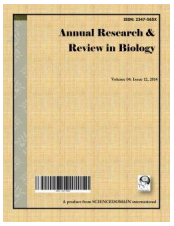

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Survey of Wetlands in and around Tiruppur District, Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration between both authors. Author KV designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author PJP managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Wetlands are amongst the most productive ecosystem On the Earth [1,2], and provide many important services to human society. Wetlands are one of the most threatened habitats of the world. Wetlands in India, as elsewhere, are increasingly facing several anthropogenic pressures. Urbanization is the irreversible, and most dramatic, transformation of land affecting ecology and natural resources. This study was carried out to document the wetland status from June 2017 to March 2018 in and around Tiruppur district, TamilNadu. The study results demonstrated that there are 88 wetlands in and around Tiruppur districts and that they might be categorized in terms of dimension and state. Out of the 88 wetlands, 68% of the wetlands consist of land plots of less than 5 acres in size, followed by 26% of the wetlands consisting of 6-10 acres in size, 3% of the wetlands were approximately 11-15 acres in size while 3% of the wetlands were over 15 acres. According to the recorded usage of the wetlands, 42% were used for irrigation, 11% for irrigation and fisheries, 3% for recreational activities, and 44% for cattle cleaning, residential purposes including washing clothes, in the booming slums around the wetlands. For wastes dumped on wetlands, 2% were degradable wastes, 44% were non degradable wastes, and 54% were mixed wastes, including both

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degradable and non degradable waste. In Tiruppur town, 21% of the wetlands were enclosed by farm land, 8% were encircled by factories/companies, and 71% were surrounded by residential areas. During every summer season, 53% of the wetlands become dried out, 19% were partially dried up, and 28% of the wetlands retained their water holding capacity throughout the year. The results indicated that the decline of wetlands in and around Tiruppur district was due to waste dumping, construction near wetlands, lack of desilting and dredging, blocking of water channels, and the lack of strict laws. Apart from government regulation, creating wetland awareness, enlightened infrastructure development, sustainable water use planning, and implementation of zero discharge facilities practices are necessary in order to prevent the further deterioration on wetlands in Tiruppur district.

Keywords: Wetlands; pollution; anthropogenic; urbanization; residential areas; Tiruppur.

ABBREVIATIONS

***WQI**: water quality index.*

1. INTRODUCTION

Wetlands are globally important ecosystems, which are found on every continent, and are among the most productive habitats on earth [3,4]. Although they only occupy 6% of the Earth's surface, they support approximately 20% of all living organisms, providing an important source of biodiversity [4,5]. Inland wetlands receive water from precipitation, snow melt, river outflow, surface overland flow, ground water discharge, lake seiches, and seepage from streams, lakes, ponds and irrigation systems. Overall, 1052 sites in Europe, 289 in Asia, 359 in Africa, 175 in South America, 211 in North America, and 79 in the Oceania region (The geographical region comprising the Pacific Islands of Micronesia, Melanesia, Polynesia, and Australia) have been identified as Ramsar sites or wetlands of International importance [6]. Wetlands, being dynamic and influenced by both natural and man-made activities, need frequent monitoring [7]. Wetlands occupy about 1,280 million hectares (approximately 512 million acres) of the entire world's surface. However, about 134,216,253 ha, of the total world wetlands, are internationally recognized as wetlands, and this excludes marine and coastal wetlands. Presently about 50% of the world wetlands are lost due to drainage, and water diversions [8]. Wetlands cover approximately 6% of the Earth's land surface and contain a large portion of the world's biodiversity [9]. Natural wetlands in India consist of the high altitude Himalayan Lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters and estuaries; mangrove swamps; coral reefs and marine wetlands, etc. Infact, with the exception of bogs, fens, and typical salt marshes, Indian wetlands cover the whole range of the ecosystem types found [10].

The 'water-spread' area of wetlands changes over seasons. The states of Sikkim, Nagaland, Mizoram, Meghalaya, and Jharkhand have more than 90% of the total wetland area as water spread area during the post monsoon. Significant reduction in water spread area of wetlands from post monsoon to pre monsoon was found in the States of Uttar Pradesh (28%), Chhattisgarh (29%), Himachal Pradesh (29%), Tripura (29%), Sikkim (30%), Andhra Pradesh (31%), Jharkhand (32.5%), Punjab (33%), Bihar (34%), Gujarat (36%), Karnataka (38.5%),

