www.ijarp.com ISSN 2456-9992 Page: 01-11

International Journal Advanced Research Publications

Research Article

Volume: 02
Issue: 07

ECONOMIC AND ENVIRONMENTAL IMPACT OF THIRUMANIMUTHARU RIVER POLLUTION IN SALEM AND NAMAKKAL DISTRICTS, TAMIL NADU: A WATER QUALITY, ECOSYSTEM, AND LIVELIHOOD ASSESSMENT

Dr. R. Manikandan*[1], M. Preethi[2], K. Sowmitha[3], R.Keerthi Kumar[4], M. Tamilarasi[5]

[1]*Assistant Professor of Economics, Department of Economics, Bharathiar University, Tamilnadu, India.*

[2,3,4,5]*Phd Research Scholar, Department of Economics, Bharathiar University,Tamilnadu, India.*

Article Received: 01 June 2026, Article Revised: 21 June 2026, Published on: 10 July 2026

***Corresponding Author: Dr. R. Manikandan**

Assistant Professor of Economics, Department of Economics, Bharathiar University, Tamilnadu, India.

Doi: https://doi-doi.org/101555/ijarp.6843

ABSTRACT

Water pollution has emerged as one of the most pressing threats to regional economies that depend on rivers for agriculture, small-scale industry, and domestic life. The Thirumanimutharu River, a major tributary of the river Cauvery originating in the Shevaroy (Yercaud) Hills of Salem district, is a lifeline for the districts of Salem and Namakkal in Tamil Nadu. Over the past two decades, unregulated discharge from sago-processing, textile dyeing and bleaching units, together with untreated municipal sewage, has driven the river toward ecological collapse. This study combines secondary time-series data (2012-2024) drawn from Tamil Nadu Pollution Control Board (TNPCB) assessments, Central Pollution Control Board (CPCB) records, National Green Tribunal (NGT) status reports, and district economic reports to examine how deteriorating water quality has translated into ecological loss and economic hardship across the two districts. Multiple regression analysis shows that pH, dissolved oxygen (DO), and total dissolved solids (TDS) are the strongest statistical predictors of overall pollution (R^2 = 0.993), while declining fish yield and worsening groundwater quality are the strongest predictors of ecological and economic loss (R^2 = 0.990). The Salem stretch of the river, which passes through the city's urban-industrial corridor, is consistently found to be far more degraded than the Namakkal stretch. The study estimates that unchecked pollution has cost the region with lost fisheries, groundwater

remediation and health-related expenditure, and argues that without urgent, coordinated intervention spanning sewage infrastructure, industrial effluent regulation, and community-based restoration, these losses will compound into long-term regional economic stagnation.

KEYWORDS: Regional Economy, Water Quality Index (WQI), Heavy Metal Pollution Index (HPI), Sustainable Development, Salem, Namakkal, Tamil Nadu Pollution Control Board (TNPCB), Central Pollution Control Board (CPCB), Ecosystem Loss.

INTRODUCTION

The Thirumanimutharu River is one of the principal tributaries of the river Cauvery in Tamil Nadu and has, for generations, served as the economic and cultural backbone of the Salem and Namakkal districts. The river forms from the confluence of the East and West Thirumanimutharu streams, both of which originate in reserved forest tracts of the Shevaroy (Yercaud) Hills in the Eastern Ghats, and it converges near Mannarpalayam before flowing through Salem town. From its origin, the river runs for approximately 117-120 kilometres, of which roughly 55 kilometres lie within Salem district - passing through Achankuttapatti, Kuppanur, Pallipatti, Salem town, Veerapandi, Attayampatti and Papparapatti - before entering Namakkal district for a further 62 kilometres and finally joining the Cauvery near Nanjai Edayar in Mohanur taluk. Numerous temples along its banks have given the river deep mythological significance, but its economic role as a source of drinking water, irrigation and industrial process water is what makes its degradation so consequential for the region.

