RESEARCH PAPER

A Preliminary Study on Evaluating the Ecological Health and Anthropogenic Impact on Freshwater Lakes in North-Western Tamilnadu through Sensory Screening and Chemical Analysis -I

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ABSTRACT
Freshwater lakes are essential for irrigation and domestic purposes in the semi-arid northwestern ecological zone of Tamil Nadu; however, they are under escalating pressure from human activities. This initial study assesses the ecological health and anthropogenic influence on 69 freshwater lakes in the Dharmapuri district using a combined methodology of sensory screening and physicochemical analysis. Macroscopic "sensory screening" used eleven qualitative indicators, such as visual debris, domestic wastewater inflow, and livestock activity, for coming up with a Total Preservation Score. We examined physicochemical parameters such as pH, Total Dissolved Solids (TDS), and turbidity according to APHA standards. The results showed that the environment was getting worse, with 65.2% of the lakes being rated as Class E (Very Poor) and 29% being rated as Class D (Poor). No lakes were rated as Good or Very Good. Frequency analysis found that the most common stressors were human activity (75%), livestock activity (71%), and garbage accumulation (69%). The average preservation score was 20.68±2.72, and Papparapatti Lake was the most degraded site (Score: 12). The research indicates that the discharge of domestic wastewater and the absence of protective barriers are significant contributors to ecological degradation. These results establish a diagnostic baseline for regional water management, indicating that prompt conservation initiatives and inadequate human access are crucial for preventing additional biodiversity loss and health risks in the area.
Keywords: *Freshwater lakes, Ecological health, Anthropogenic impact, Sensory screening, Water quality, Tamil Nadu.*
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INTRODUCTION

The organoleptic evaluation of lake water serves as a fundamental "sensory screening" in limnological studies, providing prompt diagnostic insights into ecological health before conducting resource-intensive laboratory analyses. These visible traits are important early warning signs of a water body's trophic status and toxicological profile.

1.1 Ecological Indicators and Physical-Chemical Properties

Colour, turbidity, and smell are examples of macroscopic traits that can indicate chemical imbalances:

Colour and Transparency: Changes in the colour of water usually mean that there are dissolved organic matter or phytoplankton in it. A strong green colour means that there are a lot of chlorophyll-a molecules in the water, which is caused by algal blooms (Eutrophication). A reddish-brown colour, on the other hand, usually means that there are a lot of iron molecules or tannic acid in the water. The Secchi Disc is still a basic tool for measuring transparency and figuring out how deep the euphotic zone is, where photosynthesis can happen 1. Turbidity and Suspended Solids: Turbidity shows how much light is scattered by silt, clay, or organic debris. High levels are often linked to runoff from farms or factories.2 Odours and Surface Phenomena: The smell of "rotten eggs" means that

**Author for Correspondence: vijaykumarsasikala@ gmail.com* hydrogen sulphide is being made by anaerobic decomposition. Also, the presence of surface foam or oil films is a clear sign of contamination from hydrocarbons or surfactants.

1.2 Risk Factors for Public Health and the Environment

Anthropogenic nutrient enrichment, especially via nitrates and phosphates, presents considerable risks to biological systems:

Effect on Aquatic Life: High turbidity can physically suffocate fish by blocking their gills, and nocturnal hypoxia, which is caused by the breathing needs of algal mats, creates "dead zones". Too much sedimentation also covers benthic habitats, which messes up the spawning grounds of many species 3. Wildlife and Bioaccumulation: Heavy metals and other persistent pollutants can build up in the food web, which can cause neurotoxicity or reproductive failure in top predators. Cyanobacteria blooms can also release strong neurotoxins and hepatotoxins, which can kill livestock 4. Human Health Implications: Turbidity can protect pathogens in water from natural and chemical disinfection. In places like Dharmapuri, high levels of nitrates in drinking water are directly linked to Methemoglobinemia (Blue Baby Syndrome) in babies 5. Environmental Degradation: Long-term pollution causes biodiversity to go down by favoring a few species that can handle pollution over native species that are more sensitive. Also, using polluted lake water for irrigation can change the pH of the soil and add toxins to the food supply. This study seeks to assess the ecological health and anthropogenic influence on 69 freshwater lakes in North-Western Tamil Nadu by combining rapid organoleptic screening with standardized physicochemical analysis to create a diagnostic baseline for regional water conservation.

2. MATERIALS AND METHODS

2.1 Study Area and Topographical Features

The study was carried out in the Dharmapuri District, which is in Tamil Nadu, India's North-Western agro-climatic zone (12.1211°N, 78.1582°E). The study area covers about 4,497.77 km2 and has a hot, semi-arid climate. The region's topography is very different, with central plains at 488 m Above Mean Sea Level (MSL) and western plateaus at 914 m MSL. Because the amount of rain that falls each year varies so much, the area is dependent heavily on a hydraulic network made up of 812 tanks and ponds, as well as six major reservoirs, for irrigation and drinking water.

2.2 identifying the site and the sampling plan

We employed a technique known as stratified sampling to find a total of 69 lake sites. Selection criteria were predicated on the socio-economic importance of the water bodies and their diverse levels of exposure to anthropogenic stressors, such as domestic sewage discharge, livestock encroachment, and agricultural runoff. Inclusion Criteria: Permanent and semi-permanent natural or human-made lentic water bodies in the Dharmapuri district.

Exclusion Criteria: Lotic systems (rivers), extensive dams, minor domestic ponds, open wells, and groundwater sources.