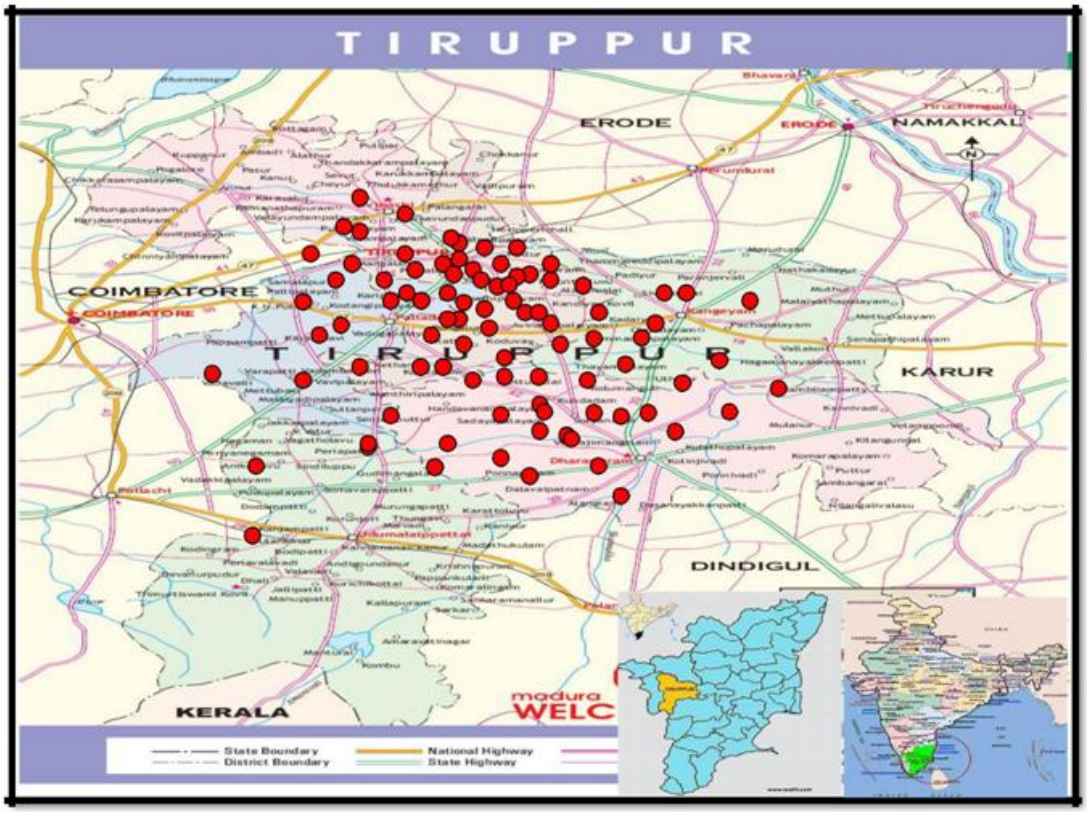
Maharashtra (53.5%), Tamil Nadu (55%), Madhya Pradesh (57%) and Rajasthan (57%). With respect to percentage area under aquatic vegetation, Andhra Pradesh, Delhi, Karnataka, Manipur, Orissa, Punjab, Tamil Nadu, Tripura, and West Bengal have 15–59% of the wetland area under aquatic vegetation [11]. The wetlands in Tamil Nadu consist of lakes, ponds, reservoirs, and seasonally waterlogged areas. The studies by SACON show that the wetland area of Tamil Nadu was 1.24% of the total area in 1991. According to the National Wetland Atlas (2011), 61% of TamilNadu's wetlands are classified under lakes, ponds, and tanks. As noted above, 24684 wetlands have been mapped in the Tamil Nadu. In addition, 18294 small wetlands (< 2.25 ha) have also been identified. In India, wetlands are increasingly facing several anthropogenic pressures. Landscape changes are an important aspect, as they play an important role in the global environment. Due to the exponential

industrial growth, since the 1980s, the employment rate increased, which increased the number of people arriving from other areas of Tamil Nadu. Now Tiruppur also hosts a migratory workforce. Rapid urbanization and expanding industries associated economic activities creates tremendous pressure on water resources and responsible for dumping 300-400 million tons of heavy metals, solvents, toxic sludge, and other wastes into water bodies each year in worldwide [12]. According to recent estimates, more than 70 per cent of industrial wastes in developing countries are dumped untreated into adjacent water resources. The aim of this study was to record the present status of wetlands in Tiruppur district and the influence of the anthropogenic activities on wetlands.

