

Identifying the Factors Causing Degradation of Urban Waterbodies: Case of Sakkardara Lake

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Abstract: Rapid urbanisation and economic development has created adverse effect on the quality of life in city. It also has adverse impact on the natural environment. At present, in India, Urban Waterbodies are in very bad shape and water quality is degraded. Urban waterbodies have environmental, social and economic significance, still we have neglected and destroyed these them. Today these water bodies are encroached and dumped with sewage and garbage. Due to unplanned urbanization, area around these lakes is covered by impervious surfaces. As a result, the sewage and effluents are filling up urban water bodies instead of rainwater. Lakes were once the sponges of urban areas, but today they have turned into hazards that get choked and cause floods even with low rainfall. Every town and city has a different socio-cultural, physical and environmental structure therefore a single approach cannot be applied to all urban waterbodies, as these factors also play an important role in its revival and rejuvenation. Thus today we are in dire need our urban lakes more than ever. This study takes the case of a Sakkardara lake in Nagpur city. Nagpur city has also experienced significant increase in population, which has impacted the urban waterbodies in and around the city. In the last two decades almost ten to twelve small lakes have been encroached in the name of development. Out of all the lakes Sakkardara Lake is the most neglected and presently there is hardly any water remaining in this lake which was once a glory of Nagpur city. This is an exploratory research which aims to identify the factors causing changes in the water quality of Sakkardara Lake, Nagpur. Field survey, historical data, interview, water quality analysis (lab tests) is done to identify these factors. The research intends to suggest the steps to restore and rejuvenate the lake as per advisory on urban waterbodies.

Keywords: Urbanisation, Urban water bodies, Factors causing changes, Pollution, Water quality.

Introduction and Background Study:

Lakes are an important part of the urban ecosystem. They have significant environmental, social and economic functions, ranging from being a source of drinking water, recharging groundwater, acting as sponges to control flooding, supporting bio-diversity and providing livelihoods. Water in lakes is an easily available source of water for agriculture, domestic and industrial sectors. In today's context, these water bodies, play a very vital role in maintaining environmental sustainability in urban environments especially when the cities are facing the challenges of unplanned rapid urbanization. This study takes the case of a lake in Nagpur city to identify the factors causing degradation of urban water bodies.

Study Area:

Nagpur City lies on the Deccan plateau of the Indian Peninsula and lies 310 meters above sea level. It is the winter capital of the state of Maharashtra, a fast growing metropolis and third largest city in Maharashtra after Mumbai and Pune. With a population of 46, 53,570 (2011) Nagpur Metropolitan Area is the 13th largest city in India. The city was founded by the Gonds but later became part of the Maratha Empire under the Bhosles. The British East India Company took over Nagpur in the 19th century and made it the capital of the Central Provinces and Berar. Nagpur city has many lakes in and around the city out of which few were built under Bhosle rule for supplying water to the city. Gorewada Lake, Ambazari Lake, Futala Lake, Gandhisagar Lake, Sonegaon Lake and Sakkardara Lake are some of the major lakes located in the city. Unfortunately, with rapid urbanisation and economic development Nagpur has experienced significant increase in population, which has impacted the lakes in and around the city. In the last two decades almost ten to twelve small lakes/ponds have been encroached in the name of development. Some lakes have decreased in size and also the water and soil quality is degraded. Out of all these lakes Sakkardara Lake is the most neglected and currently there is hardly any water remaining in this lake which was once a glory of Nagpur city. Thus Sakkardara Lake is considered as a case to identify the factors causing the degradation of lake.

Need of the Study:

Of all the lakes in the city, Sakkardara Lake is in the worst condition with very low water level. Lake also has a historical importance. Various factors are responsible for the changes/degradation of lake. Thus there is a need to study these factors causing changes to revive this urban waterbody which was once the glory of Nagpur City.

Aim: To identify the factors causing degradation/changes overtime of Sakkardara lake Nagpur, study and analyse the same and suggest the steps for rejuvenation.

Objectives:

- To study the historical significance of lake.
- To identify the physical factors causing the change/degradation of Lake.
- To identify the socio-cultural factors causing the change/degradation of Lake.
- To give recommendations to restore and rejuvenate the lake.

Scope:

This research will focus on identifying and studying the factors causing changes in Urban Waterbodies. Sakkardara Lake which is the most neglected waterbody in Nagpur is identified as a case study.

Limitation:

Many factors are responsible for causing the degradation changes/ of urban waterbodies. This research will focus on physical and socio-cultural factors causing changes/ degradation of Sakkardara Lake.

