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RESEARCH ARTICLE

Preliminary Assessment of Microplastic Pollution in Selvachinthamani and Narasampathy Lakes, Coimbatore District, Tamil Nadu

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Abstract: Plastic pollution is an emerging global concern and cause critical environment hazard to aquatic ecosystem and human health. This study assessed and provides baseline data on occurrence, abundance and characteristics of microplastics in water, sediment and fish (Oreochromis niloticus) from selvachinthamany and Narasampathy Lake, Coimbatore, Tamil Nadu. Protocols such as sieving, density separation, chemical digestion, stereomicroscopy and FTIR were applied for quantification and characterization of microplastics. Lakes shows higher microplastic concentration in Selvachinthamani Lake than Narasampathy Lake likely due to urban influence. Fibres were the dominant shape (79.5%), followed by fragments, films, and pellets, with red and green as the most prevalent colours. FTIR analysis identified polymers such as nylon, polyurethane, polyvinyl alcohol, and cellulose which may sourced from fishing activities, textiles, and domestic effluents. The findings highlight the alarming prevalence of microplastics in urban freshwater ecosystems and underscore their implications for aquatic life, food safety, and public health. This findings provide the first baseline evidence of microplastic contamination in these freshwater ecosystem and emphasizes the urgent need for mitigation measures, public awareness and further research on freshwater ecosystems and reduce human exposure risks.

Keywords: Microplastics, Freshwater Ecosystems, Lakes of Coimbatore, Plastic Pollution, Aquatic Contamination

INTRODUCTION

Plastic pollution is a major environmental threat and its impact will remain for generations. Due to their resistance to natural degradation, it persists in the environment for centuries typically in landfills, incinerators, and natural ecosystems by polluting terrestrial areas and water bodies (Neha et al.,2024).Overtime, plastics undergo slow fragmentation through a combination of physical, chemical and biological processes leading to the formation of smaller plastic particles known as microplastics (Crispin and Parthasarathy,2021). They are synthetic polymer particles ranging from 0.1 to 5 mm in size (Ramakrishnan et al.,2025). It occurs in diverse forms and colors such as fragments, fibres, beads, pellets, foams and films and composed of various polymers (Nair and perumal,2023) and their density determines their fate in aquatic system. Approximately 65% of plastic litter floats, inturn facilitating long distance transport via ocean current and pose serious threats to marine and freshwater species which often mistaken them for food due to their similarity in size, shape and color with plankton or prey items. These particles disrupt aquatic ecosystem by integrating into their aquatic food chain which inturn potentially affect humans consuming marine species (James et al.,2023). It has the ability to absorb microbes which inturn facilitates the higher microbial community (Qiu et al.,2022). It possesses large surface area and hydrophobic properties. Due to this properties it can adsorb waterborne contaminants such as metals, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and polybrominated diphenyl ethers and results in synergistic toxic effects that can harm both aquatic organisms and human health (Varol et al.,2025).

Previous studies reveals the presence of microplastics in water, sediment and aquatic organisms in lakes and oceans. Lakes act as a freshwater resource and provides numerous ecosystem services in most of the urban areas(Manikandan and Bhuvaneswari,2022) and it also polluted by runoff from urban, industrial and agricultural areas, human interventions and effluents from waste water treatments (Dinesh Kumar and Nataraj,2020). However investigations on microplastic pollution in relatively scant compared to oceans. Several lakes such as sengulam lake, irugur lake, pallapalayam lake, vellalore lake, krishnampathy lake(Nair and perumal, 2023), kumaraswamy lake (Ephsy and Raja,2023) anchar lake(Neelavanan et al.,2022), red hills lake(Gopinath et al.,2020), Dal lake (Rather et al.,2025), Kolavai lake (Thandavamoorthy et