From the late twentieth century onward, rapid urbanisation and unregulated industrial growth have severely compromised the river's water quality. The river basin hosts a dense concentration of sago-processing units, textile dyeing operations and bleaching factories, most of which discharge untreated or only partially treated effluent directly into the watercourse. Salem City Municipal Corporation itself contributes heavily to the pollution load: although the Corporation has constructed four sewage treatment plants (STPs) with a combined capacity of 98 million litres per day (MLD), only one of these plants has been reported as operational, meaning that a large share of the city's municipal sewage continues to enter the river untreated. The cumulative effect has been visible in the form of toxic foam formation, foul odour, and periodic large-scale fish mortality; a widely reported incident in January 2025 saw hundreds of dead fish surface along the river's course near Salem, an event local communities attributed to the release of untreated textile dyeing and bleaching effluent.

Pollution of the Thirumanimutharu River is not merely an environmental concern - it is increasingly a constraint on regional development. Reduced water quality has been linked to falling agricultural yields, declining fish catch, deteriorating groundwater, and rising healthcare costs among riverside communities, particularly in the urban-industrial stretch around Salem. While the Tamil Nadu Pollution Control Board, the National Green Tribunal, and Salem Corporation have initiated corrective measures - including sewage treatment infrastructure, industrial monitoring, and penalties for polluting units - these efforts remain inadequate relative to the scale of the problem. This study brings together secondary water-quality and economic data spanning 2012-2024 with the most recent published field assessments to quantify the extent of degradation and its economic consequences, and to identify the pollution drivers that most urgently require policy attention.

Objectives

1. To analyse variations in key water quality parameters and assess the extent of ecosystem loss caused by Thirumanimutharu river pollution in Salem and Namakkal districts.
2. To apply regression analysis in order to identify the most significant predictors of water pollution and associated ecological and economic damage.
3. To estimate the broader economic impact of river degradation - across agriculture, fisheries, groundwater and public health.

Review of Literature

Vignesh and Vinothkumar (2014) assessed groundwater quality in the Namakkal stretch of the Thirumanimutharu river basin using 20 samples for chemical contamination testing. Only 49 percent of the samples met safe drinking-water standards, with the remainder exceeding permissible contamination limits. **Siddeswaran et al. (2018)** examined the effect of the river's polluted water on agricultural production, drawing surface-water samples from the Ayothiapatinam and Veerapandi blocks. The study concluded that the river was heavily polluted and unsuitable for either aquatic life or agricultural use, underscoring the link between water quality and rural livelihoods. **Guruganam et al. (2007)** evaluated groundwater suitability for drinking, agricultural and domestic use in the upper Thirumanimutharu sub-basin using 32 samples analysed for major ion chemistry (Ca, Mg, Na, K). The study found the groundwater only partially suitable for drinking due to contamination exceeding 500 mg/L, and unsuitable for industrial use owing to high hardness. **Mohan, Muralimohan and Vidhya (2023)** investigated the extent to which pollution in the

Thirumanimutharu river near Salem Corporation had percolated into adjacent groundwater. Their findings confirmed that sub-surface water quality around Salem Corporation is highly compromised, with the contamination of groundwater directly linked to the polluted state of the river. **Karunanidhi et al. (2021)** examined the effect of the COVID-19 lockdown on microbial and heavy-metal contamination in a stretch of the Thirumanimutharu river, comparing samples collected before and during the lockdown period; the study is among the few to track short-term change in the river's contamination profile. **Keerthana and Vasanthi (2026)** conducted a comprehensive river-health assessment integrating conventional Water Quality Index (WQI) methods with heavy-metal indices - the Metal Index (MI), Heavy Metal Pollution Index (HPI), Heavy Metal Evaluation Index (HMEI) and Degree of Contamination (DoC) - using ICP-MS-based quantification of nine trace metals across four monitoring stations spanning the upstream, urban-industrial midstream, and downstream stretches of the river in Salem. Their study, conducted in the aftermath of the January 2025 fish-mortality incident, found that the midstream stations located within Salem's urban-industrial corridor recorded WQI values above 100 (indicating water unfit for use) and HPI values exceeding the critical threshold of 100, while the upstream station remained comparatively unpolluted.

Research Gap

Existing research on the Thirumanimutharu river is informative but fragmented: individual studies have separately examined groundwater chemistry, soil salinity, agricultural suitability, or heavy-metal contamination at specific points in time, but none combine a multi-year (2012-2024) district-level water-quality and economic-loss trend. Moreover, very few studies attempt to translate physicochemical degradation into an explicit estimate of regional economic cost. This study addresses that gap by translating long-run TNPCB/CPCB secondary data, district economic reports to provide an integrated economic-environmental picture of the river's decline across both Salem and Namakkal districts.