Literature Review:

Lakes are an important part of the eco system. A lake is the Water Body which holds certain volume of water generally in all seasons of the year (Advisory on Conservation and Restoration of Water Bodies in Urban areas, 2013). Urban lakes are very important feature in the landscape of any town or city. They play a vital role in maintaining the biodiversity, influence the microclimate and also create recreational opportunities. However, over the period of time due to urbanisation and development of cities these urban waterbodies have been impacted severely leading to degraded water and soil quality. It has thus become important that we take some measures to save these dying waterbodies. Various Physical and Socio-cultural factors are responsible for degradation of urban waterbodies. The factors that lead to degradation of lakes include urbanization, reclamation or encroachment, pollution of water due to sewage, nutrient rich agricultural run-off and industrial toxic liquid waste, Eutrophication, Unplanned tourism activities, Cultural misuse etc. Of all the above mentioned factors Urbanisation is one most important factor responsible for this degradation. The case of small urban waterbodies is most pathetic. They are in the most neglected state. Many of these are reclaimed by the builders in the name of development and the remaining are systematically destroyed by dumping the waste and garbage. Both for the government and the private builders these lakes are extremely valuable opportunities (Kang). After independence government took control over these water resources. In cities these waterbodies are under the

landowning agencies who are more interested in maximising the land availability not in protecting the waterbodies. This shift abruptly disengaged and alienated local communities whose lives were intertwined with these local water resources for generations (Kang).

However there are many government and non-government organisations who are involved in protection and rejuvenation of these urban waterbodies. At the Central Government level, Ministry of Environment and Forests (MoEF) plays an important role in restoration of lakes in India under its initiative called National Lake Conservation Plan (NLCP) developed in 2001 specifically for the protection and management of lakes.

Other important factor responsible for degradation of the urban waterbodies is pollution of water due to sewage and industrial toxic waste. Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application (Pimple & Amrutar, 2015). Due to which most of the urban waterbodies are non-potable & biodiversity threatened. To identify the level of degradation of Lake Water, Water quality index (WQI) can be used which is based on aggregate data on water quality parameters. The quality of water of lakes can be assessed with help of a checklist on designated best use, enclosed at Annexure-I. From all the research papers, articles, BIS standards study it can be concluded that the physical and socio-cultural factors are main reasons for the degradation of the urban waterbodies. Small urban waterbodies are most neglected and are being encroached. Thus this issue needs to be addressed.

Methodology:

For Objective 1

- Collect the historical data from literature study, newspaper articles, photographs, site visit, interviewing historian, local residents, and government officials.
- Create timeline based on the collected data to trace these changes.

For Objective 2

- To identify and study various physical factors causing the changes by doing site survey, mapping, studying the google images.
- Collection of water sample from the lake to assess the change in water quality.
- Laboratory testing of collected water samples.
- To compare and analyse the data obtained from the tests with the standards for water quality parameters.

For Objective 3

- To identify and study the socio-cultural factors causing changes by doing site visits, observations, interviewing the local residents.
 - To identify the change in activities over the time period by doing activity mapping.
- For Objective 4
- To study and analyse all the physical and socio-cultural factors causing changes/ degradation of lake.
 - To suggest the steps to restore and rejuvenate the lake as per advisory on urban waterbodies

Results and Discussions:

Sakkardara Lake is about 5kms south-east of Nagpur City. The lake is spread around 8 acres of Area. The lake is surrounded by residential and commercial zone in the Development Plan of Nagpur with the only exception being the Southern edge which has been reserved as a green area.

Historical Background:

In 1729 Raghuji Bhosle's rule was established in Mahal (Nagpur). Nagpur started progressing (Shukrawari Talao). In Budhwari, some Marathi soldiers were given shelter. Soldiers were sheltered in areas like Indora, Sakkardara and Sitabuldi. Raghuji-1 developed a lot of factories & industries in Sitabuldi. At initial stage, lake was not present as today it is, slums were there for soldiers. Under Rule of Raghuji Bhosle – 2 (1755 To 1816) to the increasing population of soldiers, they were provided a place backside the lake which was called as sevadal and now known as Sevadal Nagar. Being religious Raghuji Bhosale visited Sakkardara frequently and wished to build a temple there. Looking forward to the increasing number of soldier, factory was constructed. The place for the temple was predefined and construction was started. A stepwell was constructed towards the left of the temple. A wada was pre-existing which was built by Raghuji-1 and then a 2nd wada was constructed by Raghuji-2 after the Temple was built up. During reign of Raghuji-2, a temple, lake and garden were built. Residential Complex were built up on south of the Temple.