2. MATERIALS AND METHODS

2.1 Study Area

Tiruppur town (Tier II cities) is located at (latitude: 11º.05'N, longitude: 77º.20'E). The total area of the district is 5186.34 sq. kms, with a population of 24, 790,520. It is India's top textile area. Tiruppur district was formed in 2009, carved out of the Coimbatore and Erode, districts making it the 32nd district of Tamil Nadu, and one of the ten most industrialized and economically developed districts of TamilNadu. Before the formation of Tiruppur district, Avinashi, Madathukulam, Palladam, Tiruppur, and Udumalpet were taluks (a subdivision of a revenue district) of the Coimbatore district, and Dharapuram and Kangeyam were taluks of the Erode district. The district is surrounded by the Coimbatore district in the west, The Erode district to the North and northeast, the Karur district in the East, and the Dindigul district in the South east. The south of the district is surrounded by Kerala state (Idukki district). In 2011, the Tiruppur Corporation area limit was extended to 159 sq. km, which now encompasses 60 wards, by merging nearby Velampalayam Municipality, Nallur Municipality, Andipalayam, Chettipalayam, Mannarai, Muthanampalayam, Murugampalayam, Veerapandi, Neruperichal, and Thottipalayam village panchayats (a village council in India). Tiruppur now has an area of 159 sq. km, with a population of 8.78 lakhs per the 2011census. The city has an area of 159 sq.



Map 1. A satellite map showing the location of the wetlands (in red circles) of Tiruppur district

km, The southern and south western parts receive maximum rainfall, due to the adjacent Western Ghats. The remaining locations in the city fall in the 'rain shadow' region of the Western Ghats, and they experiences a salubrious climate most of the year, except in the extreme eastern part of the city. The maximum and minimum temperatures of Tiruppur city during summer and winter vary between 35°C and 18°C respectively. The average annual rainfall is around 700 mm, with the North East and the South West monsoons contributing 47% and 28% respectively to the total annual rainfall. The major rivers flowing through the district are the Noyyal and Amaravathi. The Amaravathi River is the main source of irrigation in the district. Economic base of Tiruppur is the export business. It is internationally known because of its numerous apparel (Banian) manufacturing industries spread over the entire town. The relatively large growth rate was due to an influx of workers from other parts of India, due in turn to Tiruppur's rapid industrialization during the period. The migrant population in Tiruppur is very high, given the high employment opportunities in the hosiery industry, and this directly impacts the projections for infrastructure needs based on the resident population.

2.2 Methods

The present study was conducted by means of a field visit along with a questionnaire survey. The study assessed the status of the wetlands in Tiruppur, from June 2017 to March 2018. Before the start of the actual data collection, a preliminary survey was conducted during mid-June 2016. A total of 88 wetlands were surveyed in and around Tiruppur district. The questionnaire was designed to collect data on the status of wetlands with respect to the conservation challenges in the Tiruppur district. Data on wetland status in Tiruppur (in previous years from 2000 to 2016) were collected from local NGO'S and the government record, which were used to make comparative studies on wetland status in the Coimbatore district. The data were analyzed using spss (statistical package for social sciences) 17 version computer software program.

3. RESULTS AND DISCUSSION

The wetlands have been classified under four groups by land area size. The Group I (n=39), which is less than 5 acres in size (Fig. 1), contain 44% of total wetlands where Group II (n=25) wetlands were between 6-10 acres (Fig. 2), and represent 28% of the wetlands. Group III (n=2) wetlands were (11-15 acres) in size (Fig. 3), and occupies 3% of wetlands. Group IV (n=22) wetlands were (above 15 acres) in size (Fig. 4), and they contain 25% of total wetlands. The following wetlands were over 100 acres in size, i.e., Aachankulam, Chinnakulam, Chinnandipalayam Lake, Kannampalayam, Samalapuram Lake, Periyakulam, Sulur Big Lake, and Sulur Small Lake. From the total of 88 wetlands, the dryness of the wetlands over the years was subdivided into five categories. A large number of wetlands (n = 32) had been dry less than 5years, (n=12) between 6-10 years, (n=2) between 11 to 15 years, (n=4) above15 years, and (n=38) wetlands never dried. Overall, 43% of the wetlands were being used for irrigation, fishing and other activities. Approximately 5% of wetlands dried more than fifteen years ago, 2%of wetlands dried between 11 and 15 years ago, 12% of wetlands dried6-10 years ago, and 36% dried out less than five years ago. In Tiruppur district, during the summer season, 43% of wetlands (n=38) were dried and barren wetlands even large wetlands like Alallapuram Pond, Vadugapalayam Pond, Thottipalayam Pond, Alangiyum Lake, Pallapalayam Pond, Pannaikenarupalayam Pond, Avanasipalayam Pond, Nagalingapuram Pond, Semmandampalayam Pond, Karapalayam Pond, Katturpudur Pond, Santhanamanayakkan Palayam Pond, Muthanampalayam Pond, and Andipalayam Pond. Nearly 14% of the wetlands were partially dried, and 43% of wetlands (n=38) had stagnant water throughout the year.

