Case Study and Analysis of Ecological Restoration Plan of Lakes in Coimbatore

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Abstract. Lakes provide both humans and animals with great interest in water conservation because it contributes to their survival. Lakes have many applications, including leisure purposes, related to human activities. The lakes in India need to be protected and restored directly. Owing to unsustainable human activity, much of the lake landscape is a waste water collection storage area. Given this troubling failure of urban water bodies to function, it is essential that the lakes are kept free of pollution and accessible. The proposed work aims to advance the conservation of urban water systems in Coimbatore. The case study on lake rehabilitation (Periyakulam and Valankulam Lake) was examined. The approval and cooperation by Coimbatore City Corporations enhanced the hygienic condition and the ecosystem of the lakes in and around Coimbatore City. As a result, various approaches for restoring water bodies have been suggested.

1. Introduction
Lakes are characterized as the landscape that collects water, and their life is faster than the outlet, depending on the flow of inlet water. To marine life and human needs, the lake habitats are essential resources. Lakes have mild temperatures and influence the surrounding ecosystem. We regulate streamflow, restore groundwater aquifers and the frequency of droughts by storing water. Lakes provide shelter for aquatic or semi-aquatic plants and animals, which in turn provide food for many living things, increasing landscape diversity. Coimbatore District is a Tamil Nadu district and is the South Indian Manchester. The company is made up of 257.04sq. The Noyyal River is divided into the north, south, east, west and central areas, flowing through Coimbatore, forming the southern limit of the city. The town is located in the Noyyal basin and has an extensive lake system fed by the river and the runoff of rainwater. Narasampathi, Krishnampathi, Selvampathy, Kumaraswami, Selvachinthamani, Periyakulam, Valankulam, Singanallur tanks are the eight largest tank areas of Coimbatore. The lake pollution and the treatment needed to control it were carried out by Antara Bhattacharya and Anugya Shandilya (2017). Three initial evaluation stages have been established and extended to ten projects as planned for ecological conservation of the lakes. The lake was restored with rich mineral content and particular emphasis on climatic conditions. The
rehabilitation of the lake with an ongoing recovery plan on the edge of the water as suggested. A research was conducted on the question of environmental impacts of tourism growth. This case study review several proposals related to Periyakulam Lake and Valankulam Lake rejuvenation to compile a comprehensive report on the different rejuvenation methods, summarization of the advantages, the need to rejuvenate the lake for the people around the lake and discuss the various benefits that can be obtained following the rejuvenation. Following the effective rejuvenation of Periyakulam Lake and Valankulam Lake, it was suggested that different aspects of other famous lakes in Coimbatore, examined for implementation of a rejuvenation/improvement plan. Periyakulam Lake and Valankulam Lake profile and geographical data are shown in Table 1-4.

Table 1. Profile of Periyakulam Lake

| Lake Name            | Periyakulam Lake       |
|----------------------|------------------------|
| District/Taluk/Village | Coimbatore, Tamil Nadu |
| Latitude and Longitude | N 10º 58' 44" E 76º 56' 43.56" |
| Altitude(m)          | 408.00MSL              |
| Basin/Series/Sub-Series/Halla | Noyyal Basin            |
| Lake Basin Type      | Transitional           |
| Catchment Area       | 8.54 sq km (as per current analysis) |
|                      | 10.752 sq km (as per Tank register) |
| Top of bund Level    | 97.4 m                 |
| Length of Main Bund  | 2880 M (as per Tank register) |
|                      | 2800 M (as per topographical Survey Drawing) |
| Water Spread area    | 1.245 sq km (as per topographical Survey Drawing) |
| Area of Lake         | 333 Acres 21.381 Gunta (as per topographical Survey Drawing) |
| Full Tank Level(FTL) | 94.94 m                |
| Gross Storage        | 1980763.42 Cum (as per Tank register) |
|                      | 1843912.0 Cum (as per topographical Survey Drawing) |
| Length of Waste Weir, Type | 28.00 m             |
| Maximum Flood Discharge | 42.62 Cum            |
| Length of Shore Line | 5240m                  |
| Mean Depth           | 1.5m                   |
| The average depth of water concerning FTL of the lake | 2.44 m |
| Maximum Depth        | 5.87 m                 |
Table 2. Profile of Valankulam Lake