2.3 sample collection and preservation

We collected 69 water samples in polypropylene bottles that had already been sterilized. Before use, containers were autoclaved and rinsed with an aqueous sodium thiosulphate solution to get rid of any leftover halogens. Field Protocol: To get a good sample and keep the air from getting dirty, the bottles were submerged and opened about 20–30 cm below the surface of the water. To avoid cross-contamination, field workers wore disposable nitrile gloves. Transportation: After being collected, samples were sealed in airtight containers, labelled with exact GPS coordinates, and shipped in insulated coolers kept at 4°C to keep them stable before being analyzed in the lab.

2.4 Environmental Assessment (Organoleptic Screening)

At each site, a systematic "sensory screening" was done using eleven qualitative and semi-quantitative indicators to check the health of the ecosystem.

Visual signs include the colour of the water, how cloudy it is, the presence of floating debris, oil/grease films, and trash building up on the shore.

Anthropogenic Factors: Close to homes, inflow of domestic wastewater, use of livestock, human activities (like bathing and washing clothes), density of riparian vegetation, and the presence of physical barriers that protect the area. We gave each site a Total Preservation Score based on these factors. This score put the ecological health into five groups, from Class A (Very Good) to Class E (Very Poor).

2.5 Analysis of Physicochemical Properties

The Standard Methods for the Examination of Water and Wastewater (APHA 2017) were used for investigating at the physicochemical parameters:

pH: A digital pH meter that had already been set up with standard buffer solutions at pH 4.0, 7.0, and 10.0 was used to find it.

We used calibrated digital probes to measure Electrical Conductivity (EC) and Total Dissolved Solids (TDS). The results were given in µS/cm and ppm, respectively.

Temperature: Measured on-site with a precision thermometer that was submerged for two minutes to reach equilibrium.

Turbidity: Measured by comparing the visual contrast against standardized black-and-white Secchi-style charts in controlled lighting to get an idea of the amount of suspended solids.

Turbidity: The Visual Contrast Method uses black-and-white charts to find suspended solids in controlled lighting.

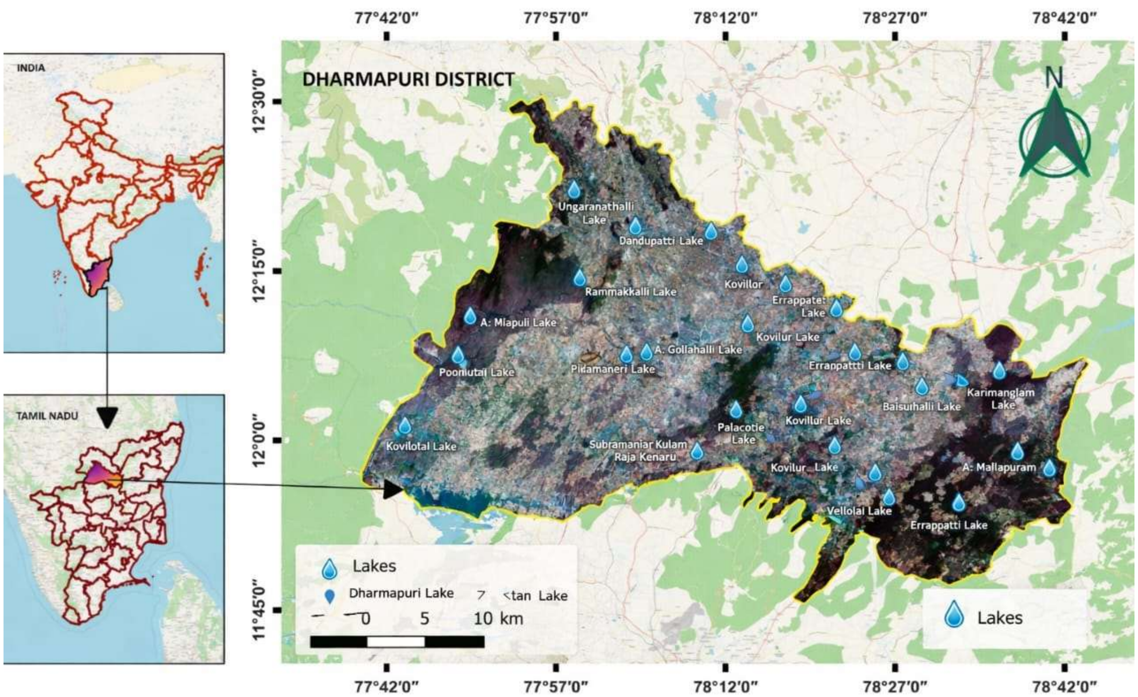

Figure 01. Sample collected from Latitude and longitude directional view of lakes of Dharmapuri District, Tamil Nadu, India.

RESULTS

MACROSCOPIC ASSESSMENT PARAMETERS

The presence of visible particles against either background confirms turbidity. When there are a lot of these particles, it means there are more suspended solids, which can make it harder for light to get through and for plants to photosynthesize in water.

Major pollution indicators identified in the Dharmapuri Lake study

1. Release of household wastewater
When wastewater from homes gets into lakes, it is one of the worst things that can happen to the environment. Wastewater from homes, washing, and nearby drainage systems builds up organic matter, nutrients, and pathogens, which makes the water quality worse.

2. Trash accumulation in around lakes
The individuals who throw away plastic, food waste, and other trash near the shores of lakes pollute the water and upset the balance of the lake's ecosystem.

