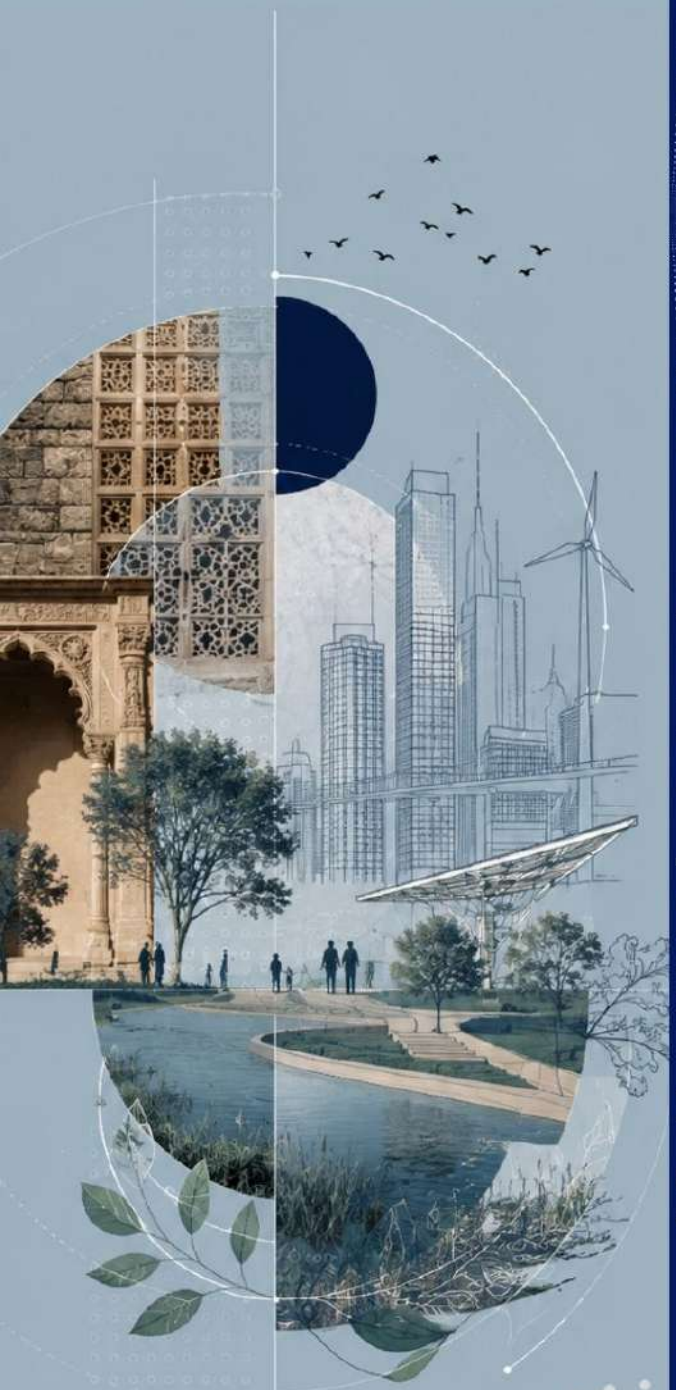


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Sacred Hydrology: Traditional Water Tanks and Water Management Practices in Cuddalore, Tamil Nadu

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Abstract: Temple tanks and water management systems in the Cuddalore district are a community-driven activity and an ecologically adapted method to connect to nearby rivers, and represent a sacred cosmology. Centred around the Chidambaram Natraja temple and extended through canals and ooranis, these systems sustained ritual life, secured water supply for agriculture, and maintained groundwater balance in a monsoon-dependent, flood-prone region. A religious meaning was integrated with an ecological function, reflected in indigenous hydrological intelligence. Urbanisation and colonial interventions changed the old networks which led to siltation, deterioration of water quality and a functional decline. The current restoration initiatives have prioritised desilting, encroachment removal, community engagement, bund strengthening, ecological planting and heritage conservation. This study aims to document the ecological and hydrological impacts alongside the socio-cultural aspects of the restoration effects and evaluate its effectiveness in enhancing resilience. The methodology includes a quantitative evaluation of water quality, storage capacity, groundwater recharge rates and biodiversity, as well as an evaluation of legal urban water management frameworks and uses comparative case analysis. The research explores how integrating insights from traditional water systems in current municipal practices offers comparative perspectives on climate-adaptive urban infrastructure in Cuddalore and Tamil Nadu.

