Open Access
Volume 7 Issue 1
Research Article

Journal of Water Engineering and Management
ISSN: 2582-6298

# From Water Bankruptcy to Climate-Resilient Sustainability: A Decentralized Water Management Roadmap for Tamil Nadu Water Self Sufficiency

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**Article Info**

Received on: March 21, 2026
Revised on: March 22, 2026
Accepted on: March 27, 2026
Published on: April 30, 2026
Published by Academic Hope

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*How to Cite*:
Prabu, D. 2026. From Water Bankruptcy to Climate-Resilient Sustainability: A Decentralized Water Management Roadmap for Tamil Nadu Water Self Sufficiency, Journal of Water Engineering and Management 7(1):55-61
DOI:
https://doi.org/10.47884/jweam.v7i1pp55-61

## Abstract

Tamil Nadu is facing an ever-growing water crisis because of unpredictable monsoons, urbanization, and poor water management. By 2050, demand is expected to outstrip supply. A lot of rain falls, but a lot of it is wasted because of bad storage, encroachments, and water bodies that aren't used enough. The state has a lot of wells, lakes, and tanks, but many of them don't work or aren't useful. The proposed water self-sufficiency project aims to fill all traditional tanks and lakes with flood water surplus using automation and modern technologies, in addition to maximizing rainwater harvesting, restoring and connecting water bodies, and increasing storage capacity through modern technologies like GIS and remote sensing. This means that all Ayacut laws need to be changed. It's very important to retrofit existing TWAD water supply systems so that they can send extra floodwater into tanks and ponds to recharge groundwater. A big part of the plan is to turn non-system tanks into system tanks and make sure that water is distributed in a decentralized way. The initiative also puts a lot of stress on using a lot of drip irrigation in areas that get rain to boost agricultural productivity while saving water. Another goal of treating wastewater and using it again in industry is to cut down on the need for fresh water. Even though interstate water projects are being thought about, the main goal is still to make the best use of internal resources. The plan generally tells Tamil Nadu to manage its water resources in a way that is sustainable, decentralized, and able to withstand climate change.

**Keyword:** Tamil Nadu: Water self-sufficiency: Decentralized water management: Rainwater harvesting: Sustainable water management.

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## Introduction

Tamil Nadu state is present in southernmost tip of peninsular India, located between 8° 05' and 13° 35' North latitudes and 76° 15' and 80° 20' East longitudes. The state with a literacy rate of 80.09 %, and population of 72.2 million (Census of India, 2011). The most of the rainfall occurs during October to December as northwest monsoon and June to august as southwest monsoon. Tamil Nadu has rivers and the Cauvery comprises the major part. Ancient kings had the sense of storing the rain water in tanks or lakes and they were mostly interconnected to each other by the means of channels (State Water Policy of Tamil Nadu, 2014). Currently those tanks are mostly non-functional and dry due to erratic monsoon and water supply (Central Water Commission, 2019). Current scientific paper works on how well the water can be harvested, utilised and stored in a self-sustainable way. The Tamil Nadu Water Self-Sufficiency Project (TNWSSP) analyses all the pros and cons in the available schemes and deliberately gives a solution to the water problem faced by the state. The aim of this study is to make Tamil Nadu a water self-sufficient state by estimating total rainfall, runoff, and annual surplus floodwater, and ensuring their effective governance and storage in all water bodies through artificial pumping and modern technologies, thereby enhancing groundwater levels

and minimizing dependence on inter-state water resources. This paper is a longitudinal analytically retrospective as well as solution oriented prospective study.

## Material and Methods

Data was collected from the government websites pf various departments such as water resources department and public works department. Certain data and analytical points were taken from cross references published in reputed journals and conference proceedings of national and international conferences. Optimal usage of water data was obtained from case studies of earlier projects like Ranthamal irrigation project. Data related to infrastructure in water distribution is taken from Tamil Nadu Water Supply and Sewage Board Department manuals and official sites. Historic data was obtained from already published material available in the form of books and magazine articles (Vaidyanathan et al., 2001). Tabulation and presentation of data was done using SPSS software. Standard research methodological procedures were followed (Kothari, 2004) by using the international guidelines. Certain schemes like Athikadavu Avinashi project was taken as bench mark to replicate even better scheme which is cost efficient and better utility (Athikadavu–Avinashi Scheme, 2019).