al.,2023),Dharapadavedu lake(Ramakrishnan et al.,2025), Nainital lake (Jain et al.,2024),Chilika lake(Kumar et al.,2024) and Ashtamudi lake(Gayathry et al.,2024)indicates the presence of microplastics. It became inseparable in everyday human life. Most of the studies on fish have been conducted in controlled laboratory settings, mainly on marine species. Danio rerio is the most studied species. It shows effects like oxidative stress, reduced mobility, gene expression disruption, and reproductive organ damage. . Oryzia melastigma and Sparus aurata also experiences severe impacts such ad growth inhibition, gut dysbiosis, liver oxidative stress reproductive damage, oxidative damage, behavioral changes, immune system impairment and survival challenges(Bhuyan,2022). Moreover, humans are also not an exception microplastics is identified in ovarian follicular fluid, seminal fluid (Montano et al.,2025), human breast milk and placenta(Nair and perumal, 2023). These studies proved that microplastic is spreading rapidly everywhere and it should be lit down before it cause more harm.

India ranks among world's top ten plastic producing nations and alone produces 1.5 million tons of plastic waste annually(Neha et al.,2024). However, microplastic studies carried out in India is lesser than any other countries and also studies conducted on lakes are relatively scant compared to marine environment. Researchers highlighted the need for study on the freshwater fauna to obtain a complete picture of the microplastic pollution in the specific freshwater ecosystem and researches emphasized the need for study on freshwater fauna to provide complete picture of the microplastics in specific freshwater ecosystem. Hence the present study focuses on identifying the intensity of microplastic pollution by quantifying the microplastics in water, sediment and fish population of the lakes. This study focus on the Narsampathi and Selvachinthamani lakes of Coimbatore. No previous study has been conducted along these fresh water ecosystems in Coimbatore especially for examination of microplastics. This study aims to generate baseline information on the the microplastic contamination of these fresh water sources which may create new avenue for research and reference for future studies 0.

MATERIALS AND METHODS

Study Area

The Coimbatore district is located between 10°55' and 11°10'N and 77°10' and 76°50'E, is around 470 meters above sea level, in Tamil Nadu state, India. It is the second largest city in Tamil Nadu and also often referred to as the "Manchester of South India. The present investigation was carried out to assess the pollution status and microplastic contamination of lakes in and around Coimbatore to examine the changes in water quality that have happened during the last decades. Currently, the Noyyal river basin, has 24 lakes based on the number of studies, pollution status and usage by people for fishing and other domestic purposes, selvachinthamani and Narasampathy lakes (Fig. 1 and 2) was selected for the present study.

Fig. 1. Selvachinthamani lake

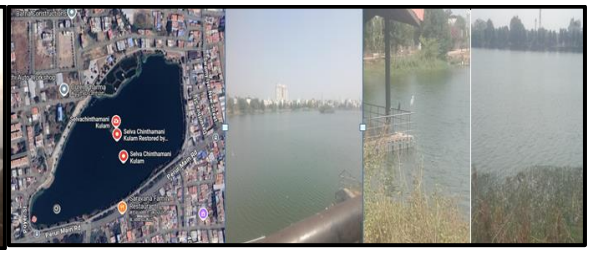

Fig. 2. Narasampathy lake

Sample Collection

Collection of water from sample sites

Approximately total five litres of water sample (10-20cm depth) was collected from each sampling point using pre cleaned one litre glass bottles and transported to the laboratory without air borne contamination. The samples were filtered using a set of four stainless sieves(1mm, 355µm, 125µm, and 63µm sieve) stacked one above another. The residues in the sieves were transferred into glass containers, sealed with aluminium foil and stored at 4°C for further analysis

Collection of sediment from sample sites

For sediment analysis, one kg of soil was collected in a glass beaker from each five-sampling point at a depth of 5cm. samples were shade dried for 4-5 days to prevent microbial degradation and to facilitate more efficient desnity separation, filtration and microplastic extraction

Collection of fish from sample sites

Fishes were collected from both lakes (five fishes from each lakes) with the help of local fishernen and it was identified as Oreochromis niloticus (Fig. 3.). Species identification was confirmed using standard FAO identification keys and the data from the fish base website based on their morphological characteristics . Fishes were wrapped in aluminium foil and they

were refrigerated at -20°C in laboratory until the further analysis. During the experiment, fishes were thawed under room temperature. The length, weight of the fish was recorded.