Different types of waste dumped (Fig. 5) in and around the wetlands of the Tiruppur district were classified as: (I)- Degradable (Food waste, Wood waste, Cloth waste, bottles); (II)- Non degradable (Plastic, Polythene products) and (III)- Mixed waste (MW) containing both hazardous waste and radioactive waste.

Out of 88 wetlands, 4% of the wetlands were polluted by degradable waste (Oothupalayam Pond and Perumbali Pond). Almost 44 % the wetlands had non-degradable waste and mixed waste (MW) dumped in them, consisting of materials like food waste, wood waste, cloth, glass, plastic products, polythene. Effluent and sewage mixing were noted in each of the Tiruppur wetlands. Based on usage, the wetlands were subdivided into: (I)- Irrigation; (II)- Irrigation and Fishing; (III)-(Cattle grazing, Washing, and Sewage mixing); (IV)-

Recreational/entertainment uses. Thirty seven wetlands (42%) were used for irrigation purposes, ten wetlands (11%) were used for irrigation and fishing. Fishing activities were carried out in Annur Lake, Chinnandipalayam Lake, Kannampalayam Lake, Karisalkulam Lake, Ottukulam Lake, Pallapalayam Lake, Periyakulam Lake, Sengulam Lake, Sulur Big Lake and Thinaikulam Pond. Approximately 44% of wetlands were used for other purposes. Cattle grazing, and garbage dumping were recorded in most of the wetlands. Residential sewage mixing occurred in Thonguttipalayam Pond, Akkanampalayam Pond, Alaampalayam Pond, Thottipalayam Lake, Chellapillaipalayam Pond, and Kallimadu Pond. Industrial effluent mixing occurred in Karaipudhur Pond, Kasipalayam Lake, Anaimadu Pond, Kanchipuram Bridge (Nizhilikarai) Kandiankovil Pond and Alaampalayam Pond. Nearly 3% of wetlands used for recreational and entertainment activities like boating, included Andipalayam Pond, Amaravathi Palayam Pond, and Thottipalayam Pond. Based on water color, five wetlands (13%) were green (Thonguttipalayam Pond, Alaampalayam Pond, Kandiankovil Pond, Nanjarayan Pond and Kallimadu Pond), Seven wetlands (18%) had black in color(Thottipalayam Lake, Velliyampalyam Pond, Anaimadu Lake, Kasipalayam Lake, Amaravathi Palayam Pond and Nanjiyampalayam Pond). Four wetlands (10%) were colorless (Aankovil Pond, Mannarai Lake, Andipalayam Pond and Samalapuram Pond). Twenty- two (59%) wetlands were brownish in color. Anthropogenic practices observed in and around the wetlands of Tiruppur districts: (I)- Companies/Factory; (II)- Farming; (III)- Building construction (Residential, government, private company, and slums). A total of 21% of the wetlands were surrounded by farmland, 7% were covered by companies or factories in Uppaaru Bridge (Nanjiyampalayam Pond), Kanchipuram Bridge (Nizhilikarai), Kasipalayam Lake, and Thottipalayam Lake. Bird diversity, including migratory birds was observed in Samalapuram Pond, Andipalayam Pond, Nanjarayan Pond, and Mannarai Lake. Almost 72% of the wetlands were covered by residential areas. We also recorded recent changes of wetlands, within 5 years, which various anthropogenic activities. Based on the changes, we classified the wetlands into 3 categories: (I)- Changes occurred in the area of the Wetland; (II)- changes occurred in the water quality; (III)- No changes. Under these categories, eleven wetlands (14%) never changed their characteristics. The water quality (physico chemical and biological parameters) has been changed in (n=41), 46% of wetlands. The area has been occupied in (n=36), 40% of the total wetlands by construction, booming slum areas, and encroachment. These Lakes have illegal construction of buildings, and most of the time, slum dwellers occupy the adjoining areas. In 38 wetlands, water is used for washing and household activities, and fishing was observed at 10 wetlands in and around Tiruppur wetlands. Some of the Lakes have been restored by the city, and concerned authorities. Lack of conformity among government policies in economics, environment, nature conservation, and development planning is one reason for the deterioration of these water bodies. Encroachment activities were observed in Kallimadu Pond, Samalapuram Pond, Andipalayam Pond, Semmandampalayam Pond, Ayyampalayam Pond, Subanur Pond, Mettukatai Pond, Nanjarayan Pond, Kasipalayam Lake, Uppaaru Bridge (Nanjiyamp alayam Pond), Devanampalayam Pond, Velampatti Pond, and Alaampalayam Pond.