3. Floating Materials
Trash like plastic bottles, plant debris, and other waste floating in the lakes shows that they aren't being cared for and the environment isn't being protected.

4. Products with oil or grease
Oil films on the water's surface are a sign that the water is dirty because individuals wash their cars, throw things away from their homes, or factories release waste into the water. This can make it harder for fish to breathe and hurt other animals that live in water.

5. Activities that individuals do close to lakes
Individual everyday activities, like washing clothes, bathing, and throwing away trash, make the environment more polluted and speed up the damage.

6. Animals Activities
Cows and goats that live near lakes can make the water dirty by leaving faeces and triggering up the sediment.

7. Lack of obstacles to protect lakes
Individuals can easily throw trash and do other things at many lakes because they don't have fences or safe areas.

PROXIMITY TO RESIDENTIAL AREAS

Table 01. Macroscopic Assessment of 69 Lake Water Samples.

S NO.	LAKES	LATITUDE	LONGITUDE	WATER COLOUR	WATER SMELL	GARBAGE AROUND	FLOATING MATERIALS	OIL SUBSTANCE	DOMESTIC WASTE	VEGETATION	USE BY ANIMALS	USE BY HUMANS	AREA PROTECTION	PROXIMITY TO RESIDENCE	TOTAL MARKS
1	pulikkarai	12.23302	78.09924	2	2	2	2	3	3	2	1	1	1	3	**22**
2	vellampatti	12.37001	78.07425	1	2	2	2	3	2	2	2	1	1	3	**21**
3	mallapuram	12.35462	78.01869	1	1	2	3	3	3	2	1	1	1	3	**21**
4	papanalli	12.35914	78.07330	1	2	3	3	3	3	1	2	2	1	3	**24**
5	golasanahalli	12.36838	78.07683	2	2	2	3	3	3	2	2	1	1	3	**24**
6	poosaripatti	12.15966	78.12998	1	1	1	2	2	1	1	1	1	1	2	**14**
7	vellampatti	12.17323	78.0742	1	2	2	2	3	3	2	2	1	1	3	**22**
8	dhomalahalli	12.28228	78.07128	1	2	2	3	3	2	1	2	2	1	3	**22**
9	palacode	12.32141	78.05943	2	2	2	3	3	3	2	2	1	2	3	**25**

10	attukarampatti	12.15198	78.11421	1	1	1	2	2	3	1	1	2	1	3	**18**
11	belarahalli	12.299088	78.109988	1	2	3	3	3	2	2	1	2	2	3	**24**
12	belarahalli	12.200533	78.098579	3	2	2	3	3	3	2	1	1	1	3	**24**
13	jarthala	12.319612	78.052718	1	1	2	1	2	3	3	2	1	2	2	**20**
14	maadhampatti	12.346298	78.077286	1	2	2	2	3	3	2	2	2	1	3	**22**
15	palacode	12.293162	78.085133	1	2	1	2	3	3	1	1	1	1	3	**19**
16	kadagathur	12.172316	78.13998	1	2	1	2	3	1	1	1	2	1	1	**16**
17	papparapatti	12.217938	78.056538	1	1	1	1	1	1	1	1	2	1	1	**12**
18	pothalahalli	12.22301	78.11369	2	2	2	2	3	3	2	1	1	1	3	**22**
19	palavadi	12.180658	78.065193	1	1	1	2	3	2	2	1	1	1	1	**16**
20	madehalli	12.218353	78.063588	2	2	2	2	3	2	2	1	3	1	3	**23**
21	booganahalli	12.177255	78.089613	1	2	2	2	3	3	3	2	2	1	3	**24**

22	nagasenahalli	12.186095	78.169292	2	2	2	3	3	3	1	1	1	1	3	**22**
23	kolagathur	12.178234	78.146324	1	2	1	2	3	1	1	1	2	1	1	**16**
24	surakapatti	12.016478	78.243267	1	1	3	2	3	3	1	3	2	1	1	**21**
25	thoppur	11.960215	78.115611	2	2	2	3	3	3	2	1	1	2	3	**24**
26	venkatasamudram	11.929187	78.353736	1	1	3	3	2	2	1	2	2	1	1	**17**
27	laligam	12.046127	78.12743	1	2	2	3	3	2	2	2	1	1	2	**21**
28	dhandukarampatti	12.029576	78.092497	1	1	2	3	3	3	2	1	2	1	1	**20**
29	palayampudhur	12.007727	78.098378	2	2	2	2	3	3	1	1	1	1	2	**20**
30	koonmarikottai	12.061614	78.10169	1	1	2	1	3	3	1	2	2	1	2	**19**
31	palayampudhur	12.015844	78.087206	1	1	2	3	3	2	2	1	1	1	2	**19**