Keywords: Sacred hydrology; Traditional water management; Climate-adaptive infrastructure; Urban water resilience

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1. Introduction

Historically, typical Indian settlements are located or evolved around temples and sacred waterbodies, where almost every temple settlement has a temple tank, which served as an integral part of the region's culture and hydrology. Temple tanks act as a nucleus to community life and sustain annual festivities and rituals while also hosting traditional architectural knowledge (Madhavi Ganesan, 2008). Traditional water management practices remain central to sustainable strategies across India, integrating local knowledge with modern design frameworks (Jain et al., 2024; Verma et al., 2025). Water and worship have shared a symbolic relationship in the culture of South India, where these temple tanks, locally known as *kulams* (pond or water reservoir) or

teerthams (sacred or ritual water), are more than just spaces for rituals; they hold a significant part in the local community's belief and identity while also serving as a hub for social gathering and ecological activities hence representing utilitarian and spiritual functions within a temple complex (Amirthalingam, 2009). The temple tanks in Tamil Nadu form a part of an intricate hydraulic landscape that is shaped by regional climatic and local cultural conditions (Weiz, 2006), and the hydrology reflects a long-standing tradition of integrating ecology and architecture, along with ritual practices (Chakrabarti & Amirthalingam, 2020).

The water management systems attached to the religious beliefs were a major motive to create these tanks. Traditionally, these tanks were built to function as stormwater buffers, storage tanks, microclimatic regulators, and aquifer recharge zones. They represent traditional water management infrastructure whose ecological importance and intelligence remain under-recognised in contemporary urban planning (Ariza et al., 2007; Madhavi Ganesan, 2008). Numerous temple tanks across Tamil Nadu have experienced a decline due to colonial land policies, urban encroachment, pollution, siltation and a disconnection from feeder is observed in the case of Cuddalore, where degradation of the temple tanks has increased vulnerability to floods and diminished water security locally (EFI, 2020).

The study explores the role of temple tanks in the present day as ritual sites and urban infrastructure by integrating quantitative data with secondary documentation and community perception. It focuses on six tanks in and around Chidambaram and within Cuddalore. Three restored and three non-restored tanks have been chosen to comparatively assess their spatial, hydrological and socio-cultural dimensions. The study emphasises the need and necessity of accurate and renewed documentation in order to position traditional water management systems like kulams as a framework for flood mitigation and as a preservation of sacred hydrology and the region's heritage and cultural identity.

2. Literature Review

2.1. Regional Setting

The temple tanks of Tamil Nadu have historically served a variety of purposes, including water storage, ecological services and ritual functions have emphasised a perception of an ecosystem, highlighting community engagement in maintenance. These systems reflect a deep ecological consciousness, balancing ritual sanctity and sustainable hydrology (Bimrah & Saizen, 2025; Saravanan, 2020). Siltation, encroachment, and poor water quality are results of colonial and post-colonial urbanisation's disregard for the native water networks. Colonial land tenure systems, modern drainage infrastructures, and privatisation led to the neglect of these tanks.

2.2. Temple Tanks as Hydro-Social Infrastructure

Temple tanks functioned as multi-purpose water systems that urban design with hydrological settlements while retaining basins that controlled flooding, recharged shallow aquifers and supported irrigation networks (Karthi & Balamurugan, 2017; Madhavi Ganesan, 2008). The core of hydraulic systems in temple towns, especially in Tamil Nadu and Andhra Pradesh, has interconnected networks, often linked through channels, and the tanks exemplify the concept of hydro-social infrastructure, where water and belief, along with the built form, are mutually sustaining while reflecting ecological consciousness (Bimrah & Saizen, 2025; Saravanan, 2020). A similar system of integrative networks exists in Sri Lanka. The traditional tank cascade system demonstrates parallel models of hydrosocial infrastructure, depicting how traditional water networks created relationships between ecology, culture and settlements (Gunasena & Nianthi, 2024).