1. Velampati Pudur Pond **2.Velliyampalayam Pond** **3.Subbanur Pond**

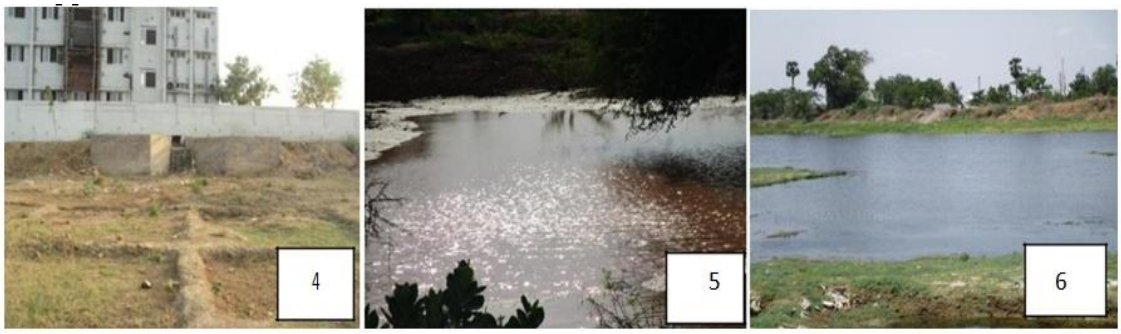
Fig. 1. Photos of Group I type (1-5 acres) of Wetlands in and around Tiruppur district, Tamil Nadu

Table 1. Wetlands in and around Tiruppur districts, Tamil Nadu

Wetland name	Dryness	Usage of water	Waste dumping	Anthropogenic impact
Aachankulam, ☆☆	Never dried	Irrigation	Non Degradable	Farm land
Annur lake, ☆☆☆☆	6- 10 years	Irrigation, Fishing	Mixed waste	Residential area
Chettiyarkulam, ☆☆☆☆	Never dried	Irrigation	Mixed waste	Farm land
Chinnakulam☆☆☆☆	Never dried	Other	Mixed waste	Residential area
Chinnandipalayam lake, ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Company
Chinnaveerampatty lake, ☆☆	>5 years	Other	Mixed waste	Farm land
Jammunai lake☆☆	Never dried	Other	Mixed waste	Residential area
Kannampalayam lake ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Farm land
Karisalkulam ☆☆☆☆	Never dried	Irrigation, Fishing	Non Degradable	Farm land
Marulpatti lake☆☆☆☆	>5 years	Irrigation	Non Degradable	Farm land
Oothupalayam pond☆☆☆☆	Never dried	Irrigation	Degradable	Residential area
Ottukulam, ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Farm land
Pallapalayam lake ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Farm land
Pateeswarar lake ☆☆☆☆	Above15 years	Irrigation	Mixed waste	Residential area
Periyakulam (k) ☆☆☆☆	Never dried	Irrigation	Mixed waste	Farm land
Periyakulam ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Farm land
Perumbali pond ☆	>5 years	other	Degradable	Farm land
Ramiyapalayam lake ☆☆	Above15 years	other	Mixed waste	Farm land
Samalapuram lake ☆☆☆☆	Never dried	Irrigation	Mixed waste	Residential area
Sangamamkulam ☆☆☆	11-15 years	other	Mixed waste	Residential area
Sellanur pond, ☆	6- 10 years	Irrigation	Mixed waste	Farm land
Sevur lake☆☆☆☆	6- 10 years	other	Mixed waste	Residential area
Semmandampalayam lake ☆☆☆☆	Never dried	Irrigation,	Non Degradable	Farm land
Sengulam ☆☆☆☆	Never dried	Irrigation, Fishing	Mixed waste	Farm land
Sulur big lake ☆☆☆☆	Never dried	Irrigation, Fishing	Non Degradable	Farm land
Sulur small lake ☆☆☆	Never dried	Irrigation,	Mixed waste	Farm land
Thamaraikulam, ☆☆☆☆	11-15 years	other	Mixed waste	Residential area
Thinaikulam ☆☆☆☆	Never dried	Irrigation, Fishing	Degradable	Farm land
Vadakalur lake☆☆☆☆	6- 10 years	Irrigation	Mixed waste	Farm land
Thonguttipalayam pond☆	Never dried	Other	Non Degradable	Residential area
Velayuthampalayam pond ☆	Never dried	Irrigation	Mixed waste	Residential area
Vadugapalayam pond☆	>5 years	Other	Mixed waste	Residential area
Alallapuram pond ☆	>5 years	Irrigation	Non Degradable	Residential area
Akkanampalayam pond☆	Never dried	Other	Mixed waste	Residential area
Maniyampalyam pond ☆☆	Never dried	Irrigation	Non Degradable	Residential area
Kaikatti pond ☆	Never dried	Irrigation	Non Degradable	Residential area
Ramalingapuram pond☆	6- 10 years	Irrigation	Non Degradable	Residential area
Alaampalayam pond ☆	Never dried	Other	Mixed waste	Company
Kandiankovil pond ☆	Never dried	Other	Mixed waste	Residential area
Kariyampalayam pond ☆	Never dried	Other	Non Degradable	Residential area
Uppukaraipalayam pond ☆	Never dried	Other	Mixed waste	Residential area