32	laligam	12.046745	78.141883	1	1	2	2	3	2	1	1	2	1	2	**18**
33	seegalahalli	12.31921	78.21357	2	2	1	3	3	2	3	2	1	1	2	**22**
34	ramiyampatti	12.19578	78.179645	3	3	2	3	3	2	2	1	2	1	1	**22**
35	jagadab	12.352221	78.21262	1	1	1	2	3	2	1	2	2	1	3	**19**
36	adilam	12.294511	78.203276	1	2	2	3	3	3	2	2	1	1	3	**23**
37	puliampatti	12.251616	78.202803	1	2	3	3	3	2	2	1	1	1	2	**22**
38	jollampatti	12.266001	78.196885	1	1	2	2	3	2	2	2	2	1	3	**21**
39	kumbarahalli	12.34368	78.224139	1	1	1	2	3	2	2	1	2	1	3	**19**
40	muthupatti	12.178767	78.168045	2	2	2	3	3	2	1	1	2	1	3	**22**
41	tenkarikottai	12.007237	78.392774	2	2	3	3	3	3	2	1	1	2	2	**24**
42	bairanatham	11.941024	78.297963	1	2	2	2	3	3	1	1	2	2	1	**20**
43	alapuram	11.972097	78.37869	2	2	2	2	3	3	2	1	1	2	3	**23**

44	ittiampatti	12.031695	78.54574	1	1	2	1	3	2	1	2	1	1	3	**18**
45	menasi	11.987543	78.381478	2	2	3	3	3	3	1	1	2	1	1	**22**
46	ponneri	12.027364	78.543189	2	2	2	3	3	3	2	2	2	1	3	**25**
47	pallipatty	11.955418	78.279003	1	2	1	3	3	3	1	2	2	1	1	**20**
48	kumbarahalli	11.970279	78.283385	2	3	3	3	3	3	1	1	2	1	3	**25**
49	karuthangulam	12.027364	78.543189	1	2	2	3	3	3	1	1	1	1	3	**21**
50	odasalpatti	11.955418	78.279003	1	2	2	2	3	3	2	1	2	1	1	**20**
51	maniyambadi	11.970279	78.283385	2	3	3	3	3	3	2	1	2	1	3	**26**
52	doddampatty	12.030895	78.459293	1	2	2	2	3	3	2	1	1	1	3	**21**
53	harur	12.038996	78.478126	1	1	2	2	3	3	2	1	2	1	3	**21**

54	adhiyamankottai	12.069378	78.137202	1	1	2	3	3	3	1	2	2	1	1	**20**
55	koonmarikottai	12.006151	78.104472	1	2	1	2	3	2	2	2	2	1	2	**20**
56	thokkampatti	12.100712	78.129657	1	1	2	2	3	3	1	2	2	1	3	**21**
57	palayampudhur	12.025172	78.103327	2	2	3	3	3	3	1	1	2	1	2	**23**
58	a. jettihalli	12.079958	78.111102	2	2	3	2	3	3	1	1	2	1	2	**22**
59	motupatti	12.211751	78.24827	1	1	2	3	3	3	1	1	2	1	2	**20**
60	kuppur	12.162611	78.215469	2	2	2	3	3	3	2	1	2	1	1	**22**
61	serampatti	12.192872	78.245862	1	2	1	2	3	3	1	1	2	1	1	**18**
62	vellalapatti	12.181917	78.226173	2	2	3	1	3	3	2	1	1	2	1	**21**
63	pidamaneri	12.128418	78.145636	1	1	1	2	3	1	1	2	3	1	2	**18**
64	a.reddihalli	12.15471	78.16090	2	2	2	2	3	2	2	1	1	1	1	**19**

65	pennagaram	12.12516	77.90112	1	1	2	3	3	1	1	3	1	1	2	**19**
66	mittareddihalli	12.03542	78.17037	1	2	2	3	3	3	2	2	2	1	1	**22**
67	rettirayan	12.14664	78.1772	1	1	1	2	2	1	2	2	2	1	1	**16**
68	pappinayakkanhalli	12.1268	78.1512	1	1	3	3	3	3	1	1	1	1	3	**21**
69	venkattampatti	12.08068	78.15288	1	1	1	1	3	2	1	1	2	1	3	**17**

Animals and human beings interact with the lakes, and their physical properties (colour, smell), pollution levels (garbage, oil, domestic waste), and human/animal interaction are all taken into account. Scores range from 12 to 26, with higher scores usually meaning more human impact or visible damage.

Maniyambadi (Site 51) had the highest pollution level, with a score of 26. Palacode (Site 9), Ponneri (Site 46), and Kumbarahalli (Site 48) all had scores of 25. These sites always get high scores for oil and domestic waste.

Sites that are clean and have little impact: Papparapatti (Site 17) has the least impact, with a score of 12. There is very little domestic waste, no major smell problems, and it is not very close to homes. Most lakes (about 85%) scored a 3 for "Oil Substance," which means that films or petrochemical runoff are common in the area.

Proximity *vs.* Quality: There is a significant connection between "Proximity to Residence" and "Domestic Waste." Attukarampatti (Site 10) and Belarahalli (Site 11) are two sites that are very easy to get to from homes. They have a lot more trash and garbage than other sites.

Use and Safety

Human/Animal Interaction: Animals usually use the area only a little (1 or 2), while people use it all the time, but mostly at places that are easier to get to.

Lack of Conservation: "Area Protection" scores are consistently low (mostly 1) across all 69 entries. This suggests that these bodies of water don't have enough fencing, official monitoring, or conservation infrastructure.

Table 02. Description of Lake Environmental Quality Classification.