Table 1 shows the overall water availability, demand projections, and groundwater and surface water potential in Tamil Nadu, highlighting the projected deficit scenario; the data are derived from state and national water resource assessments (Aishwarya et al., 2024; CGWB, 2023; MoWR, 2012; Chakravarty et al., 2006). Table 2 shows the water use pattern across agriculture, domestic, and industrial sectors along with land use distribution, irrigated area, and rain fed land in Tamil Nadu based on agricultural and irrigation statistics (Aishwarya et al., 2024; FAO, 2020; NABARD, 2020; Prabu, 2025). Table 3 shows the distribution of irrigation sources in Tamil Nadu, including canals, tanks, open wells, and tube wells, reflecting the dominance of groundwater-based irrigation systems. Table 4 shows the approximate number of dams, reservoirs, tanks, lakes, ponds, and wells in Tamil Nadu, indicating the extensive but underutilized water infrastructure of the state (First Census of Water Bodies 2017–2018., 2023, TWAD 2022

**Table 1** Tamil Nadu state water availability and demand

| | | | |
|---|---|---|---|
| Tamil Nadu total water availability | 1,644 TMC | Tamil Nadu water demand by year 2050 | 2,039 TMC |
| Tamil Nadu current total water demand | 1,921 TMC | Tamil Nadu current water deficit by year 2050 | 278 TMC |
| Ground water utilizable potential | 791 TMC | | |
| Surface water potential | 853 TMC | | |
| Surface water generated within state | 592 TMC | Surface water to be received from other states | 261 TMC |

**Table 2** Water use pattern, land area, irrigation potential of Tamil Nadu

| | | |
|---|---|---|
| **1** | Percentage of water use in Tamil Nadu for agricultural purposes | 75 % |
| **2** | Domestic water usage | 4-14 % |
| **3** | Industry usage | 6-26 % |
| **4** | Total geographic land area of Tamil Nadu | 1,30,033 ha (1,30,058 km$^2$) |
| **5** | Net irrigated land of Tamil Nadu | 29,21,324 ha |
| **6** | Rain fed land area | 19,16,475 ha |
| **7** | Total sown cultivable area | 48,37,799 ha |

**Table 3** Type of irrigation infrastructures developed in Tamil Nadu (ha)

| | | |
|---|---|---|
| 1 | Canal irrigation | 6,83,168 |
| 2. | Tanks , lakes and ponds | 3,99,567 |
| 3 | Open wells | 12,92,246 |
| 4 | Tube wells | 5,41,758 |
| 5 | Other sources | 4,574 |

**Table 4** Approximate numbers of dams, reservoirs, tanks, lakes, ponds and wells in Tamil Nadu

| | | |
|---|---|---|
| 1 | Dams, reservoirs in Tamil Nadu | 87 |
| 2 | Tanks, lakes (system tanks 28,000 and non-system 13,123) | 41,123 |
| 3 | Small ponds and wetlands below 2.5 hectares | 19,343 |
| 4 | Domestic wells | 748542 |
| 5 | Open wells | 1469825 |
| 6 | Tube wells and other wells | 417557 |

## Tamil Nadu Water Self-Sufficiency Project

First priority in Tamil Nadu water self-sufficiency is to conserve the rain water to the maximum and put it to use. Tamil Nadu receives annual average rainfall of 960MM. Based on the geographic area 139,058 km$^2$, the gross rainfall generated is around 4,227 TMC (Aishwarya et al., 2024; CPCB, 2021). But due to urbanization, evaporation loss, traditional loss, encroachments of water security pathways and catchment areas, the conversion from gross rain water generated 4,227 TMC to net water realization is 1200-1382 TMC, which when compared to other states in India this was observed to be very low, and it's the pivotal grey area which should be addressed to realize much higher net rainwater inside the tate as demonstrated in Fig. 1 (CPCB, 2021).