Wetland name	Dryness	Usage of water	Waste dumping	Anthropogenic impact
Kandhampalayam pond☆☆	>5 years	Other	Non Degradable	Residential area
Aankovil pond☆	Never dried	Other	Mixed waste	Residential area
Velampatti pond ☆	>5 years	Other	Non Degradable	Residential area
Devanampalayam pond☆	>5 years	Irrigation	Non Degradable	Residential area
Kattupalayam pond☆	Never dried	Other	Mixed waste	Residential area
Kovilpalayampudhur pond☆	>5 years	Irrigation	Non Degradable	Residential area
N.kanchipuram bridge(nizhilikarai) ☆	>5 years	Irrigation	Non Degradable	Company
Uppaaru bridge (nanjiyampalayam pond) ☆☆	>5 years	Irrigation	Non Degradable	Residential area
Amaravathipalayam pond☆	>5 years	Recreational activity	Non Degradable	Residential area
Alangium lake ☆	>5 years	Irrigation	Non Degradable	Residential area
Kasipalayam lake ☆	Never dried	Other	Mixed waste	Company
Mannarai lake ☆	Never dried	Irrigation	Non Degradable	Residential area
Anaimadu pond ☆	Never dried	Other	Mixed waste	Company
Nanjarayan pond ☆☆	Never dried	Irrigation	Non Degradable	Residential area
Velliyampalayam pond☆	Never dried	Other	Non Degradable	Residential area
Mettukatai pond ☆	Never dried	Irrigation	Mixed waste	Residential area
Anaipalayam pond ☆☆	>5 years	Irrigation	Mixed waste	Residential area
Subanur pond ☆	Never dried	Irrigation	Non Degradable	Residential area
Thottipalayam lake ☆☆	Never dried	Other	Mixed waste	Residential area
Kathankanni pond ☆☆	>5 years	Other	Mixed waste	Residential area
Nachipalayam pond ☆	>5 years	Other	Non Degradable	Residential area
Avanasipalayam pond ☆	>5 years	Other	Non Degradable	Residential area
Peruntholuvu pond☆☆	>5 years	Other	Mixed waste	Residential area
Kosavampalayam pond ☆	>5 years	Irrigation	Mixed waste	Residential area
Chellapillaipalayam pond ☆☆	>5 years	Other	Non Degradable	Residential area
Ayyampalayam pond ☆	>5 years	Other	Non Degradable	Residential area
Nagalingapuram pond☆☆	>5 years	Irrigation	Mixed waste	Residential area
Thottipalayam pond ☆	>5 years	Recreational activity	Non Degradable	Residential area
Semmandampalayam pond ☆	>5 years	Irrigation	Non Degradable	Residential area
V.kallipalayam pond☆	>5 years	Other	Mixed waste	Residential area
Thuththeripalayam pond☆☆	6- 10 years	Other	Non Degradable	Residential area
Velampattipudhur pond☆	>5 years	Other	Non Degradable	Residential area
Thottapatti pond ☆	>5 years	Irrigation	Non Degradable	Residential area
Kattur pond ☆☆	>5 years	Irrigation	Mixed waste	Residential area
Chinnakattur pond ☆☆	>5 years	Irrigation	Non Degradable	Residential area
Karapalayam pond ☆☆	6- 10 years	Other	Mixed waste	Residential area
Katturpudhur pond ☆☆	>5 years	Irrigation	Non	Residential area

Wetland name	Dryness	Usage of water	Waste dumping	Anthropogenic impact
Santhamanayakkan palayam pond☆☆	>5 years	Irrigation	Degradable Mixed waste	Residential area
Muthanampalayam pond☆☆	6- 10 years	Irrigation	Non Degradable	Residential area
Andipalayam pond ☆☆	Above15 years	Recreational activity	Non Degradable	Residential area
Samalapuram pond☆☆	Above15 years	Irrigation	Non Degradable	Residential area
Velam palayam pond☆	>5 years	Other	Non Degradable	Residential area
Karaipudhur pond ☆	6- 10 years	Other	Mixed waste	Company
Kallimadu pond ☆	Never dried	Other	Non Degradable	Residential area
Pannaikenarupalayam pond ☆☆	6- 10 years	Irrigation	Mixed waste	Residential area
Pudhupalayam pond ☆☆	6- 10 years	Other	Mixed waste	Residential area
Pallapalayam pond ☆☆	6- 10 years	Other	Mixed waste	Residential area