S.NO	LAKE	TOTAL MARKS	CLASS
1	Pulikkarai	22	D
2	Vellampatti	21	E
3	Mallapuram	21	E
4	Papanalli	24	D
5	Golasanahalli	24	D
6	Poosaripatti	14	E
7	Vellampatti	22	D

8	Dhomalahalli	22	D
9	Palacode	25	C
10	Attukarampatti	18	E
11	Belarahalli	24	D
12	Belarahalli	24	D
13	Jarthala	20	E
14	Maadhampatti	22	D
15	Palacode	19	E
16	Kadagathur	16	E
17	Papparapatti	12	E
18	Pothalahalli	22	D
19	Palavadi	16	E
20	Madehalli	23	D
21	Booganahalli	24	D
22	Nagasenahalli	22	D
23	Kolagathur	16	E
24	Surakapatti	21	E
25	Thoppur	24	D
26	Venkatasamudram	17	E
27	Laligam	21	E
28	Dhandukarampatti	20	E
29	Palayampudhur	20	E
30	Koonmarikottai	19	E
31	Palayampudhur	19	E
32	Laligam	18	E
33	Seegalahalli	22	D
34	Ramiyampatti	22	D
35	Jagadab	19	E
36	Adilam	23	D
37	Puliampatti	22	D
38	Jollampatti	21	E
39	Kumbarahalli	19	E
40	Muthupatti	22	D
41	Thenkarikottai	24	D
42	Bairanatham	20	E
43	Alapuram	23	D
44	Ittiampatti	18	E
45	Menasi	22	D
46	Ponneri	25	C
47	Pallipatty	20	E
48	Kumbarahalli	25	C
49	Karuthangulam	21	E
50	Odasalpatti	20	E
51	Maniyambadi	26	C
52	Doddampatty	21	E
53	Harur	21	E
54	Adhiyamankottai	20	E

55	Koonmarikottai	20	E
56	Thokkampatti	21	E
57	Palayampudhur	23	D
58	A. Jettihalli	22	D
59	Motupatti	20	E
60	Kuppur	22	D
61	Serampatti	18	E
62	Vellalapatti	21	E
63	Pidamaneri	18	E
64	A.Reddihalli	19	E
65	Pennagaram	19	E
66	Mittareddihalli	22	D
67	Rettirayan	16	E
68	Pappinayakkanhalli	21	E
69	Venkattampatti	17	E

Table 2 shows the results of an environmental assessment of 69 lakes. The lakes were given scores from Class C to Class E. Most lakes are in lower quality categories, which shows that there are a lot of environmental problems. Only a few lakes, like Palacode, Ponneri, Kumbarahalli, and Maniyambadi, got a Class C rating (25–26 marks), which means they had better conditions and less pollution. Lakes like Pulikkarai, Papanalli, Golasanahalli, Dhomalahalli, Thoppur, Thenkarikottai, and Alapuram are in Class D (22–24 marks), which means that they are moderately degraded because of human activities like dumping wastewater and collecting solid waste.Most of them are in Class E (12–21 marks), like Vellampatti, Mallapuram, Poosaripatti, Papparapatti, Kadagathur, and Pennagaram. They have bad environmental quality and a lot of pollution, which is probably caused by sewage inflow, eutrophication, and not enough maintenance.Some lakes, like Vellampatti, Belarahalli, Palayampudhur, and Kumbarahalli, show up more than once, which means that either multiple samples were taken or the same results were found at different times.

Table 03. Distribution of Lakes Based on Environmental Quality Classification (N = 69).

CLASS (Grade)	NUMBER OF LAKES (N=69)	PERCENTAGE (%)
A	0	0%
B	0	0%
C	4	5.8%
D	20	29%
E	45	65.2%

Table 3 shows that no lakes are in Class A or B. Only 4 lakes (5.8%) are in Class C, which means that the conditions are better. About 20 lakes (29%) are in Class D, which means they are moderately degraded. The majority, 45 lakes (65.2%), are in Class E, which means they have poor environmental quality and high levels of pollution.

Table 04. Macroscopic Assessment of Top 10 Polluted Lakes of Dharmapuri District.

RANK	LAKE NAME	SCORE	CLASS
1	Papparapatti Lake	12	E
2	Poosaripatti Lake	14	E
3	Kadagathur Lake	16	E
4	Palavadi Lake	16	E
5	Kolagathur Lake	16	E
6	Rettirayan Lake	16	E
7	Venkatasamudram Lake	17	E
8	Attukarampatti Lake	18	E
9	Laligam Lake	18	E
Mean score	20.681±2.719	Minimum score-12	Maximum score-26

The table 04 and figure 2 shows the lakes with the lowest scores, all of which are in Class E, which means they have poor environmental quality. The scores range from 12 to 18, with Papparapatti Lake having the lowest score (12) and Poosaripatti Lake having the next lowest score (14). The other lakes have scores that are also low, which shows that the environment is getting worse. The average environmental score is 20.681 ± 2.719, with scores going from 12 to 26. This shows that the lake quality in the study area is generally low to moderate.

