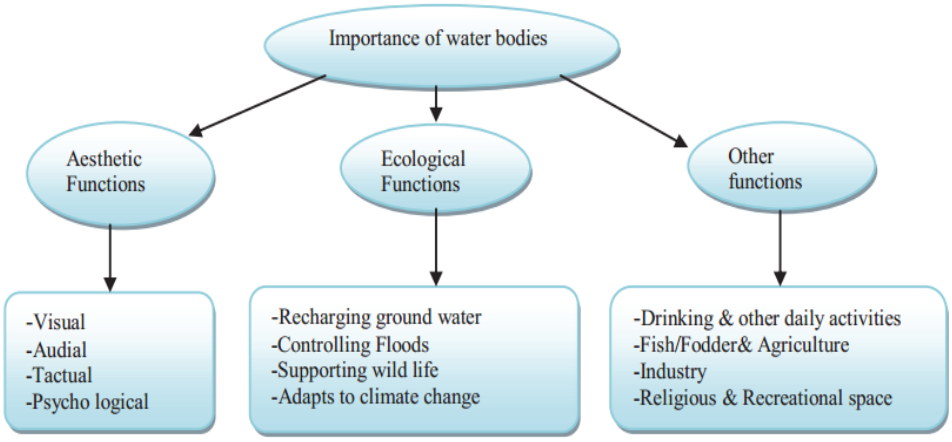


Fig. 3. Importance of Water Bodies.

IV. THE CHALLENGES/GAPS IN THE URBAN WATER BODIES MANAGEMENT APPROACHES IN INDIA

Despite various acts, policies and organizations the status of urban water bodies are not clear. This means there are definitely some gaps in our system which must be addressed for an effective management of urban water bodies. Some of these gaps/challenges include:

Lack of a Clear and Detailed Definition of Lakes: One of the obstacles for an effective protection of urban lakes is lack of a clear definition of a 'lake'. The definition provided under the guideline of NLCP acknowledges only broad hydrological criteria to define a water body as a lake. According to NLCP, a water body should have a minimum water depth of 3m and should cover a water spread of more than ten hectares to be considered as a lake. This definition ignores the fact that the water depth and spread keep changing every year depending on the various environmental factors. In fact, there are very few urban lakes that fit into this definition since most of them occupy a small area, are seasonal and shallow.

Lack of Data/Information: India Has a Number of water bodies, but Data about Their Existence is extremely hazy as there is no orderly or scientific census of lakes. In many cases, we do not even have correct data on the number of waterbodies that exist in a particular area. Lack of Acknowledgement of a Waterbody as a Land Use Category: Another major challenge that makes the conservation and management of urban lakes difficult is the absence of a specific land use category for urban waterbodies. As a result, the water bodies are often easily used for other purposes.

Lack of Systematic Strategy and Coordination: The prime reason behind the deteriorating situation of urban lakes is a complete lack of an effective institutional framework to manage waterbodies, which simply does not exist in our cities. Though, there are a number of government and non-government organization working for the protection of waterbodies, there is no systematic strategy and coordination among them. Thus, the results are short-term and do not result in long-term improvements.

Lack of an Ecosystem Approach: A number of lakes and water bodies in India are disappearing due to mismanagement of its watersheds, catchments and shoreline. The restoration programmes and management plans often lack an ecosystem approach towards water body management. For example in many cases, the urban lakes are encompassed by a wall. The lakes without a well-managed shoreline loss their natural ability to maintain their balance in various situations. A well-managed shoreline plays an important role in protecting the waterbody e.g. by filtering pollutants before the storm water runoff enters the lake.

Lack of Participation and Capacity Building: Without making people aware of the environmental and economic importance of their local waterbodies and, harmful impacts of polluting and destroying these waterbodies, it is almost impossible to protect our waterbodies. If people can be made aware of all these then automatically they will contribute in protecting their local waterbodies and the law can be easily implemented in the society. However, unfortunately, government policies often lack the efforts to build bridges between people and their local waterbodies.

Lack of Balance of Interests in Management Approaches: Another big challenge for the protection and management of urban lakes is to bring diverse groups of people together, getting them to talk to each other and solve common problems. Citizen's groups, resident welfare associations, local organizations, activist groups, green organizations, political organizations, educational institutions and government agencies all have a very different ideologies, agendas, issues and needs that they considered important and fight for their view point and interests. This lack of a strong sense of a community often makes protection and management of common resources difficult.