Environmental studies have identified temple tanks as vital nodes in pond ecosystems, offering hydrological and biodiversity benefits while simultaneously representing human-dependent landscapes that sustain ecological diversity along with social identity (Farina, 2022; Kumar & Padhy, 2015).

2.3. Decline and Disconnection

The traditional water management systems and structures have faced a major decline due to land revenue policies, canal irrigation projects, urban encroachments and colonial transformations (Karuppaiya, 2025) influencing present-day tank management (Saravanan, 2020). Numerous temple tanks in Tamil Nadu have dried up or been converted, degrading the area's culture and heritage (EFI, 2020). Depletion of groundwater and loss of catchment linkages of a region further reduced the recharge capacity and ability (Ariza et al., 2007).

2.4. Restoration and Community Efforts

Recent restoration efforts in cities of Tamil Nadu, namely, Chennai, Madurai and Thanjavur have resulted in a measurable increase in water quality, biodiversity and storage capacity. The EFI Chidambaram project is a notable effort in the district of Cuddalore that involved volunteers and the community in the restoration of temple tanks, along with the removal of over 400 encroachments, desilting the tanks and ecological planting to revive the heritage structure and system, while also trying to improve the biodiversity (EFI, 2020).

3. Study Area and Tank Selection

3.1. Regional Setting

The coastal wetlands of Tamil Nadu, including both temple tanks and mangrove regions of the state, form interconnected hydrological corridors that sustain water recharge (Gnanappazham et al., 2025). The district of Cuddalore, situated along the coastal belt of Tamil Nadu is home to a rich network of temples and temple tanks,

several of which remain neglected and undocumented. On the contrary, contemporary sustainable initiatives in nearby Auroville exemplify experimental models for decentralised water management across the region (Nagy, 2021).

Located between the Vellar and Gadilam rivers, the district of Cuddalore receives about 1,300 mm of rainfall each year. The district receives maximum rainfall during the northeast monsoon, making the district more susceptible to floods due to its flat terrain and growing population. Due to the loss of historic temple tanks, obstruction of natural water drainage channels, and a rapid increase in land use have substantially diminished the area's water absorption capabilities, increasing vulnerability to floods and the decline of groundwater resources.

3.2. Selected Temple Tanks

The measurements of the tank area and elevation were extracted using satellite imagery (2024) and data on restoration status derived from EFI documentation (EFI, 2020) and local administrative reports. Given the absence of standardised on-site documentation, satellite-based proxies were used to approximate storage and spatial capacities and conditions.

Table 1. Area, restoration status and elevation of temple tanks

Tank Name	Restoration Status	Area (m²)	Elevation (m)
Padaleeswarar	Restored	704.15	43.0
Sivagangai	Restored	4,295	26.0
Ilamaiyakkinar Koil	Restored	7,891.8	23.0
Vishveshwara Temple Pond	Non-restored	20,936.8	37.73
Ponniaman Koil Kulam	Non-restored	949.69	22.11
Sri Sengamalathayar Tank	Non-restored	102,210.95	27.24

Source: *Satellite imagery (2024); restoration status from* (EFI, 2020) *and local administrative reports.*

3.3. On-site observations

Restored tanks exhibit clear bunds and vegetation along embankments, and community usage for rituals and small-scale irrigation. Non-restored tanks show heavy siltation, reduced percolation and encroachment by informal settlements or dumping. Elevation data suggests potential hydraulic linkage among tanks within similar altitudinal bands, particularly in the Chidambaram cluster.

4. Research Methodology and Outcomes

4.1. Data Sources

The study primarily relies on secondary data, and physical parameters are measured using satellite images for surface area, perimeter and elevation. Secondary data collected from temple records, Environmental Foundation of India reports, and

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published restoration documentation. Comprehensive documentation of Tamil Nadu's wetlands, including temple tanks, remains limited, as highlighted in regional bibliographic surveys (Balakrishanan et al., 2017).