Present Status of Lake (Observations):

Almost all of the area around the lake is demarcated as residential and commercial zone in the Development Plan of Nagpur with the only exception being the Southern edge which has been reserved as a green area. Lake view is blocked due to the barricades around the lake. Bollywood Centre point (Entertainment plaza) is located on the Northern bank of the lake. Construction Debris (Demolition of compound wall) of Bollywood Centre point is dumped in

the lake. Slum and Residential area is on the Eastern side of the lake. The habitants of slum settlements located are seen using the readily available lake water for domestic activities. Garbage is dumped by the slum dwellers into the lake. Southern edge of the lake was developed as a recreational open space (garden and Restaurants) which is now closed and inaccessible. Western side of the lake has residential and commercial development. Lakshmi Narayan Temple is also located on the western side of the lake. (fig. 1 here)

Lake water Quality: Physio-Chemical

The pH was found to be in the range of 7.1-7.5 in Sakkardara Lake. Total Alkalinity (Carbonates) and Total hardness were found in the range of 300-320 mg/L and 510-534 mg/L. Sulphates and Nitrates were found in the range of 36-186 mg/L and 3-40 mg/L respectively. Turbidity was found to be the Lakes which was found to be 7.9-10 NTU. The COD and BOD range between 25-70 mg/L and 5-8 mg/L respectively.

Lake water Quality: Bacteriological

Total coliform and thermos tolerant coliforms (faecal coliforms-FC) were found in the range of 233-22 and 96-20 respectively.

Comparative Analysis of Water Quality Data: (fig 2. here)

To check the water quality (physio-chemical parameters) of the lake water sample was collected and tested in laboratory. The lake water sample was tested for 17 water quality parameters as per IS 10500. The lab reports were then compared with the BIS Limits and ESR-NEERI Report of Sakkardara Lake to determine present the water quality status of the Lake.

- pH Value: Presently the pH was found to be in the range of 7.5 in Sakkardara Lake. In the year 2019-2020 it was 7.10 which is the permissible BIS range.
- Turbidity: Presently the turbidity level is in the permissible limit, previously it was 10 NTU which was higher than the BIS limit.
- Total hardness and total alkalinity is in the BIS permissible range.
- Electro Conductivity: Presently it is 990 uS/cm which is quite high than the permissible BIS limit. Previously it was 850 uS/cm which is quite higher than BIS limit.
- Chloride and Sulphate level is 75.5 and 141 mg/L which is low than the permissible limit.
- Phosphate: It is 0.65 mg/L which is quite higher than the BIS limit. Increase level of phosphates is the main reason of Eutrophication in Lake.

- Fluoride and Magnesium level is 0.18 and 28.12 which is lower than the permissible limit.
- Potassium level was high in the year 2019-2020. The major source of potassium is due to the disposal of wastewater.
- BOD is 3.60 which is lower than the BIS limit.
- Dissolved Oxygen: Do value is 4.80

Identification of the Factors causing Changes: (fig 3. here)

Physical changes:

(fig. 4, 5, 6, 7, 8 and 9 here)

Suggested Recommendations:

- Awareness programmes should be conducted in the surrounding residential localities about the benefits and importance of the lake. Do's and Don'ts poster/artwork should be displayed in the surrounding areas of lake.
 - People should be restrained from throwing garbage and other waste in the lake premises. Littering around the lake should be made a punishable offence.
 - Construction work should be prohibited on the banks of the lake.
 - Encroachment on the bank of lakes should re-located.
 - Sewage and wastewater should not be directly dumped in the lake. Waste Water should be treated before disposal.
 - Solid waste collection bins should be installed around the lake premises.
 - Local authority should take up the work of cleaning, desilting, aeration, reduction of nutrients of the lake.
 - The historical sanctity of the lake should be preserved. Any kind of recreational activity should be taken up considering the historical, social and cultural importance of lake.
 - Water centric approach should be developed while drafting the master plan of the city.
 - Establish a Lake Conservation Authority at State level to devise a new mechanism to sustain lakes as finite natural resource and rejuvenate them at eco system based approach.
- (Advisory on Conservation and Restoration of Water Bodies in Urban areas, 2013).