Fig. 3. Oreochromis niloticus

Microplastic examination

Sample treatment and extraction of microplastics

To avoid any contamination, the glass wares and laboratory apparatus were meticulously cleaned with double distilled water and digestion procedures were carried out in a laminar airflow chamber. No plastics were utilized during the work and cotton lab coats were worn. At present there is no universally accepted procedures for surveying, measuring and monitoring microplastics in natural ecosystems (NOAA, 2009). Existing methods involves counting microplastics in waters and by isolating suspected microplastic fragments from other materials through flotation in saline solution. Then the fragments were filtered, sieved and examined visually using light

Fish analysis for Microplastics

Prior to examination, gills, gastrointestinal tract and muscle tissue were removed and examined under a dissection microscope for any visible micro plastics. The edible and inedible samples were digested with 10% KOH (60 °C, 48–72 h) and then followed by oxidation with 30% H_2O. The solution was filtered using Whatman filter paper grade 1 (125 mm), and the filter paper was dried and saved for microscopic examination (Fig. 4.).

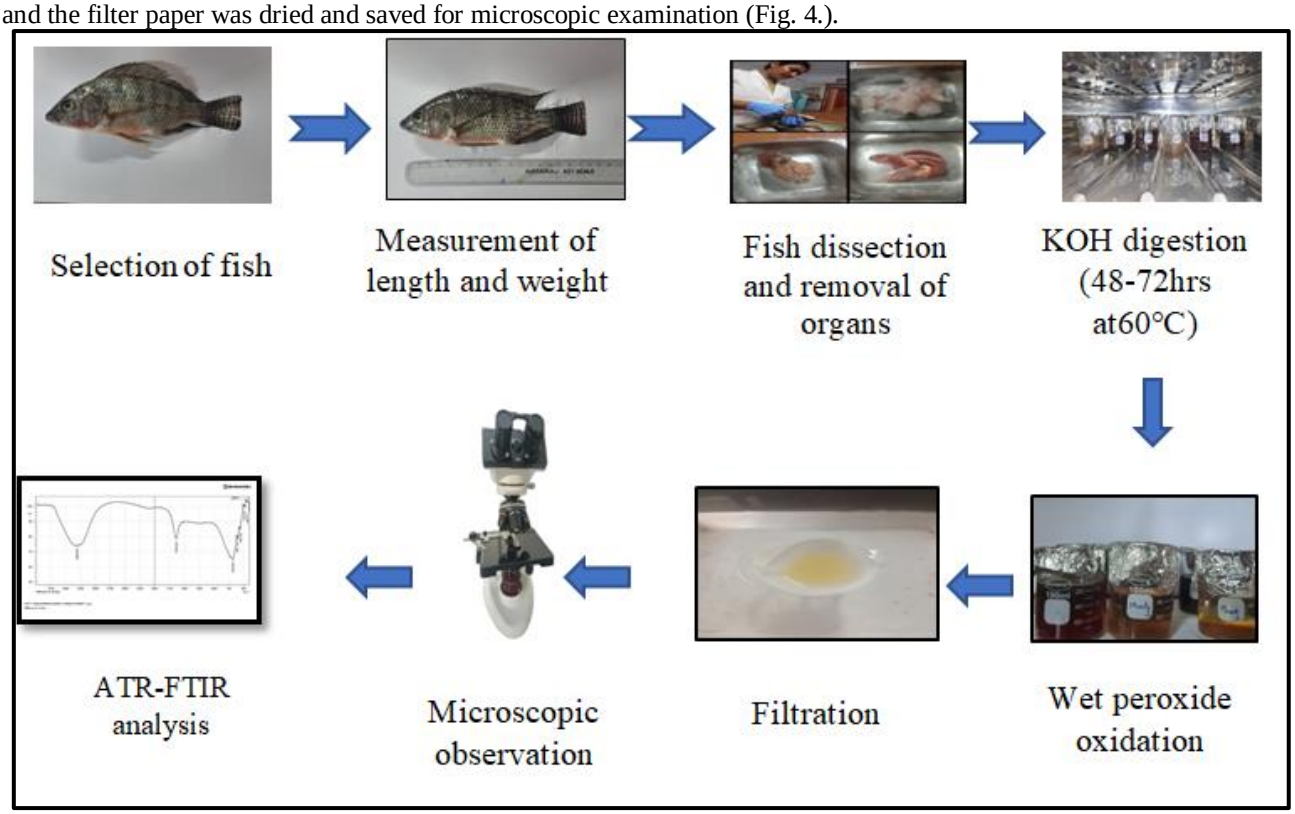

Fig. 4. Microplastic separation and characterization of Oreochromis niloticus in selected lakes of Coimbatore

Water analysis for Microplastics

Microplastic identification for water sample was done using National Oceanic and Atmospheric Administration protocol (NOAA) with slight modifications. Sample was filtered through a sieve was heedfully collected and subjected to wet peroxide oxidation. Wet peroxide oxidation was processed by adding 20 ml of H2O2 to sample and digested using a magnetic stirrer for 30 minutes at 350 rpm. After digestion water samples were rested for 24 hours and filtered using Whatmann filter paper. The filter paper was dried in hot air oven at 45°C and saved for microscopic examination (Fig. 5.).

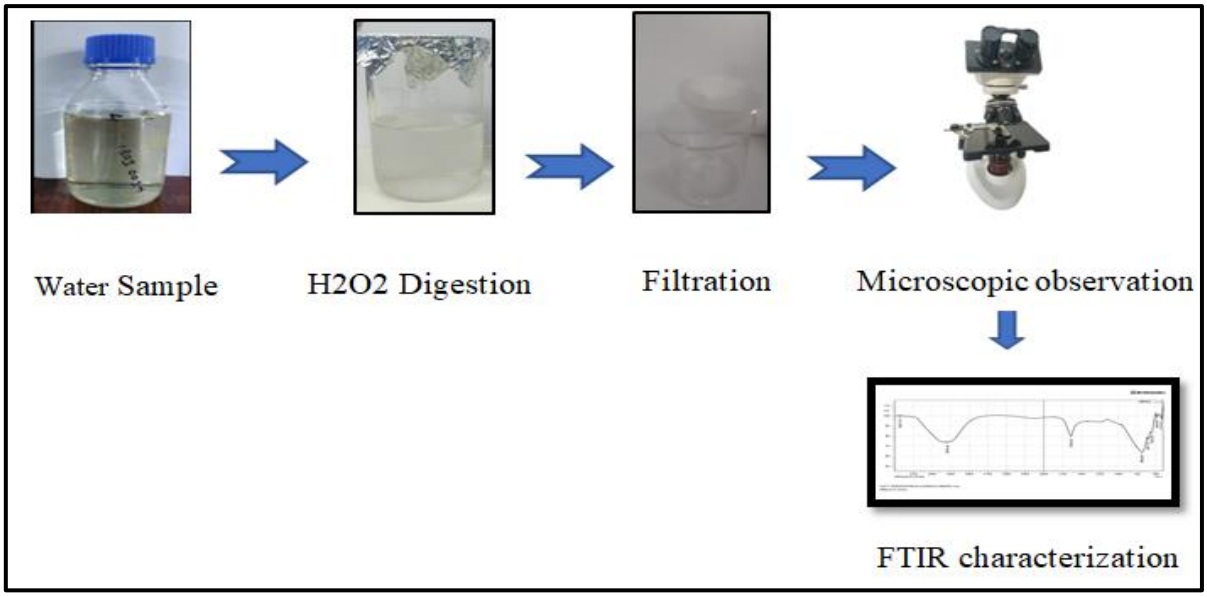

Fig. 5. Microplastic separation and characterization of Water samples in selected lakes of Coimbatore