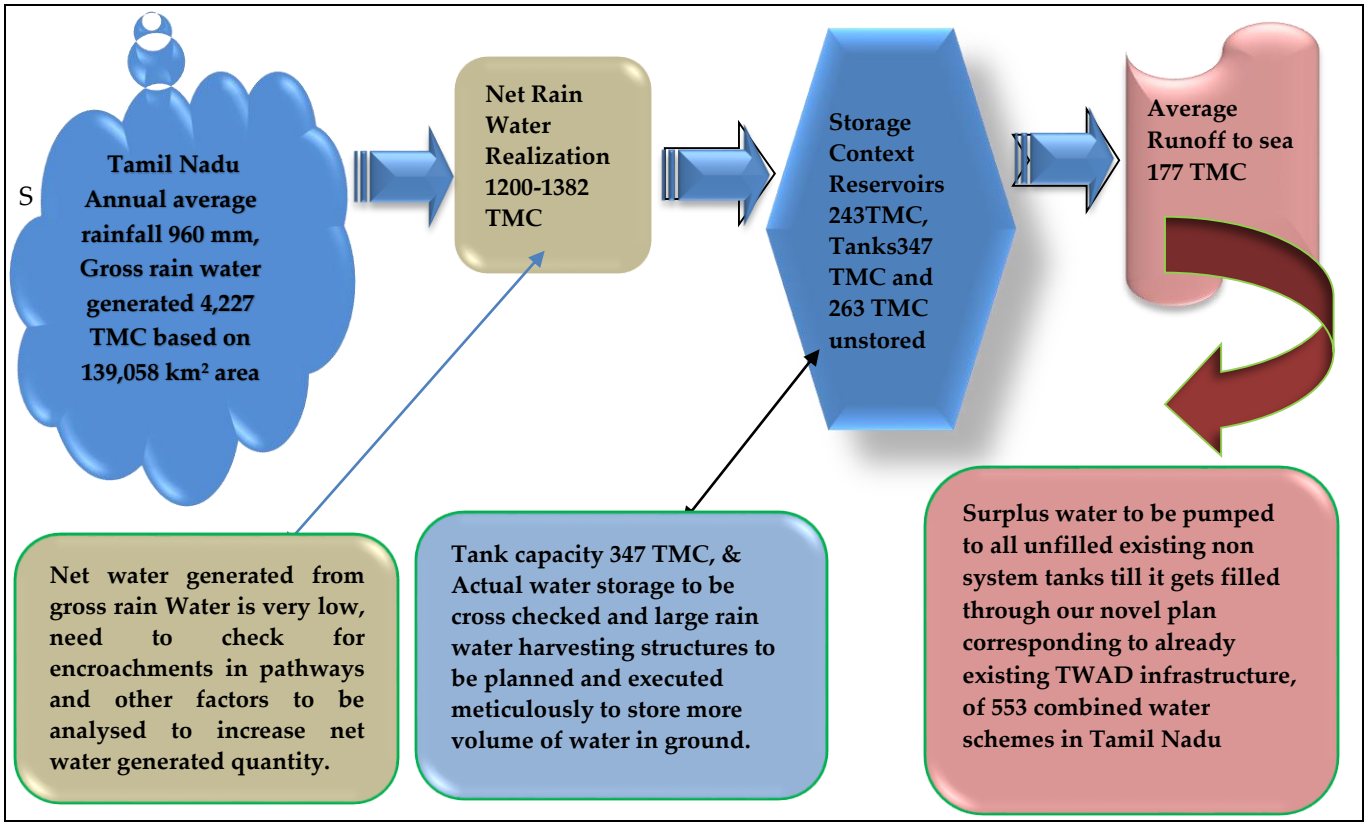



**Fig. 1** Tamil Nadu Water Self-Sufficiency Project (Generation, Distribution, and Utilization of Intra-State Fresh and Wastewater Resources)

Next step is about storage within the state. Among the total water stored, 243 TMC is stored in 87 reservoirs of the state. 347 TMC in tanks and lakes within the state, remaining 263 TMC it goes unsorted (TWAD, 2022; Shah et al., 2004). From the existing 243 TMC reservoir storage, an audit should be undertaken to identify additional on-grid and decentralized (off-grid) storage potential. Water storage is considerably lower than the net realizable water available. An average of about 177 TMC of water flows into the sea every year (Aishwarya et al., 2024; TWAD, 2012).

Assessing the storage potential of Tamil Nadu's

traditional tank systems is essential, given their long-standing development under royal and feudal patronage, as seen in Veeranam Lake. According to India's first census of water bodies done in the year 2017-2018, Tamil Nadu has around 43,837 tanks and 13,629 lakes (Census of Water Bodies, 2023). Estimates of water bodies in Tamil Nadu vary across sources, ranging from 39,202 to 41,948. Of these, 8,366 water bodies including 1,458 lakes and 3,565 tanks are reported to be under encroachment. In terms of management, the State Public Works Department oversees tanks with a command area exceeding 100 acres, while the remaining smaller tanks (below 100 acres) are managed by the Panchayat Unions (Prabu, 2025). The most important classification which is useful for water management is the distinction between system and non-system tanks. System tanks are the ones which are fed with canals from reservoirs and rivers and mostly managed by Public Works Department which are around 3,697 in Tamil Nadu.