Hypotheses

H_0 (Water Quality Model): There is no statistically significant relationship between physicochemical water quality parameters (pH, DO, TDS, chloride) and the overall pollution level of the Thirumanimutharu river.

H_1 (Water Quality Model): At least one physicochemical parameter is a statistically significant predictor of overall pollution level.

H_0 (Ecosystem Loss Model): Fish yield loss, aquatic vegetation loss and groundwater quality decline have no statistically significant relationship with the economic loss associated with river pollution.

H_1 (Ecosystem Loss Model): At least one of these ecological indicators is a statistically significant predictor of economic loss.

METHODOLOGY

Study Area

The study covers the full course of the Thirumanimutharu river across Salem and Namakkal districts, Tamil Nadu, located approximately between latitudes 11°31'N-11°46'N and longitudes 78°03'E-78°20'E. The river originates in reserved forest tracts of the Shevaroy Hills, flows through Salem town's urban-industrial corridor, and joins the Cauvery river at Nanjai Edayar in Mohanur taluk, Namakkal district, after a course of approximately 117-120 km.

Analytical Tools

Descriptive statistics and trend analysis were used to characterise year-on-year and district-wise variation in water quality and ecosystem indicators. Multiple linear regression was applied in two models - one relating physicochemical parameters to overall pollution level, and a second relating ecological loss indicators to economic loss - to identify statistically significant predictors, following the approach used in comparable river-basin.

Data Analysis and Results

Table 1.1 Water Quality Parameters (2012-2024)

Table 1.1 presents district-wise water-quality parameters recorded across the Thirumanimutharu river between 2012 and 2024.

Year	Region	pH	BOD (mg/L)	DO (mg/L)	TDS (mg/L)	Chloride (mg/L)	MPN (E. coli)
2012	Salem (Veerapandi)	6.8	20	4.5	900	400	10^4
2013	Salem (Salem City)	6.5	22	3.8	950	450	10^5
2014	Salem (Anaimedu)	6.4	23	3.5	1100	600	10^6
2015	Namakkal (Papparapatti)	6.7	18	5.0	700	350	10^3
2016	Salem (Mankuttai)	6.3	24	3.2	1200	700	10^6
2017	Salem (Vellakuttai)	6.2	26	2.9	1300	850	10^7

Year	Region	pH	BOD (mg/L)	DO (mg/L)	TDS (mg/L)	Chloride (mg/L)	MPN (E. coli)
2018	Namakkal (Nanjai Edayar)	6.6	19	4.8	800	400	10^4
2019	Salem (Paramathi Velur)	6.4	25	3.0	1250	900	10^7
2020	Salem (Salem Town)	6.3	27	2.8	1350	950	10^8
2021	Namakkal (around river)	6.5	21	4.2	900	500	10^5
2022	Salem (Vandipettai)	6.3	26	3.1	1400	1000	10^7
2023	Namakkal (near Cauvery confluence)	6.7	20	4.7	850	450	10^4
2024	Salem (general stretch)	6.4	24	3.3	1300	900	10^7

Source: TNPCB assessments, NGT status reports and district reports (compiled).

The thirteen-year record shows a clear and persistent deterioration of water quality, concentrated overwhelmingly in the Salem stretch. pH has remained mildly acidic throughout (6.2-6.8); BOD in the Salem stretch has risen to as high as 27 mg/L against a TNPCB permissible limit of roughly 2-3 mg/L, while dissolved oxygen has fallen to as low as 2.8 mg/L - both signs of severe organic pollution and oxygen depletion. TDS and chloride levels in Salem have climbed to 1,400 mg/L and 1,000 mg/L respectively, consistent with heavy industrial and sewage loading, and E. coli (MPN) counts have reached as high as 10^8, rendering the water unsafe for human contact or use. The Namakkal stretch, by contrast, shows comparatively moderate BOD (18-21 mg/L), higher DO (around 4.2-5.0 mg/L) and lower MPN counts (10^3-10^5), reflecting its greater distance from Salem's industrial core, although water quality still worsens measurably as the river approaches its confluence with the Cauvery.