V. ISSUES OF URBAN WATER BODIES DUE TO URBAN DEVELOPMENT

There are many problems faced by the urban water bodies as they are neglected even though they are an important environmental asset of any urban settlement. Some of the issues are:

Spatial Development: Urban development has had a significant impact on the surface water bodies and their riparian zones either by size reduction or complete reclamation. The reduction, disappearance and pollution of surface water may contribute to the undervaluation of the water bodies' ecological potential among the general public which in turn, may further intensify the process of water-to-land conversions for urban construction. The vegetative cover on the riparian areas is limited and has decreased as a result of urban development. Finally, the priority given to fast urban-economic development has led to the large scale utilization of surface water bodies and their riparian areas for building purposes. As the cities expand in area with more population growth the land use gets changed with the hitherto non-urban areas like agricultural lands, other vegetative areas, water bodies etc., getting replaced by concrete structures and black-topped roads. Despite the emphasis on ecological frameworks and environment in recent policies, current planning concepts and approaches need to be challenged.

Floods: Flood is one of the threat to urban water bodies especially during the rainy seasons most of the low lying areas in India experience floods. The floods repeatedly draw our attention to only one fact: our urban sprawls have not paid adequate attention to the natural water bodies that exist in them (Sushmita Sengupta, 2016). A case in point is Chennai, where each of its lakes has a natural flood discharge channel which drains the spill over. But we have built over many of these water bodies, blocking the smooth flow of water. We have forgotten the art of drainage. We only see land for buildings, not for water and the result is seen every year.

Pollution: For the last two decades, there has been an explosive increase in the urban population without corresponding expansion of civic facilities such as adequate infrastructure for the disposal of waste. Hence, as more and more people are migrating to cities the urban civic services are becoming less adequate.

As a result, almost all urban water bodies in India are suffering because of pollution and are used for disposing untreated local sewage and solid waste, and in many cases the water bodies have been ultimately turned into landfills.

Encroachment: Encroachment is another major threat to waterbodies particularly in urban areas. As more people are migrating to cities the availability of land is getting scarce. Today, even a small piece of land in urban areas has a high economic value. Hence, these urban water bodies are no more acknowledged for their ecosystem services but as real estate. Both for the government and the private builders these lakes are extremely valuable opportunities. Charkop lake in Maharashtra, Ousterilake in Puducherry, Deeporbeel in Guwahati are well known examples of encroachment. Another interesting example of encroachment, not by some private builder but the government itself is Pallikaranai marshland in Bangalore. The size of this city wetland is decreasing rabidly. Once a bird sanctuary, it is now the dumping yard of Chennai City. Construction of new buildings such as a railway stations and a new road have shrunk this wetland to a great extent. Today, Pallikaranai wetland is also one of Chennai's largest official dumping sites. Similarly, the case of government encroachment of Sola Beel in Guwahati where the state revenue department allotted lake-bed for construction in spite of Guwahati High Court's order to protect all wetlands in the state.

Social and Cultural Misuse: Adding to the sorry state of urban water bodies is also the misuse of these water bodies by local communities for their cultural or religious festivals such the immersion of idols. These activities are particularly a source of serious pollution in lakes. Open-defecation is still prevalent in major parts of India where under privileged people who stays in the squatters, slums and other illegal settlements have no sanitary facilities.

Illegal Mining: Illegal mining for building material such as sand and stones both on the catchment and on the bed of the lake also have extremely damaging impact on the waterbody and one the reasons behind the destruction of many waterbodies in India. For example, the Basamand lake in Jodhpur, once the only source of drinking water for the city of Jodhpur, has been suffering from illegal mining for the last 20 years despite the court's order to stop mining in 1999. Surajkund lake in Haryana is another example of illegal mining activities that have destroyed the lake.

Eutrophication: Industrial effluents, run-o from agricultural fields, refuse and sewage, domestic wastes like food remnants, soaps, detergents and sewage are dumped into lakes which break down and release nutrients in the lake water. Microscopic organisms ingest these nutrients and survive on them. Following ingestion of carbonic elements, carbon dioxide is released, while some of the elements are converted into nitrates and phosphates. This is called oxidizing and uses up a lot of dissolved oxygen. The depleted levels of dissolved oxygen in water lead to a situation where other aquatic life-forms cannot survive. This process is called eutrophication.