## Increasing net water availability in Tamil Nadu

To convert maximum gross rain water to net rain water availability, first step is to make assessment using GPS/MAPS for average area gross rainfall by using Thiessen or isohyet methods if gauges vary spatially. For Tamil Nadu, local soil characteristics and monsoon intensity should be incorporated using tools such as NRCS spreadsheets to aid computations, with results validated through on-site audits across all water catchment pathways (CPCB, 2021). Encroachments in water pathways and in water body are to be rectified by using scientific methods (TN-IAMWARM, 2020). Water body census data carried out by Government of India in 2017-18 must be cross validated by onsite inspections and surveys and Tamil Nadu latest water body inventory with scientific GPS and GIS tagging should be created. Even extent and capacity of water bodies may be validated through LIDAR Terrestrial and remote sensing technology (CPCB, 2021).

Capacity as such in perennial system tanks to be crosschecked and same should be done for non-system tanks since; the accountability of 347 TMC storage in tanks and lakes is still questionable. During monsoon season, when nearby water bodies like dams and rivers get overflowed, many tanks would stay high dry. This is the root cause of inappropriate water management. Moreover, non-system tanks should be converted to system tanks (TWAD 2022: Shah et al., 2004). All the water bodies should be filled perennially through a decentralized pumping model using the surplus runoff during monsoon. The method of distribution of water to all tanks and water bodies through existing infrastructure modification which reduces resource consumption is discussed below.

## TWAD Retrofitting Concept

Retrofit TWAD (Tamil Nadu Water Supply and Drainage Board) schemes are implemented by integrating pipelines to capture surplus flood water from rivers during monsoons, channeling it to nearby tanks and ponds for storage and groundwater recharge. This enhances water security in water-scarce regions like Tamil Nadu. The process starts at the river where intake structures divert excess flood water. Pipes transport it to filtration units, and then branch to local tanks and ponds, preventing floods while replenishing reserves. Pumps ensure flow during low river levels, if needed (Fig. 2).

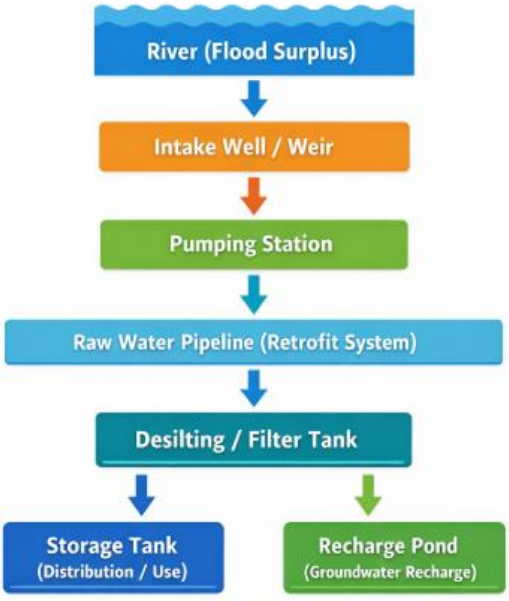



**Fig. 2** Flow diagram of TWAD retrofitting concept

This approach mirrors TWAD's combined water supply schemes, adapting them for flood management. TWAD schemes typically use centrifugal or turbine pumps for raw water diversion, sized based on flow needs from rivers to tanks and ponds. Vertical turbine pumps handle high heads in intake wells, while submersible or centrifugal pumps suit retrofits for surplus flood water. These are selected for capacities matching scheme demands, often 1-10 MLD per station. For Mettur-like surplus

projects, pumps fill tanks/ponds at 5-20 MLD rates during floods, with HDPE/DI mains. Capacities ensure 5-30 min cycles to avoid overload. Primary Pump Models Clear water and booster stations feature vertical turbines at 29000 LPM against 30m head, often in 3-working/2-standby setups. Submersible open-well types (10-15 HP) from serve sumps at 1000-1800 LPM for 25-43m heads.

These models suit retrofits for flood surplus to tanks/ponds, with duties like 9076 LPM at 100m (vertical turbine) for raw water mains. Configurations ensure redundancy and energy efficiency per TWAD standards. TWAD's PPP models for pump maintenance emphasize replacing outdated pumps with energy-efficient ones to cut power costs, which form 55% of operations. Energy-efficient pump sets, along with capacitor banks and harmonic filters, are being installed in schemes such as Thoothukudi and Pollachi to improve operational efficiency and power quality. The operation incorporates real-time monitoring and predictive maintenance systems to optimize runtime and minimize the risk of overloads. Furthermore, through the tendering process, vetted partners have been engaged to manage more than 91 pumpsets, with the initiative also extending to fluoride-affected areas in Salem.