Sediment analysis for Microplastics

The extraction of micro plastics from sediment samples was carried out through modified method of National Oceanic and Atmospheric Administration (NOAA) protocol. Sediment samples were separated using density separation using saturated NaCl solution. 200 ml of 5M NaCl solution was added to the sediment sample and stirred vigorously for 20 minutes at high rpm and then allowed to settle for 6 hours. The supernatant was digested with 30%H2O2. After digestion, the samples were with aluminum foil and left undisturbed overnight. Then final suspension were filtered through Whatman Filter paper, dried and saved for microscopic examination (Fig. 6.).

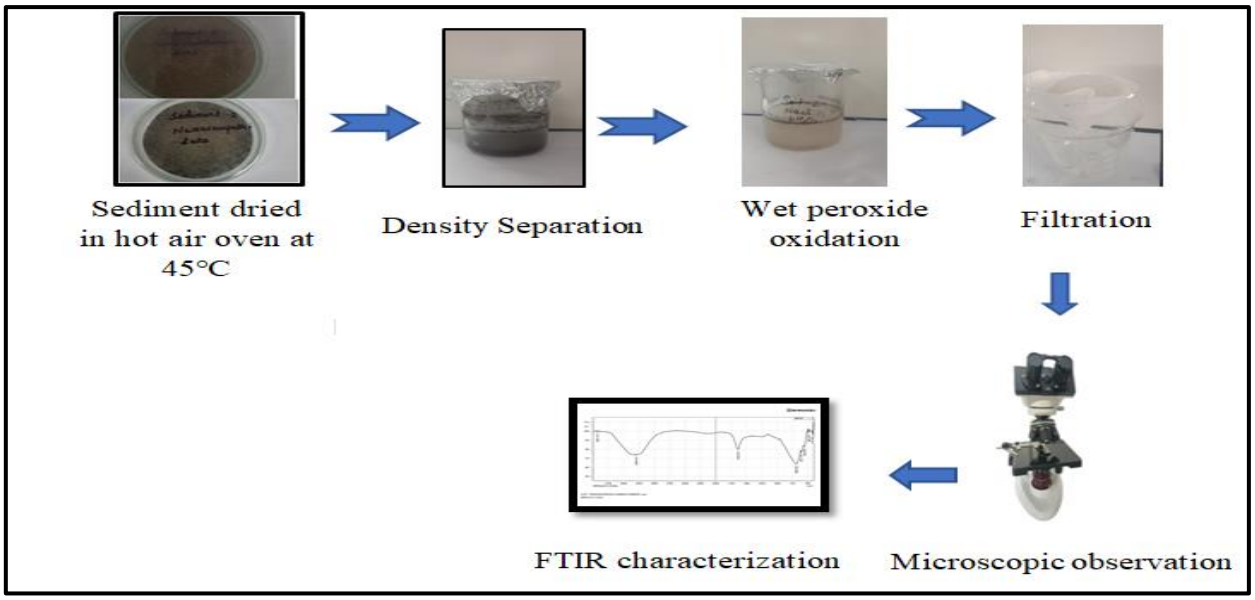

Fig. 6. Microplastic separation and characterization of Sediment samples in selected Lakes of Coimbatore

Microplastic Examination

Collected microplastic particles were examined under a stereomicroscope at **40× magnification**. During the microscopic examination, the colour of each microplastic particle was noted. Each particles were classified by shape such as film, fibre, foam, pellet or fragment and colour such as black yellow, red, green, blue, pale white or transparent

Polymer characterization

Polymer types were identified using FTIR Analysis The absorption bands of the resultant spectrum are compared with polymer spectral libraries. In addition, FTIR characteristic peak for polymers was identified. (Smith,2023;Nandiyanto et al.,2023).