VI. POLICY AND PROGRAMMES

Global Watershed Treatment Policies and Strategies:

Watershed treatment is an indispensable element of effective drinking water strategy. The solution for the problem is to develop a "Sustainable Water Resource Management Policy" based on the principles of:

•Holistic ecosystem based approach,
•Understanding behaviour of urban water bodies,
•Private Sector involvement in maintenance, and
•People's involvement

'UNEP's Global Perspective of Fresh Water Stress' states, "Conservation and restoration requires a systematic and comprehensive plan to study selective and representative freshwater ecosystems." Details of the study should include the status of lakes, their suitable use, management and conservation so that they serve as a good resource for future use and formation of strategies for long-term management in the urban areas.

World Lake Vision: The World Lake Vision has been developed by International Lake Environment Committee (ILEC), Japan, in collaboration with UNEP, aiming at illuminating the growing crisis in management of lake ecosystem, articulating principles to guide the transition towards managing lakes for their sustainable use and to provide a practical blueprint for ensuring long-term health of lakes and integrity of their survival and economic development. The Seven Principles of Sustainable Lake Management are:

- A harmonious relationship between humans and nature is essential for the sustainable use of lakes.
- A lake drainage basin is the logical starting point for planning and management actions for sustainable lake use.
- A long-term, preventive approach directed to preventing the causes of lake degradation is essential.
- Policy development and decision making for lake management should be based on sound science and best available information.
- The management of lakes for their sustainable use requires the resolution of conflicts among competing users of lake resources taking into account the needs of present and future generations and of nature.

- Citizens and other stakeholders should be encouraged to participate meaningfully in identifying and resolving critical lake problems.
- Good governance, based on fairness, transparency and empowerment of all stakeholders, is essential for sustainable lake use.

National Water Policy (2012): Water Framework Law- There is a need to evolve a National Framework Law as an umbrella statement of general principles governing the exercise of legislative and/or executive (or devolved) powers by the Centre, the States and the local governing bodies. Enhancing Water Available For Use- The availability of water resources and its use by various sectors in various basin and States in the country need to be assessed scientifically and reviewed at periodic intervals, say, every five years. Demand Management and Water Use Efficiency- A system to evolve benchmarks for water uses for different purposes, i.e., water footprints, and water auditing should be developed to promote and incentivize efficient use of water. Conservation of River Corridors, Water Bodies and Infrastructure- Conservation of rivers, river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation. The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws through planned development of urban areas, in particular. Database & Information System- All hydrological data, other than those classified on national security consideration, should be in public domain. However, a periodic review for further declassification of data may be carried out. A National Water Informatics Center should be established to collect, collate and process hydrologic data regularly from all over the country, conduct the preliminary processing, and maintain in open and transparent manner on a GIS platform.

National Lake Conservation Policy, India (NLCP): 'The National Lake Conservation Policy, India (NLCP)' carved out of the Wetland Program focuses on urban lakes that are subjected to anthropogenic pressures. Under this, the 'Ministry of Environment and Forests (MoEF)' has identified 10 polluted urban lakes for conservation and management in 1994 and has already released a large number of proposals for funding. Out of these, Bhoj Lake from Madhya Pradesh is already getting assistance under funds provided by Overseas Economic Cooperation Fund (OECF), Japan. Approval has also been given for Dal Lake Conservation Program (DLCP) in Jammu and Kashmir. Others like Nainital Lake, a number of lakes in Karnataka, Andhra Pradesh, Maharashtra and Haryana are in the pipeline waiting to be taken up depending on the pollution status and availability of funds.

National Project for Repair, Renovation & Restoration (RRR) Of Water Bodies: The Government of India sanctioned a Pilot Scheme for "National Project for Repair, Renovation & Restoration (RRR) of Water Bodies directly linked to Agriculture" in January, 2005 with an estimated cost of Rs.300 crore to be shared by Centre and State in the ratio of 3:1 proposed to be implemented during the X Plan period. The objectives of the Scheme were to restore and augment storage capacities of water bodies, and also to recover and extend their lost irrigation potential. The water bodies with the size of 20 ha - 2000 ha are covered under the scheme with external assistance. To revive, restore and rehabilitate the traditional water bodies, The Government of India has launched Repair, Renovation and Restoration (RRR) of water bodies which has multiple objectives like Comprehensive improvement and restoration of water bodies thereby increasing tank storage capacity, Ground Water Recharge, Increased availability of drinking water, Improvement in agriculture/horticulture productivity, Improvement of 4 catchment areas of tank commands, Environmental benefits through improved water use efficiency; by promotion of conjunctive use of surface and ground water, Community participation and self-supporting system for sustainable management for each water body, Capacity Building of communities, in better water management and Development of tourism, cultural activities, etc.