Conclusion:

From the research various factors were identified which were the main cause of degradation of Sakkardara lake Nagpur. Physical factors include encroachment, releasing of untreated

sewage into the lake and Construction and demolition work around the lake. Socio-cultural factors identified include increase in the population in the surrounding area of lake, dumping of garbage in lake by the local residents, open defecation and Religious activities such as immersion of idols/nirmalya/materials used in the worship of god. All these factors are responsible for change in size and shape of lake, low water holding capacity, degraded water quality of lake and Eutrophication. The lab reports of the water sample shows that all the parameters which were analysed showed a permissible amount of concentration. Since there is an influx of sewage water, the water shows concentration of various salts above the average level which is the main cause of Eutrophication and low DO levels. Thus there is a need for integrated governance, awareness and effective restoration of the quantity, quality and ecology of the lakes. Development should take place in a planned manner considering the historical, social and cultural importance of the lake as every city and town has a different socio-cultural background, physical structure and environmental scenario. Also merely developing waterfronts as recreational and economic zones will not be successful if they are contaminated and unclean.

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Lake
Residential
Slums

Open space
Commercial
Mix-use

Water Quality : Physio-Chemical Parameters				
Sr. No.	Tests	BIS Limit	Results (ESR - NEERI)	Results (Lab reports)
1	Ph	6.5 to 8.5	7.10	7.50
2	Turbidity NTU	1 to 5	10	1.16
3	Total Dissolved Solids mg/L	500 to 2000	510	576
4	Electrical Conductance uS/cm	400	850	990
5	Total Hardness mg/L	200 to 600	248	337
6	Total Alkalinity mg/L	201 to 600	320	309.3
7	Chloride mg/L	250 to 1000	102	75.5
8	Sulphate mg/L	200 to 400	77	141
	Phosphate mg/L (WHO limit)	0.1	0.5	0.65
9	Nitrate mg/L	45	5	10
10	Fluoride mg/L	1 to 1.50	0.8	0.18
11	Calcium mg/L	75 to 200	51	88
12	Magnesium mg/L	30 to 100	20	22.12

Factors Causing Changes in the water quality of Lake			
Physical Factors	Changes Occurred	Socio-Cultural factors	Changes Occurred
Encroachment on the bank of lake	Shape and Size of Lake, Reduction in water holding capacity	Increase in Population in the surrounding lake area	Size and shape of lake, Change in Water quality
Release of untreated sewage	Change in water quality (phsio-chemical), Low water level, Eutrophication	Garbage dumping in the lake by the local residents (garbage in the form of plastic waste/metal/glass bottles/paper/sanitary waste/leftovers of vegetable, fruits and food)	Change in water quality (phsio-chemical), Eutrophication
Construction/Demolition work around the lake	Change in water quality (phsio-chemical), Reduction in water holding capacity	Washing of clothes	Change in water quality (phsio-chemical), Eutrophication
		Open Defecation	Change in water quality (phsio-chemical), Eutrophication
		Religious activities (visarjan of idols/nirmalya/material used in worship of god)	Change in water quality (phsio-chemical), Eutrophication

Year 2000	Area in acre
Lake	9.05
Residential	0.50
Mixeduse	0.62
Slums	12.30
Open space	12.68

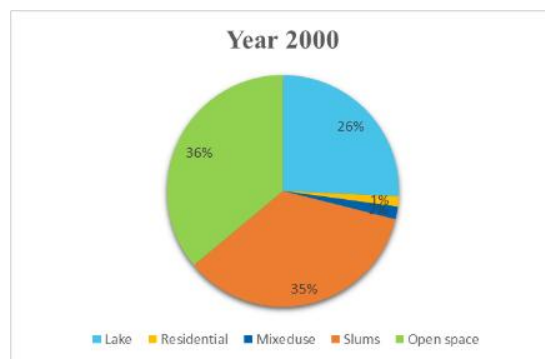
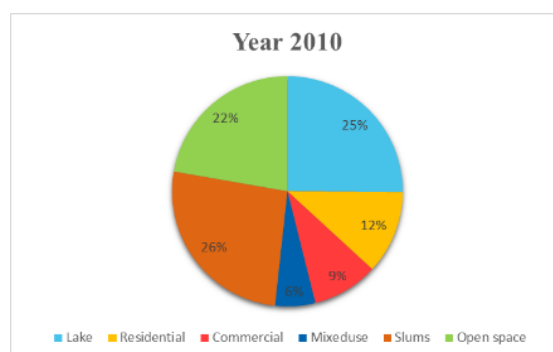


Figure 4

Year 2010	Area in acre
Lake	8.70
Residential	4.07
Commercial	3.21
Mixeduse	1.95
Slums	9.02
Open space	7.71



Year 2021	Area in acre
Lake	8.09
Residential	4.53
Commercial	3.32
Mixeduse	1.95
Slums	9.02
Open space	7.42