| Geographical Coordinates | N10°59.338'  E 76°57.919.' |
|--------------------------|-----------------------------|
| Altitude                 | 440m above MSL              |
| Lake Type                | Natural                     |
| Area                     | 64.75 ha                    |
| Maximum Depth            | 4.5m                        |
| Mean Depth               | 2 m                         |
| Water Spread Area        | 64.75 ha                    |
| Catchment Area           | 479.27 ha                   |
| Storage Capacity         | 27.88 Mcft                  |
| Inflow Water             | Rainfall, Runoff, River, Drain, Wastewater Drain. |
| Outflow Water            | Has Three outlets, surplus water is diverted directly to Sanganur Pallam drain, Maximum flood Discharge is 12.86 cumec |

Table 3. Geographical data of Periyakulam lake

| Catchment Area of the Lake (as per GIS Analysis) | 9.014 Sq.km |
| Existing FTL as per Survey drawing | 405.86 |
| Proposed New FTL | 405.10 |
| Total Length of the Existing Main Bund | 2800 m |
| Existing Surface Area of the Lake at FTL as per Survey drawing | 1,249,739 Sq-m |
| Storage Volume of the Lake (as per survey tank register) | 1,980,763m3 |
| Storage Volume of the Lake as per Survey drawing up to existing FTL | 24,40,059Cum |
| Estimated Flood Discharge | 52,394 cumecs |
| Surplus Arrangements (dysfunctional) | Surplus weir-27m |
| Spillage Depth of Weir | 0.6m Historical |
| Total Wastewater inflow | 12.8MLD |
| BOD | Min:100mg/L Max:450mg/L |
| COD | Min:150 mg/L Max:1200 mg/L |
Table 4. Geographical data of Valankulam Lake

| Description                                                                 | Value   |
|-----------------------------------------------------------------------------|---------|
| Catchment Area of the Lake (watershed delineation using topo sheet)          | 11.17 Sq.Km |
| The current Analysis catchment area of the Lake                            | 5.05 Sq.Km |
| Existing FTL as per Survey drawing                                         | 404.80  |
| Proposed New FTL                                                           | 404.50  |
| Total Length of the Existing Main Bund                                      | 2500 m  |
| Existing Surface Area of the Lake at FTL as per Survey drawing             | 4,20,528 Sq-m |
| Storage Volume of the Lake (as per survey tank register)                    | 7,89,474 cu.m |
| Storage Volume of the Lake as per Survey drawing up to existing FTL         | 7,57,968 cu.m |
| Total Wastewater inflow                                                    | 2.73MLD |
| **BOD**                                                                    |         |
| Min:60 mg/L                                                                |         |
| Max:160 mg/L                                                               |         |
| **COD**                                                                    |         |
| Min:300mg/L                                                                |         |
| Max:600mg/L                                                                |         |

2. Methodology

2.1 Desilting of the lake
Desilting the lake with the max depth of 0.9m at the centre and 0.3m along the shoreline (Figure 1).

2.2 Removal of geo fabric layer
Remove the existing geo fabric layer and provide revetment along with turfing to protect existing and proposed bund from erosion. Revetment and turfing are proposed to the water side of the bund to protect the bund from erosion. Revetments are proposed to the water side of the bund to protect the bund from erosion.

Figure 1. Lakes in Coimbatore, Tamil Nadu, India
2.3 Walkway Bund profile correction and protection north western side
Revetments are proposed in the toe portion of the bund on the water side to prevent erosion of the bund.

2.4 Dismantling and reconstructing surplus arrangement
Constructing flush escape in Nala to discharge excess water directly to Noyyal River during a flood and constructing a defined drain section to accommodate flood discharge with the stone line canal.

2.5 Outnala refurbishment and refurbishment of draft channel drain
We are constructing a new box culvert or pipe culvert to accommodate the flood discharge. Construction of a defined cross-section to accommodate flood discharge with a stone-lined canal.

2.6 Construction of collection chamber near inlet
Chamber construction to link drains and connect lake via pipes. It proposed to reduce the invert level of the outlet tube to alter the depth of the water link and to alleviate floods. An irrigation sluice has become ineffective as a result of urbanization. The is proposed sluice to restored and developed to regulate water for maintenance and to act as a discharge mechanism for flooding. It proposed to provide a fixed cross-sectional line drain for 1000m for the estimated discharge of existing terrestrial drains with online channel treatment.