## Integrated Drip Irrigation Project for Rain Fed Areas

Water is assured to all tanks and ponds of Tamil Nadu by converting maximum non system ponds to system ponds by changing and amending all the existing river based ayucut laws in Tamil Nadu**.** Water required for integrated drip irrigation project for rain fed areas can be realized so that total sown cultivable area can be water self-sufficient. Tamil Nadu's rainfed cultivable lands cover about 19,16,474 ha (around 50% of net sown area of 49 lakh ha), facing erratic monsoons and low yields like Ramthal's pre-project drylands. Tamil Nadu rain fed integrated drip irrigation project can adapt Ramthal's water harvesting (farm ponds/check dams) with drip systems for 20 lakh ha over 5 years, targeting 40-50% water savings and 2-3 times productivity gains. Project objectives secure supplemental irrigation via harvested runoff (target: 50 TMC/year capture) paired with drip for millets/pulses/horticulture. Ramthal model integration succeeded by storing 80% monsoon runoff in 200+ ponds/tanks on 3,000 ha, then drip-irrigating dry crops—TN scales this to 1,000 micro-watersheds.

## Waste Water Treatment and Gradual Reuse for Industrial Purposes

Tamil Nadu's 17 major river basins face severe pollution from untreated sewage (5,499 MLD generated vs. 2,260 MLD treated) and industrial effluents, discharging into rivers and sea. The project cleans all basins via STP expansions, bioremediation, and AI monitoring, reclaiming ~2,500 MLD (0.9 TMC/year) treated wastewater for mandatory reuse in new SIPCOT and industrial clusters (Aishwarya K et al., 2024). It aligns with TN's 2019 Treated Wastewater Policy mandating industrial reuse, scaling Chennai's model (120 MLD to industries) statewide.

## Interlinking of Rivers and Water Projects for Water Augmentation

Pandiyaru is a river which originates in O valley of Gudalur, Nilgris District and enters Kerala at punnapuzha. Totally 14 TMC of water is generated in overall in which 7 TMC for Kerala and 7 TMC for Tamil Nadu. Both Governments came into an agreement for implementation in 1980s but stopped due to certain delay in process. Now, instead of 7 TMC, diversion of 3 TMC does not require Keralas acceptance since 3.5 TMC of water is let from Pandiyaru to Kerala as riparian rights. Senior engineer's association has submitted a proposal to Tamil Nadu government for its implementation within 110 crores (Water and related statistics, 2019). The project augments 3TMC of water to western Tamil Nadu to fill all the leftover tanks and ponds, which is aimed at water self-sufficiency (Vaidyanathan et al., 2001). Similar projects should be explored in other sub basins too. Due to climate change, currently monsoon pattern is very much erratic, heavy downpour in a single day occurs many a times. So, during such times even neighboring states tend to release excess water as riparian duty. In such conditions, proper storage of the huge volume of water is very much needed and forms an important part of Tamil Nadu water self-sufficiency project.

Water projects that depend on other state concurrence and pending since ages are as follows.

- Pampa Achankovil Vaipar Link
- Interlinking of rivers Ilr
- Phase 2 of Parambikulam Aliyar Project
- Anamaliaru Nallaru Thittam

When it comes to Pampa Achankovil Vaipar Link, phase 2 Parambikulam Aliyar Project, Kerela concurrence is needed. But it hinges on the settlement of Mullaiperiyar, Siruvani Projects. Until both parties ready to give some part and take some part as give and take policy, issues are not going to settle. Interlinking of rivers also requires southern states concurrence. Currently even this project even though oldest in nature should follow technological advancements used in Athikadvu Avinashi as pipeline scheme instead of acquiring large tracts of land (Athikadavu–Avinashi Scheme, 2019). National water ways project was proposed as a high platform water transport project proposed by Tamil Nadu. Even though, the project is costly whenever water becomes top priority, this scheme can also be explored (Water and related statistics, 2019). All of the above projects bring more water to Tamil Nadu. As more water will be available, this can be pumped into all existing ponds and lakes through drinking water retro fitting scheme and distributed through judicious drip irrigation technique.

## Conclusions

Achieving water self-sufficiency and long-term sustainability in Tamil Nadu necessitates a transformative approach that integrates advanced, AI-based technologies into existing drinking water and irrigation systems. Retrofitting current infrastructure to enable the capture and redistribution of climate-driven surplus floodwaters can ensure that traditional tanks and water bodies are effectively replenished. However, such a transition requires supportive legislative reforms to amend existing ayacut and water management laws. At present, the paradox of allowing nearby rivers to overflow while traditional water bodies remain underutilized highlights a critical policy gap. Addressing this through technology-enabled, decentralized water management and legal restructuring offers a practical and resilient pathway toward climate-adaptive water security in the state.

### Statements and Declarations

### Funding

The authors declare that no funds, grants or other support were received during the preparation of this manuscript

### Acknowledgements

The authors sincerely appreciate the contributions of our technologists for their assistance during this study.

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