4. Maniampalayam pond **5. Anaipalam pond** **6. Andipalayam pond**

Fig. 2. Photos of Group II type (6-10 acres) of Wetlands in and around Tiruppur district, TamilNadu

7. Sangamamkulam Lake **8.Sulur small Lake**

Fig. 3. Photos of Group III type (11- 15 acres) of Wetlands i in and around Tiruppur district, TamilNadu

9. Chinnandipalayam lake 10.Periyakulam lake 11. Pallapalayam lake 12. Kannampalayam lake 13. SulurBig lake 14. Periyakulam pond

Fig. 4. Photos of Group IV type (above 16 acres) of Wetlands in and around Tiruppur district, Tamil Nadu

15. Akkanampalayam pond 16. Avanasipalayam pond 17. Kosavampalayam pond

Fig. 5. Photos of Garbage dumping of Wetlands in and around Tiruppur district, Tamil Nadu

According to Scott and Pole's (1989) listing, 45% of all Indian wetlands are considered moderately to highly threatened. No single effort is going to protect these wetlands [13]. Large areas of India's watershed area are being physically drainage systems, over population (50% growth in population in the past 10 years), decline in storage water holding capacity, lack of desilting, building and construction, dredging, blockage of water channels, and the spreading of the *Vachelia nilotica* species, led to alteration of the wetland ecology. Most of these wetlands become dry in summer, and serve as a dumping yard for garbage and industrial waste [14]. Loss in wetland areas result in adverse impacts on the key functions (ecosystem goods and services) performed by wetlands [15]. Throughout India, stripped of their vegetation for human use [16]. The study clearly indicated that fifty- seven percent (57%) of wetlands vanished in Tiruppur district due to a large number of factories, lack of infrastructure, absence of underground the landscape development pattern shows that areas adjacent to wetlands provide excellent dry season foraging opportunities for grazers, along with irrigation. In the Tiruppur district the main reason for wetland pollution is caused by improper textile dying unit mixing and improper waste management in the district. This might be due to the mixing of the effluent from the textile and dying units, and dumping municipal waste into the wetlands [17]. Untreated effluent water impacts farm lands, and it increases pressure on environment by damaging the ecology.

Approximately 2% of wetland remains clean because they located inside the religious area. Nearly 2% of wetlands were polluted by degradable waste, 44 % by non-degradable waste and mixed waste (MW) consisting of materials like food waste, wood waste, cloth, glass products, plastic, and polythene products. This makes wetlands unusable. The draining of wetlands has depleted the ground water. In rural India, about 6000 villages are without a source for drinking water due to the rapid depletion of ground water [18]. About 26% of wetlands were used for irrigation purposes and were located outside of town. And almost 11% were used for irrigation and fishing. The effluent discharge in the river and nearby wetlands has caused socio-economic stress by reducing agricultural productivity and fish stock, leading to the relocation of many farmers and/or their result occupational change [19,20,21,22]. Approximately 39% of wetlands were used for other purposes like washing clothes and cleaning. The MSE (2002) report also documents the impact of water pollution on livestock. Livestock rearing was traditionally a subsidiary occupation in rural areas. However, since the water quality has deteriorated, livestock rearing has declined. The livestock do not drink the polluted water. In areas where the livestock were dependent on polluted water, MSE's primary survey revealed that many calves were born without hair and suffered high mortality rates. The results suggested that the water in the river was polluted and not good for agriculture. It is therefore recommended that unless the authorities implement the laws governing the disposal of wastes, this may affect the lives of the people [23].

Fully 19% of wetlands are used for recreational and entertainment activity. More than 50,000 small and large Indian Lakes are polluted to the point of being considered dead. The primary sources of pollution are human sewage, industrial pollution and agricultural runoff, which contains pesticides, fertilizers and herbicide [24]. The study indicated that 98% of wetlands in Tiruppur district was polluted by degradable and non degradable waste material. According to [25], the disappearance of natural wetland vegetation, and invasion of non wetland (upland) vegetation or weedy species, is the sign of environmental degradation in the wetlands. This is because each plant species has a limited tolerance to change in their habitat requirement. Thus, change in composition and loss of wetland plants in cultivation sites could change the habitat condition of the wetland or alter water regimes by wetland drainage [26,27]. The present study showed that in the Tiruppur district, twenty wetlands were usable and the remaining sixty-eight wetlands were non usable. Water pollution, due to effluent discharge, was ranked as the second biggest problem for agricultural productivity. Noyyal pollution ranked first in the 'anthropogenic factors' affecting productivity loss. Dumping dye effluents into the sea, through pipe lines from Tiruppur is not a permanent solution for the people of Tiruppur garment or the manufacturers.