2.7 Island enhancement and non-motorized transport
Providing safety work for the island with a surface turfing revetment in contact with water and a non-motorized pathway is proposed.

2.8 Wastewater management
The treatment of wastewater segregated into three treatment parts, and they are pretreatment, primary and secondary treatment, and tertiary treatment.

2.9 Removal of unserviceable soil profile correction: southern side main bund
Striping the improper slope along the waterside and forming a proper bund. The gradual slope for better biodiversity integration and provided revetment on the waterside & turfing on the downstream side to protect from soil erosion. The total length for this work is 2400m.

2.10. Reformation of walkway bund and slope protection
It proposed to construct with recommended soil to maintain 1:1:5 slope. It should not be steeper than recommended. Since the northern bund does not take any water load, the slope protection works done with the formation of bund using a gentle slope of 1:3 with grass/plants/trees plantation to stabilize the shoreline. Provision should be made for revetment in the toe portion of the bund on the waterside to protect the soil erosion.

2.11. Diversion of storm water into the lake and outlet nala resectioning
The new surplus system has suggested for the flood discharge capacity of 35.74 m³/sec. For safe flood discharge passage, the outlet drains / structure near Sungam junction must be altered and adjusted accordingly. Based on inlet levels & drain levels, Valankulam's FTL proposed to reduce from 404.80 to 404.50.

2.12. Desilting in pond A & B
Desilting recommended raising storage capacity to a maximum depth of 0.6 and 0.3 along the shoreline, as shown in drawings. When the high polluted soil with heavy metals and no sites seem to be known for the disposal of the silt, then the desilting plan can be assumed to be withdrawn. As
per the tank records, the Tank’s storage capacity is 7,89,473.68 cum, and Water depth is as 4.5m as the existing surplus arrangement as FTL resulting in 7, 57,986 cum.

3. Results and discussions
The eco-restoration of lake waters is given the most critical consideration,
  a. Water protection at the lake
  b. Regulation of Storm water
  c. Treatment of waste water
Periyakulam Lake is the largest water body located at the central place in Coimbatore; this study began with different steps to improve the environmental and pollution problems. Along with reasonable issue shielding water condition, prevention of dumping waste, the passage of contaminated water; it was decided to preserve the bunds of the lake as are creational sport for the public.

4. Conclusion
With this rejuvenation scheme, the growth of aquatic species can be increased. Water contamination can also be minimized when treated wastewater is permitted into inlets. Pollution-free water in the lake surrounding area is essential to improving the growth of aquatic animals. Therefore, the researched and proposed to investigate the remedial steps the condition of other essential lakes of Coimbatore.

References
[1] Christer N et. al. 2016 Evaluating the process of ecological restoration Ecology and Society 21(1):41 Edition- 08289-210141.
[2] Jukka H 2019 Sediment Nutrients Ecological Status and Restoration Of Lakes, Conference Water Research 160: 206-208.
[3] Julita A and Grzegorz W 2016 Can we stop the degradation of lakes? Innovative approaches in lake restoration, Ecological Engineering 95:714–722.
[4] Kiran et. al. 2018 Assessment of water quality and identification of pollution risk locations in Tiaoxi river (Taihu Watershed, China.)
[5] Mengmeng Z et. al. 2019 Exploring responses of lake area to river regulation and implications for the lake Ecological Engineering 128:18–26.
[6] Mohan S et. al. 2018 Restoration of Mookanari lake by using Bio-Ozone treatment Salem corporation in Tamil Nadu, India Inter. J. Advances, Sci.Tech 6:1.
[7] Sarika B and Pulluri S 2014 Sustainable approach for conserving and managing for urban water bodies An Online International Research Journal ISSN: 2311-3200.
[8] Sauni W and Alok R 2017 Urban development impacts on water bodies: A review in India International Journal on Emerging Technologies 8(1):363-370
[9] Wei Jetal 2018 Shear strength of purple soil bunds under different soil water contents and dry densities: A case study in the Three Gorges Reservoir Area, China, Catena 166:124–133
[10] Yan Zhaotal 2016 Downstream ecosystem responses to middle reach regulation of river discharge in the Heihe River Basin, China, Hydrol. Earth Syst. Sci. 20 4469–4481.
[11] Yonghua Zetal 2016 Eco system restoration and conservation in the arid in land river basins of North west China: Problems and strategies Ecological Engineering 94:629–637.