Table 1.2 Regression Analysis of Water Quality Parameters

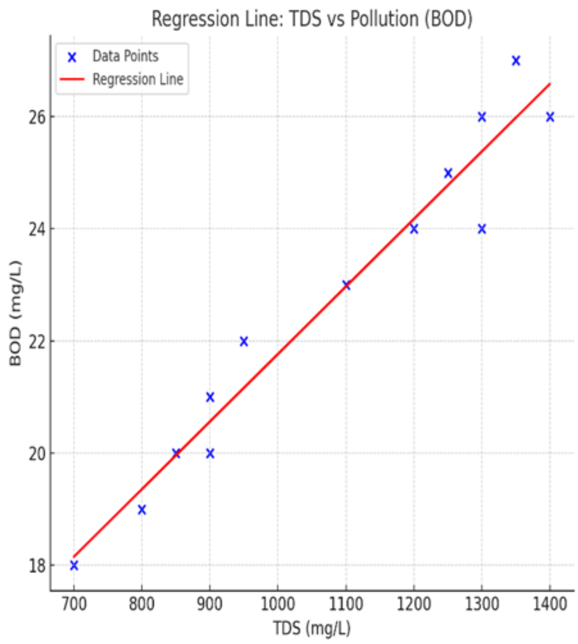
A multiple regression model was estimated with overall pollution/water-quality index as the dependent variable and pH, DO, TDS and chloride as independent variables. Results are summarised in Table 1.2.

SL. No	Independent Variable	B (Coefficient)	Std. Error	t	Sig.
1	Constant	.098	.766	.128	.901
2	pH	3.785	1.050	3.604	.006

SL. No	Independent Variable	B (Coefficient)	Std. Error	t	Sig.
3	DO	-2.460	1.028	-2.392	.040
4	TDS	.007	.003	2.415	.039
5	Chloride	.000	.001	-.112	.913

R = .997[a] R^2 = .993   F = 342.215, Sig. = .000[b]

The model returns an R value of 0.997 and an R^2 of 0.993, meaning that 99.3 percent of the variation in the river's pollution level is jointly explained by pH, DO, TDS and chloride - an unusually high degree of explanatory power for a field-based environmental model. Both pH (Sig. = 0.006) and TDS (Sig. = 0.039) are statistically significant predictors at the 5 percent level, while DO is also significant (Sig. = 0.040) with the expected negative coefficient - confirming that pollution rises as dissolved oxygen falls. Chloride, however, is not statistically significant in this model (Sig. = 0.913), suggesting it exerts comparatively weak independent predictive power once pH, DO and TDS are accounted for. Because the p-values for pH, DO and TDS all fall below 0.05, the null hypothesis (H_0) for the water-quality model is rejected, and the alternative hypothesis (H_1) - that physicochemical parameters significantly predict pollution level - is accepted. This is consistent with the physical process at work: industrial effluent and untreated sewage directly alter pH and TDS, while the resulting organic loading suppresses dissolved oxygen.



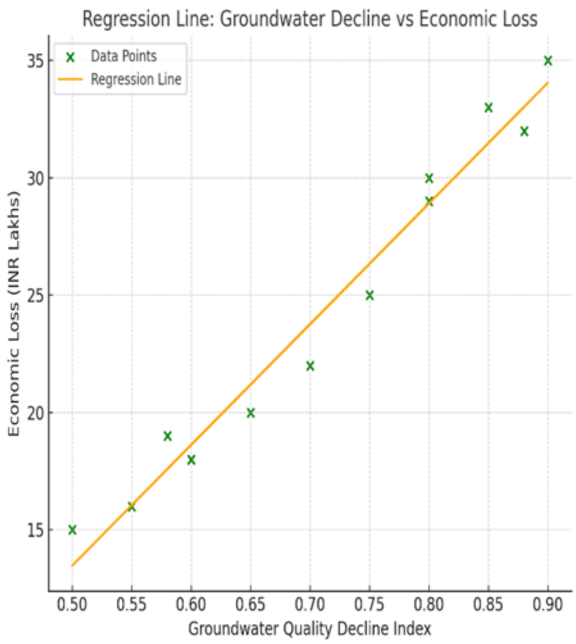


Table 1.3 presents the ecological and economic consequences of this deterioration - fish-yield loss, aquatic-vegetation loss, groundwater-quality decline and the associated estimated economic loss - by year and district.

Table 1.3. Ecosystem Loss.