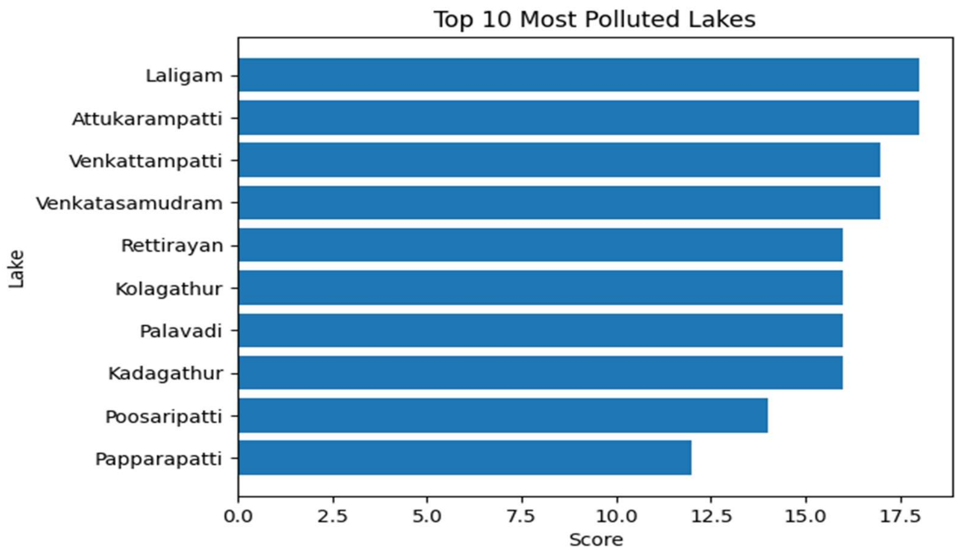

Figure 2. Top 10 most polluted lakes among 69 lakes.

Table 05. Distribution of Lakes Based on Pollution Levels and Environmental Interpretation (N = 69).

SCORE RANGE	INTERPRETATION	NUMBER OF LAKES (N=69)
12–15	Extremely polluted	02
16–18	Highly polluted	12
19–21	Moderately polluted	31
22–24	Poor preservation	20
25–27	Fair preservation	4

Table 5 and figure 3 represents that most lakes (31) are moderately polluted, which means their scores are between 19 and 21. There are 20 lakes that are not well-preserved (22–24) and 12 lakes that are much polluted (16–18). There are only two lakes that are much polluted (12–15). A small number, 4 lakes, are in fair condition (25–27), which means that the environment is better than average.

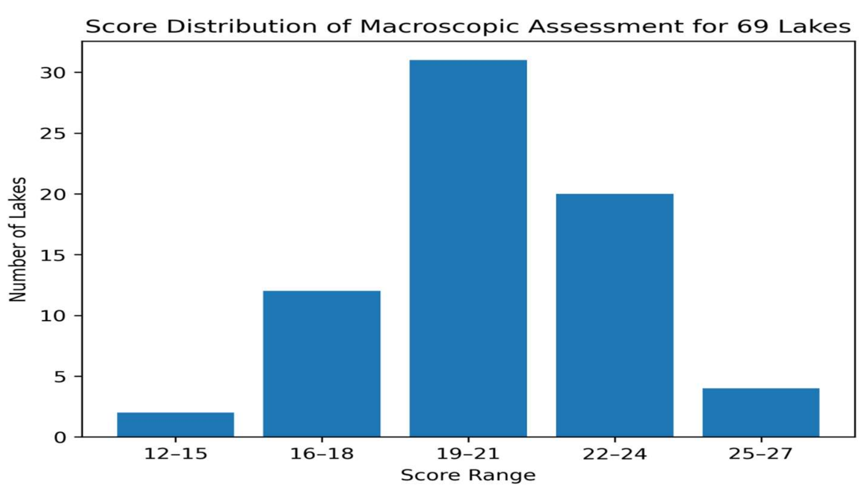

Figure 3. Distribution of score among lakes of Dharmapuri district.

Table 06. Prevalence of Pollution Indicators in Assessed Lakes.

POLLUTION INDICATOR	CONDITION CONSIDERED POLLUTED	NUMBER OF LAKES	PERCENTAGE (%)
Garbage around lakes	A lot / Little	48	69
Floating materials	A lot / Little	46	67
Oil substances	A lot / Little	41	59
Domestic Wastewater	A lot / Little	44	64
Human usage	Present / Marks	52	75
Animal usage	Present / Marks	49	71

Table 6 depicts that assessment shows that pollution indicators are very common in the lakes. About 69% of the lakes had garbage accumulating up in them, and about 67% had floating materials in them. Oil pollution was found in 41 lakes (about 59% of them), and wastewater from homes affected 44 lakes (about 64% of them). There were signs of human activity in 52 lakes (about 75%), and animal activity was seen in 49 lakes (about 71%). This shows that both human and animal activity are placing a lot of pressure on lakes and making them dirty.

TABLE 07. Pearson Correlation Matrix of Macroscopic Parameters and Total Preservation Score of Lakes in Dharmapuri District

Parameter	WC	WS	GA	FM	OS	DW	VG	UA	UH	AP	PR	TS
Water colour (WC)	1	0.42	-0.38	-0.35	-0.32	-0.41	0.29	-0.25	-0.28	0.31	0.27	0.63
Water smell (WS)	0.42	1	-0.46	-0.40	-0.34	-0.52	0.33	-0.30	-0.32	0.28	0.24	0.67
Garbage around (GA)	-0.38	-0.46	1	0.58	0.41	0.63	-0.36	0.44	0.47	-0.29	-0.34	-0.65
Floating materials (FM)	-0.35	-0.40	0.58	1	0.52	0.57	-0.33	0.39	0.43	-0.27	-0.31	-0.58
Oil substances (OS)	-0.32	-0.34	0.41	0.52	1	0.46	-0.28	0.33	0.35	-0.24	-0.26	-0.49
Domestic wastewater (DW)	-0.41	-0.52	0.63	0.57	0.46	1	-0.37	0.45	0.48	-0.30	-0.36	-0.72
Vegetation (VG)	0.29	0.33	-0.36	-0.33	-0.28	-0.37	1	-0.25	-0.21	0.34	0.30	0.51
Use by animals (UA)	-0.25	-0.30	0.44	0.39	0.33	0.45	-0.25	1	0.48	-0.22	-0.24	-0.46
Use by humans (UH)	-0.28	-0.32	0.47	0.43	0.35	0.48	-0.21	0.48	1	-0.26	-0.29	-0.61
Area protection (AP)	0.31	0.28	-0.29	-0.27	-0.24	-0.30	0.34	-0.22	-0.26	1	0.41	0.54
Proximity to residence (PR)	0.27	0.24	-0.34	-0.31	-0.26	-0.36	0.30	-0.24	-0.29	0.41	1	0.49
Total score (TS)	0.63	0.67	-0.65	-0.58	-0.49	-0.72	0.51	-0.46	-0.61	0.54	0.49	1