Implementation of zero discharge facilities and integrated waste water resource management practices is necessary in order to prevent further deterioration. The colors of water bodies were mostly greenish, largely due to algal blooms from microcistis, and also due to sewage and domestic effluents [28]. Nearly 36% wetlands green in color, 46% were black in color, 5% of the wetlands were colourless and 13% of the wetlands were brown in color. Another study also supports that wetland colour in Tiruppur contains green, black, greenish black, and colourless wetlands [29]. Greenish yellow colored water restricts the penetration of light, which subsequently retards photosynthetic reactions. This also indirectly affects the reoxygenation capacity of receiving waters. Warm waters are more susceptible to eutrophication, a build-up of nutrients and possible algal blooms, because photosynthesis and bacterial decomposition both work faster at higher temperatures. Nutrients can come from many sources, such as fertilizers applied to agricultural fields, domestic drainage, municipal sewage, deposition of nitrogen from the atmosphere and erosion of soil containing nutrients from nearby catchment areas one study. [30] is of the opinion that the constant discharge of sewage into the aquatic system enriches the organic content, leading to eutrophication and deterioration of the quality of water. Eutrophication is also induced by anthropogenic activities such as fertilizer application in agriculture and land-use changes that accelerate the phytoplankton growth in aquatic ecosystems. Wetland areas have been impacted through in (40% of the total wetlands) construction, slum development, and encroachment.

Based on anthropogenic practices, a total of 21% of wetlands are surrounded by farmland, 8% are covered by companies or factories, and 71% of wetlands are covered by residential areas. In

Table 2. Wetland survey data table

Dates Surveys Performed: **Team Name:**

Team Members: 1. 2. **Wetland name:**

Colour	Size (hectares)	Depth	Condition	Usage	Dumping Waste	Anthropogenic Impacts	Wetland type/Plant Species
Comments							

ddition, Lake catchments were used as dumping yards for either municipal solid waste or building debris [31]. The anthropogenic interventions have also lead to poor water quality, which in turn has resulted in the reduction in number of native fish species, loss of biodiversity, decline in fish catches and depletion of natural resources in these wetlands [32,33,34]. The industries involved in textile dyeing and bleaching are known for their effluents having high salt content [35]. The surrounding areas of these Lakes have illegal construction of buildings, and most of the time, slum dwellers occupy the adjoining areas [36].

4. CONCLUSION

This is the first work on surveying the 88 wetlands in and around the Tiruppur district. Wetlands categorized by land area size showed that Group I(less than 5 acres) contain 44% of total wetlands, Group II (6-10 acres) represents 28% of the wetlands, Group III (11-15 acres) occupies 3% of wetlands, Group IV (above 15 acres) which contain 25% of total wetlands. According to the dryness of wetlands categorized into five types. 32 wetlands were dried out in less than 5 years, 12 wetlands were dried in between 6-10 years, 2 wetlands under 11 to 15 years, 4 wetlands dried out before 15 years ago and 38 wetlands were never dried. In Tiruppur district, during the summer season 38 wetlands were completely dried, 12 wetlands were partly dried and 38 wetlands had stagnant water throughout the year. Based on types of waste dumped in and around Tiruppur district showed that 4% of the wetlands were polluted by degradable waste, 44% the wetlands had non-degradable waste and 52% were mixed waste dumped on wetlands (Fig. 5). Based on usage, thirty seven wetlands were used for irrigation purposes, ten wetlands were used for irrigation and fishing. Nearly 3% of wetlands used for recreational and entertainment activities like boating. Based on water color, five wetlands (13%) were green, seven wetlands (18%) had black in color, four wetlands (10%) were colorless and Twenty two (59%) wetlands were brownish in color. In Tiruppur district 21% of the wetlands were surrounded by farmland, 7% were covered by companies or factories, 72% of the wetlands were covered by residential areas. According to the recent changes of wetlands within 5 years showed that eleven wetlands (14%) never changed their characteristics, the water quality (physico chemical and biological parameters) has been changed in 46% of wetlands and the area has been occupied in 40% of the total wetlands by construction, booming slum areas and encroachment. Various measures like regional conservation forums, involvement of educational institutions, researches, NGOs, and local people, are required to help restore the degraded Wetlands and conserve them.

COMPETING INTERESTS

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