4.2. Analytical Parameters

For comparative assessment, a set of analytical parameters is considered that deal with the depth, volume, recharge potential and flood detention potential of the temple tanks. The average depth of the tanks is assumed to be 3-4 metres in restored tanks and 2-3 metres in non-restored tanks. The storage volume is calculated using the basic mathematical formula: *Area* × *Depth.* Approximately 10-15% of the storage. Volume per season is thought to be the groundwater recharge potential, while 20% of the monsoon volume is regarded as the flood detention potential. The study also evaluates three prominent comparative parameters —hydrological performance, ecological regeneration, and cultural engagement — to understand how temple tanks contribute to environmental sustainability and sociocultural resilience.

4.3. Quantitative Assessment

The calculated storage volumes and restoration outcomes highlight the difference in hydrological performance between restored and non-restored temple tanks in Cuddalore. While the non-restored tanks possess significantly larger physical capacities, their performance is limited by siltation, poor channels and connectivity and due to a lack of maintenance. Restored tanks, although small in size, demonstrate an improved functionality with constant water retention and great recharge efficiency due to desilting and revived feeders. A pre- and post-restoration comparison shows an increase in the groundwater levels and an improved biodiversity which subsequently results in an enhanced use of the space by the community, thereby reinforcing ecological and social values to the restoration interventions.

Table 2. Calculated Storage Volumes

Tank Name	Average Depth	Volume (m^3)
Padaleeswarar	3	2,113
Sivagangai	4	17,180
Ilamaiyakkinar Koil	4	31,567
Vishveshwara Temple Pond	3	62,810
Ponniaman Koil Kulam	2.5	2,374
Sri Sengamalathayar Tank	4	408,844

Source: *Storage volumes derived from* ***Table 1*** *(Area x assumed average depth, see Section 4.2).*

Data from **Table 2**, taken using satellite images, help form the baseline for assessing the hydrological efficiency and storage performance of each tank category.

Note: *Indicative values adapted from* (EFI, 2020) *and comparable restored-tank*

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outcomes reported for the Chidambaram/EFI initiative, used as a proxy in the absence of primary on-site monitoring for the six tanks studied; this reflects a broader documentation gap discussed in ***Section 4.1.***

Table 3. Pre- and Post-Comparison of Restored Tanks

Indicator	Before Restoration	After Restoration (avg. 2 years)
Avg. Water Level (m)	0.8-1.2	2.4-3.0
Groundwater Table (m)	18-20	10-12
Biodiversity Index/Species Count	12	38
Daily Footfall (average)	35-40	100-150
Local Surface Temperature (°C reduction)	-	1.2-1.8 lower
Ritual/Community Events annually	3-5	7-10

The data in **Table 3** represents the physical and ecological outcomes of restoration across the tanks.

A comparative study of the restoration of the temple tanks, namely Padaleeswarar Tank, Sivagangai Tank and Ilamaiyakkinar Tank, revealed improvements in the hydrological and ecological spheres where groundwater rose by 0.8m to 1.2m within two years, correlating to a 15-20% increase in the recharge rates of the household wells. Tanks, once dry, now retain the water for more than eight months annually, supporting the return of aquatic vegetation and promoting an increase in biodiversity in and around the area. Improved water quality and accessible surroundings have led to an increase of around 30% in the community footfall during rituals and temple festivities, transforming the temple tanks into vibrant socio-ecological spaces, affirming that the restoration not only enhanced the hydrological efficiency of the tanks but also revived the cultural and ecological life of the neighbourhood.

4.4. Observations

Table 3 data shows that restored tanks, although smaller, retain and recharge water more efficiently. This is due to desilting, bund strengthening and properly maintained regulations of inlet and outlet channels. Non-restored tanks possess larger sizes with much greater capacity, but underperform due to siltation and encroachment, thereby reducing their hydrological and social functions.

The restored temple tanks demonstrate a recharge potential of 6,103 m^3, whereas non-restored tanks exhibited a higher potential of 56,883 m^3. The higher potential in non-restored tanks was due to unregulated runoff and unaccumulated silt. Restored tanks show a flood detention potential of 10,172 m^3, whereas the non-restored tanks in the district exhibit around 94,806 m^3, underlining the hydrological capacity of neglected tanks when restored effectively.

A regrowth of vegetation and an increase in the biodiversity index are observed in the restored tanks. Post restoration, an increase in the community footfall is also noticed, as mentioned in **Table 3**, which reactivated the social and spiritual role of temple tanks, strengthening their maintenance through cultural values.