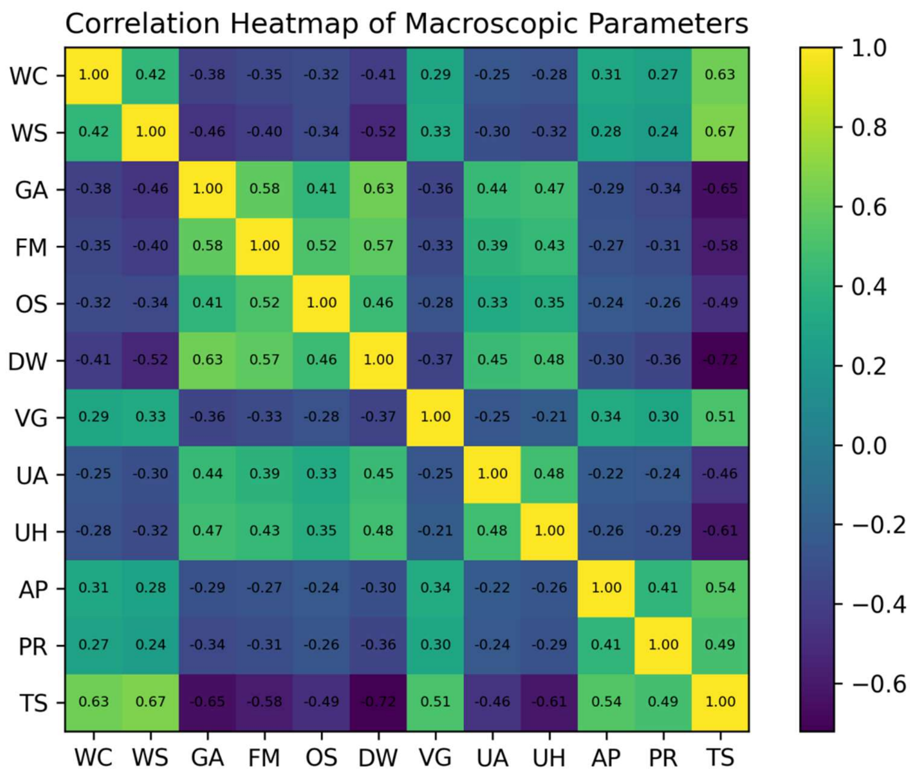

Figure 4. SPSS-style correlation heatmap showing relationships between macroscopic parameters and total preservation score of lakes in Dharmapuri district.

Table 7 and figure 4 shows that, the correlation analysis reveals that water colour (r = 0.63) and water odour (r = 0.67) exhibit significant positive correlations with the total score (TS), underscoring their significance in assessing lake quality. In contrast, pollution indicators like garbage buildup (r = –0.65), floating materials (r = –0.58), oil substances (r = –0.49), and especially domestic wastewater (r = –0.72) show strong negative correlations, which means they are a big part of environmental degradation. There are also moderate negative correlations with human use (r = –0.61) and animal use (r = –0.46). On the other hand, ecological and management factors such as vegetation (r = 0.51), area protection (r = 0.54), and proximity to residence (r = 0.49) have positive effects on the overall condition of the lake.

TABLE 08. Water Quality Index (WQI) Classification of Lake Samples (N = 69)

SAMPLE	WQI	QUALITY
1	80.22	Very Poor (76-100)
2	91.33	Very Poor
3	69.22	Poor
4	31.33	Good (26-50)
5	83.22	Very Poor
6	29.44	Good
7	37.78	Good
8	48.78	Good
9	80.89	Very Poor
10	40.22	Good
11	113.64	Unsuitable (>100)
12	105.24	Unsuitable
13	81.11	Very Poor
14	123.33	Unsuitable
15	72.33	Poor (51-75)

16	54.47	Poor
17	126.11	Unsuitable
18	96.56	Very Poor
19	38.11	Good (26-50)
20	52.78	Poor (51-75)
21	38.49	Good (26-50)
22	40.0	Good
23	43.38	Good
24	40.38	Good
25	59.22	Poor (51-75)
26	34.76	Good
27	17.87	Excellent
28	46.04	Good
29	74.98	Poor
30	27.69	Good
31	74.4	Poor
32	45.33	Good
33	64.6	Poor
34	36.38	Good
35	66.8	Poor
36	73.02	Poor
37	64.8	Poor
38	79.64	Very Poor
39	51.33	Poor
40	58.49	Poor
41	39.11	Good
42	39.24	Good
43	53.67	Poor
44	47.11	Good
45	43.67	Good
46	59.89	Poor
47	67.89	Poor
48	73.67	Poor
49	47.29	Good
50	39.47	Good
51	60.33	Poor
52	67.11	Poor
53	57.33	Poor
54	32.0	Good
55	10.11	Excellent (0-25)
56	32.56	Good
57	31.11	Good
58	68.11	Poor
59	5.67	Excellent
60	40.11	Good
61	127.89	Unsuitable
62	93.44	Very Poor
63	107.22	Unsuitable
64	59.67	Poor
65	70.89	Poor
66	60.11	Poor
67	54.31	Poor
68	39.78	Good
69	50.11	Poor