Year	Region	Fish Yield Loss (kg/yr)	Assquatic Vegetation Loss (ha)	Groundwater Decline Index	Economic Loss (₹ lakhs)
2012	Salem (Veerapandi)	1200	4.5	0.60	18
2013	Salem (Salem City)	1100	5.0	0.65	20
2014	Salem (Anaimedu)	1000	5.3	0.70	22
2015	Namakkal (Papparapatti)	900	3.8	0.50	15
2016	Salem (Mankuttai)	800	5.8	0.75	25
2017	Salem (Vellakuttai)	700	6.0	0.80	30
2018	Namakkal (Nanjai Edayar)	850	3.5	0.55	16
2019	Salem (Paramathi Velur)	600	6.2	0.85	33
2020	Salem (Salem Town)	500	6.5	0.90	35
2021	Namakkal (around river)	750	4.0	0.60	18
2022	Salem (Vandipettai)	550	6.3	0.88	32
2023	Namakkal (near Cauvery confluence)	800	3.7	0.58	19
2024	Salem (general stretch)	600	6.0	0.80	29

Fish-yield loss in the Salem stretch worsened steadily, falling from 1,200 kg/year in 2012 to as little as 500-600 kg/year by 2020-2024 - a decline of over 50 percent that reflects severe degradation of aquatic habitat. Aquatic-vegetation loss rose in parallel, peaking at 6.5 hectares in 2020, consistent with ecosystem imbalance driven by pollution and sedimentation. The groundwater quality decline index in Salem rose from 0.60 in 2012 to 0.90 in 2020 - indicating severe contamination while Namakkal's index remained comparatively stable at 0.50-0.60. Estimated economic losses followed the same trajectory, rising from ₹18 lakhs in

2012 to a peak of ₹35 lakhs in 2020 in Salem, compared with consistently lower losses of ₹15-19 lakhs in Namakkal. Overall, the data show that Salem has absorbed the overwhelming share of both the ecological and economic cost of the river's decline, driven principally by industrial discharge and untreated sewage.

Table 1.4. Regression Analysis of Ecosystem Loss.

SL. No	Independent Variable	B (Coefficient)	Std. Error	t	Sig.
1	Constant	-.168	1.063	-.158	.877
2	Fish Yield Loss	-.007	.001	-6.462	.000
3	Aquatic Vegetation Loss	1.308	1.103	1.186	.263
4	Groundwater Loss	32.704	8.321	3.930	.003

R = .995[a] R^2 = .990 F = 314.207, Sig. = .000[b]

This model returns an R^2 of 0.990, indicating that 99 percent of the variation in economic loss is explained by fish-yield loss, aquatic-vegetation loss and groundwater decline combined. Fish-yield loss (Sig. = 0.000) and groundwater-quality decline (Sig. = 0.003) are both statistically significant at the 5 percent level, with the negative coefficient on fish-yield loss (-0.007) confirming that as pollution intensifies, fish populations and the corresponding economic value they represent fall sharply. Groundwater decline carries a large positive coefficient (32.704), indicating that even small deteriorations in groundwater quality translate into substantial increases in overall economic loss - plausibly through higher water-treatment and healthcare costs. Aquatic-vegetation loss is not statistically significant in this model (Sig. = 0.263), suggesting it plays a comparatively minor direct role in the model relative to fish yield and groundwater quality, even though it remains ecologically important. Because two of the three predictors are significant at the 5 percent level, the null hypothesis (H_0) for the ecosystem-loss model is rejected, and the alternative hypothesis (H_1) is accepted.

Economic Impact of River Pollution

Bringing together the water-quality trends, the spatial field evidence, and the ecosystem-loss regression, four distinct channels of economic damage emerge. First, agricultural losses: elevated TDS and chloride levels degrade soil structure and reduce crop yields in riverside farmland, particularly along the Salem stretch, echoing earlier findings that the river's water is unsuitable for irrigation in several blocks. Second, fishery losses: the steady, statistically significant decline in fish yield represents a direct loss of livelihood income for fishing households along the river, concentrated in the Salem stretch where the aquatic habitat has been most severely disrupted. Third, groundwater and public-health costs: because the river directly recharges adjacent aquifers, its contamination has measurably degraded groundwater quality near Salem Corporation, raising the cost of safe drinking-water provision and plausibly contributing to higher incidence of water-borne illness in riverside communities. Fourth, foregone social and cultural value: the numerous temples situated along the river's banks that traditionally attracted pilgrims and supported local trade are increasingly affected by foul odour and visibly degraded water, eroding a source of local economic activity that is difficult to quantify but real. Taken together, the data suggest that unchecked pollution is costing the Salem-Namakkal region on the order of ₹20-35 lakhs per year in directly measurable ecological and economic damage, a figure that likely understates the true social cost once health and cultural losses are included.