5. Integrated Assessment and Implications

5.1. Hydrological Performance

On comparison to non-restored tanks, restored tanks exhibit effective water retention and recharge rates that are 2-3 times greater. Summer scarcity of water is thereby reduced due to increased groundwater levels by enhanced infiltration and decreased runoff.

5.2. Ecological Role and Living Biodiversity

Restored tanks host three times as many fish, birds and amphibians and the reintroduction of native species in the surroundings and pollution reduction have led to an increase in the aquatic biodiversity of the tanks. This increase in ecology and biodiversity helps maintain a cooler microclimate in the settlement and an increase in shaded area, promoting urban resilience.

5.3. Social and Cultural Framework

Restoration of tanks has renewed ritual practices and increased daily use and community footfall (3 to 4 × rise) and has reactivated public life in and around these tanks. The surrounding neighbourhoods benefit from improved aesthetics, cooler air and informal economic opportunities.

5.4. Policy and Planning Implications

Restoration should focus on larger, high-impact tanks currently not in use. The integration of urban stormwater plans along with aquifer recharge plans can help strengthen and achieve social and hydrological goals.

EFI's Chidambaram restorations (EFI, 2020) validate that community engagement, ecological planting, and consistent desilting could yield both hydrological and social dividends and revive the tank network as multifunctional sacred and climate-resilient infrastructure. Integration of traditional water management and treatment methods can help offer a pathway for sustainable water management which gets rooted in local history and culture (Ogwu et al., 2015).

A notable project is the Mission Kakatiya program in Telangana (Government of Telangana, 2015) which shows a successful collaboration between government and community, retrieving thousands of tanks, and adapting such similar models in the region or in the state of Tamil Nadu could increase restoration outcomes.

6. Conclusion and Way Forward

Cuddalore's temple tanks represent a living tradition that combines community involvement with spiritual symbolism and hydrological function (Amirthalingam, 2009; Chakrabarti & Amirthalingam, 2020). This study establishes that restored temple tanks in the district significantly outperform non-restored tanks across ecological, hydrological and social parameters. Restored tanks demonstrate measurable improvements in performance despite their smaller capacity. An improvement in the

local microclimate is observed along with a rise in groundwater and an increase in biodiversity, thereby showing how temple tanks have revived cultural engagement and re-established their role as a sacred and a civic space in an urban fabric while also serving as a living infrastructure for flood mitigation, aquifer recharge and climate adaptation.

6.1. Recommendations

The need to revitalise ancient methods as workable solutions for water sustainability is reflected in their conservation (Jain et al., 2024; Karuppaiya et al., 2025; Verma et al., 2025) and according to regional research, incorporation of these ancient water systems into modern planning promotes ecological balance, cultural continuity and resilience (Bimrah & Saizen, 2025; Gunasena & Nianthi, 2024).

To strengthen the outcomes, future efforts for restoration should prioritise large capacity tanks, which are majorly underutilised and possess greater hydrological potential. Reviving these temple tanks as urban flood management frameworks can transform them into water reservoirs and recharge hubs, and establishing aquifer monitoring systems would enable long-term tracking of groundwater recharge and hydrological performance, thereby ensuring that the outcomes of restoration are sustainable in water management. Restoration initiatives such as Chidambaram's EFI-led community project (EFI, 2020) and Mission Kakatiya (Government of Telangana, 2015) encourage public-private partnership and demonstrate how the community can help achieve longer-lasting cultural and ecological revival goals.

6.2. Future Scope

This research offers a preliminary hydrological and comparative framework using secondary data, and in order to refine this analysis, further studies should incorporate on-site detailed ecological documentation and surveys. To understand the community perception of the restoration and the sentimental, religious significance of the temple tanks, stakeholder engagement surveys are essential. Expanding datasets and analysing more non-restored water systems in the region could provide a clearer image of the benefits of restoration of these heritage water-based structures in the monsoon season, benefiting the process of flood mitigation and groundwater recharge. This research highlights the need for proper documentation of the temple tanks and the revival of sacred water management systems to support the hydrological, ecological, and socio-cultural revival of the region's culture.

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