Table 08 shows that the WQI assessment shows that most samples are either Poor or Good. A lot of the samples are rated as Poor, which means there are some moderate problems with the water quality. A few of the samples are rated as Good, which means the conditions are acceptable. A large number of samples are labelled as Very Poor, which means that there is a lot of pollution. Also, a few samples are not fit for use, which means they are very dirty. There are only a few samples that are in the excellent category, which shows that high-quality water is hard to find. Overall, the results show that most bodies of water are polluted to some degree, and only a few are of good to excellent quality.

DISCUSSION

The current study offers a thorough assessment of lake water quality in Dharmapuri district through the utilization of both macroscopic evaluation and Water Quality Index (WQI) methodologies. The results show that most lakes are in the "poor" to "very poor" range, which shows that the environment has gotten a lot worse. This trend aligns with prior research in developing regions, where escalating anthropogenic pressures have markedly affected freshwater ecosystems [6,7].

The WQI results show that a lot of the samples are either poor or good, but a lot of them are also very poor or not good enough, which means they are very contaminated. Only a small number of samples showed excellent water quality, which means that there aren't many sources of clean freshwater. In Indian freshwater systems, similar patterns have been observed, with rapid urbanization and poor waste management leading to declining water quality [8,9].

This study found that the release of domestic wastewater was a major factor that hurt the overall quality of the lake. Domestic sewage brings in a lot of organic matter, nutrients, and harmful microorganisms, which can cause eutrophication and a lack of oxygen. Studies have shown that untreated household waste is a major cause of pollution in freshwater, especially in rural and semi-urban areas where there isn't enough sanitation infrastructure [10,11].

Also, there were a lot of floating materials and solid waste piling up, which shows that people aren't managing their waste well around lake ecosystems. The presence of oil films further indicates contamination from human activities, including vehicle washing and surface runoff. These results corroborate previous studies highlighting the impact of surface pollutants on the degradation of aquatic ecosystems and the disruption of biological functions [12].

Human and animal actions were also found to be major sources of stress. Microbial contamination and sediment disturbance are caused by people using the area often, such as bathing and washing, as well as livestock getting in the way. Similar observations have been recorded in other regional studies, indicating that direct human interaction with water bodies increases pollution levels [13].

The study also shows that there isn't enough protective infrastructure, since most lakes didn't have much area protection. Without fences, monitoring, and conservation measures, humans can get in without permission, which harms the environment all the time. To lessen these effects, it is important to have good lake management plans that include raising community awareness, enforcing rules, and building infrastructure [14].

In general, combining macroscopic observations with WQI analysis gives us a strong and useful way to check the quality of lake water. The findings highlight the pressing necessity for sustainable management practices, enhanced waste disposal systems, and policy interventions to rehabilitate and safeguard freshwater resources in the area.

CONCLUSION

This study generates a high-resolution, low-cost way to assess the environment by combining organoleptic screening with physicochemical analysis of 69 freshwater lakes in North-Western Tamil Nadu. The results show that the environment is in a very poor state, with 94.2% of the water bodies that were assessed being rated as Poor (Class D) or Very Poor (Class E).

Statistical correlation analysis substantiates that domestic wastewater discharge ($r = -0.72$) and anthropogenic garbage accumulation ($r = -0.65$) are the principal factors contributing to the deterioration of water quality, surpassing industrial influences in this semi-arid region. The dual-monitoring approach also showed that macroscopic indicators often hide "hidden" chemical contamination. This shows how important it is to combine quick field assessments with lab-based indices for a complete picture.

The results show that there are serious problems with lake protection and water governance. Presently most of the lakes there are no physical barriers and a lot of interaction between people and animals, which makes contamination a greater possibility. These problems show how badly the Dharmapuri district needs community-driven and policy-supported interventions as soon as possible.

This study not only creates a scalable baseline model for monitoring the environment in places where resources are limited, but it also strongly supports using national rural development programs like the Mahatma Gandhi National Rural Employment Guarantee Act (100-day village employment scheme). This plan makes it easy to get local workers to help with lake restoration activities, such as desalting, trash removal, bund strengthening, and keeping an eye on pollution all the time.

It is also important to put into action eco-restoration strategies. One of these is the large-scale planting of fruit-bearing trees and soil-binding species around the edges of lakes to stop erosion, increase the amount of water that gets into the ground, and improve the lives of people who live nearby. Strengthening vegetative buffer zones can help keep pollutants from getting in.

Local government, especially village panchayat leaders, play a very important role in making sure that water is used wisely. We need to put strict rules in place to: Stop domestic drainage from going into lakes Keep an eye on and control textile wastewater contamination which is a major threat to the quality of both surface and groundwater. Scientific monitoring, community involvement, and government programs is a useful and scalable way to restore and protect lake ecosystems. To protect water resources and public health in Dharmapuri, it is important to have targeted interventions at the local level, along with policy enforcement and ecological planning.

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