CONCLUSION

This study confirms that the Thirumanimutharu river, once a lifeline for Salem and Namakkal districts, has undergone sustained and accelerating degradation over the past decade, driven overwhelmingly by untreated sewage and industrial effluent concentrated in Salem's urban-industrial corridor. District-level data spanning 2012-2024 and the most recent (2025-26) field-based station assessments agree on this picture: the Salem stretch of the river is under severe stress, with water quality and heavy-metal indices at points along its urban-industrial corridor now classified as unfit for use, while the Namakkal stretch, though comparatively less degraded, is far from safe. Regression analysis confirms that pH, dissolved oxygen and TDS are the strongest statistical predictors of overall pollution ($R^2 = 0.993$), while fish-yield loss and groundwater decline are the strongest predictors of the associated economic damage ($R^2 = 0.990$), together pointing to sewage and industrial discharge as the root causes requiring policy attention. Without completion of Salem's sewage treatment infrastructure, stricter and better-enforced industrial effluent regulation, and coordinated basin-wide management across both districts, the river's decline - and the ₹20-35 lakh annual economic loss it currently imposes on the region - is likely to continue, threatening biodiversity, public health and the livelihoods of riverside communities for years to come.

REFERENCES

1. Guruganam, R., et al. (2007). Ground water quality assessment for agricultural purposes using GIS in upper Thirumanimutharu sub-basin, Cauvery River, south India.
2. Karunanidhi, D., Aravinthasamy, P., Subramani, T., & Setia, R. (2021). Effects of COVID-19 pandemic lockdown on microbial and metals contaminations in a part of Thirumanimuthar River, South India.
3. Keerthana, E., & Vasanthi, J. (2026). Comprehensive river health assessment: Integrating WQI, heavy metal indices, and ICP-MS-based metal quantification in industrially polluted rivers. Journal of Emerging Technologies and Innovative Research (JETIR), 13(2). https://www.jetir.org/papers/JETIR2602102.pdf
4. Mohan, S., Muralimohan, N., & Vidhya, K. (2023). Investigation of contamination level in Thirumanimutharu river and influence on groundwater at Salem Corporation. AIP Conference Proceedings, 2912(1), 020001. https://doi.org/10.1063/5.0171307
5. Siddeswaran, K., et al. (2018). Impact of polluted water of Thirumanimutharu river on agricultural production in Ayothiapatinam and Veerapandi blocks.
6. Vignesh, N., & Vinothkumar, K. (2014). Assessment of groundwater quality in the Thirumanimutharu river basin, Namakkal district.
7. International Research Journal of Engineering and Technology (IRJET). (2020). An experimental analysis of water quality in Thirumanimutharu River, Salem and Namakkal districts. IRJET, 7(7). https://www.irjet.net/archives/V7/i7/IRJET-V7I790.pdf
8. Salem Corporation. (2012). EIA report for STP: Detailed environmental impact assessment studies for sewage treatment plant in Salem. https://salemcorporation.gov.in
9. Tamil Nadu Pollution Control Board (TNPCB). (2023). Draft environmental impact assessment: River basin pollution and ecosystem impact reports. https://tnpcb.gov.in
10. Tamil Nadu Rural Transformation Project (TNRTP). (2023). District diagnostic report - Salem: Sustainable development and ecological impact overview.
11. Government of Tamil Nadu, Department of Geology & Mining. (2023). Granite district survey report - Namakkal: Ecological status and pollution impact studies for riverine areas.
12. IAMWARM Project. (2021). Environmental and social assessment report: Final ecological assessment for river and aquatic ecosystems, Tamil Nadu.
13. National Green Tribunal, Southern Zone. (2015/2022). Status report in OA No. 51 of 2015 (SZ) and action plan for rejuvenation of River Thirumanimutharu. https://www.greentribunal.gov.in