The main objectives of the Scheme are:

- Comprehensive improvement and restoration of water bodies thereby increasing tank storage capacity
- Ground Water Recharge
- Increased availability of drinking water
- Improvement in agriculture/horticulture productivity
- Improvement of catchment areas of tank commands
- Environmental benefits through improved water use efficiency; by promotion of conjunctive use of surface and ground water.
- Community participation and self-supporting system for sustainable management for each water body
- Capacity Building of communities, in better water management, and
- Development of tourism, cultural activities, etc.

River Development and Ganga Rejuvenation : National River Ganga, along with her many tributaries, has been the source of physical and spiritual sustenance of Indian civilization for millennia, and consequently, her well-being is of prime national concern. The physical environment of the National River Ganga Basin (NRGB in short) is governed by a complex combination of natural and manmade processes. With proliferation and diversification of human activities, the resulting environmental degradation has greatly increased in recent decades.

Objectives:

Mission Aviral Dhara: For a given geological-climatic setting, alluvial rivers achieve stability through long-term balance between various parameters such as water and sediment flow rates, temporal variations of flow, terrain gradient, and seepage flow rates.

Mission Nirmal Dhara: The Ganga River's present-day water quality is abysmal due to anthropogenic wastes polluting the river network in various ways. The main approach in GRBEMP has been to identify the types of pollutants, their sources of generation, and the feasibility of collecting and treating them to the degree needed for reuse and/or safe environmental disposal.

Mission Ecological Restoration: The ecological balance in the Ganga river network has been critically affected in recent times, with major indicator species (such as Dolphins, Trouts, Carps and Hilsa fishes) having dwindled or disappeared.

Mission Geological Safeguarding: Modern human activities – such as underground explosions, excavations, tunnelling, rock fracturing, mining, and operation of large reservoirs – can damage the geological formations supporting the basin's aquatic systems.

Mission Disaster Management*:* The main potential disasters arising from the Ganga River network are floods and water-borne diseases. While the causes of floods in mountainous reaches and in plains are different, floods are not really preventable, and protection of life and valuables are the main option.

Mission Sustainable Agriculture: Agriculture has grown tremendously in since the 1960's, and irrigation water use has also increased concomitantly. Hence water depletion is significantly attributable to growing agricultural consumption, calling for more efficient irrigation practices and alternate crop

Mission Environmental Knowledge-Building and Sensitization: Environmental planning and management combines diverse fields such as water resources, land resources, biological resources, river dynamics, geological phenomena and atmospheric processes as well as traditional wisdom and grassroots knowledgeing patterns.

VI. CONCLUSION

- It is recommended that there is a need to develop a clear and elaborate definition of 'lake' and other water bodies, that must consider all the aspects including the climatic and ecological changes over the time.
- A holistic understanding and acknowledgement of an urban water system should be an important part of urban water management plan. Without a healthy catchment water body is no more than a tank and has no abilities to maintain its water balance by its own.
- 3A clear vision regarding the level of rejuvenation of water bodies is also recommended. In order to make a productive use of limited available resources, it is important to determine an acceptable level of restoration of urban water bodies.
- It is also suggested here that the ecosystem services provided by a waterbody must be valued in terms of quantification of its benefits.
- There is also a need to emphasis on developing a systematic strategy involving all the components that have an impact on the waterbody and the involved stakeholders along with a better coordination among the government agencies, as part of lake and wetlands restoration and protection programmes.
- It is also required to replace the fast track development programmes, with well analysed and environmentally sustainable programmes based on a holistic understanding of urban environment and its needs.
- Citizens should be aware of the importance and benefits of lakes and wetlands in their lives, it is extremely difficult to implement laws effectively. Hence it is strongly recommended that stakeholder participation and capacity building must be used as an important instrument for better management of urban waterbodies.

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