RESULTS AND DISCUSSION

Abundance of microplastics in lakes.

The water sample taken from the Selvachinthamani and Narsampathy were pooled together to analyse the presence of microplastics. The abundance of microplastic concentration in both lakes are depicted in figure 6. It is evident from the figure 6 that both lakes had about 19 microplastics in Selvachinthamani and 17 microplastics in Narsampathy lake.

The highest abundance was observed in Selvachinthamani lake in comparison to Narasampathy lake. The difference in microplastic concentration might be due to source of contamination or environmental conditions or human interventions. The source of contamination includes urban runoff, greater plastic usage, inefficient waste management, and also location near areas with high plastic usage. Both lakes had fishing activity which also main cause for pollution. The selva chinthamani lake is situated in the centre of the city where narasampathy lake situated slightly far from urban interventions. However , studies reported that urban lakes in Tamil Nadu has significantly higher microplastic concentration than rural lakes(Laju et al.,2023).

The Pooled five litre samples taken in the present study enhances the accuracy of detection. The higher sample volume improves the possibility of capturing microplastics that may unevenly distributed in freshwater environments, particularly in moderately polluted lakes

Abundance of microplastics in Sediments

The soil collected from both the lakes were processed and resulting sediment were analysed for its microplastic contents. It is revealed from the figure 6 that soil samples from selvachinthamani Lake had higher microplastics concentration than Narasampathy Lake. This might be due to the stagnant nature and minimal flow velocity of lake waters. These findings support the assertions that flow dynamics, such as low flow periods are crucial in forming microplastic accumulation "hotspots" in freshwater bodies. Upon discharge into aquatic environments, microplastics may remain suspended in the water column or settle into the sediment depending on their density, hydrophobic properties, composition, and shape. The density of microplastics may increase due to adherence to their surfaces by clay minerals and organisms, leading to sedimentation (Nair & Perumal, 2023).

The present study has recorded the number of microplastics observed in sediment was lower when compared to water samples. The sampling depth and sampling type might influence particle retention, where the sandy or porous substrate may not retain smaller or lighter particles effectively. Moreover, the less dense polymers such as polyethylene or polypropylene tend to float in surface water than in sediment. Similar variations were noted by (Nair and perumal,2023) suggesting that difference in sediment characteristics, urban waste inflow or any other contamination present in one lake.

Abundance of Microplastics in fishes

Analysis of pooled five fish samples from each lake revealed 17 microplastics in Selvachinthamani Lake and 10 microplastics in Narasampathy Lake. Out of the total fish sampled from the two Lakes, the highest microplastics were observed in Selvachinthamani Lake compared to Narasampathy Lake. Out of the total microplastic present in the fishes, 74.07%was present in GIT, 18.52% in gills and 7.41% in the flesh of the fishes. The comparison between these two lakes were depicted in Fig. 7.

Although microplastic identification in gastrointestinal tract and gills of fish are widely studied. They were typically removed before consumption. However, their presence in edible tissues causes food safety concern (Daniel et al., 2020). The microplastics present higher in fish skin and also act as a another major route of contamination. This is particularly important in areas such as India, where small fish are often consumed whole including the skin. The potential for bioaccumulation and biomagnification of microplastics through the food chain also raises serious ecological and health concerns(Feng et al.,2019). A recent study indicates the presence of microplastics in various environmental compartments including air, water, sediment, plankton, fish, and avian species in both river and pond ecosystem, in turn indicating the measurable degree of bioaccumulation (Qasier et al., (2023). The fish in Narasampathy Lake has higher average weight (145.85 g) than Selvachinthamani Lake fish (107.46 g). As a conclusion , this suggests that the fish size alone does not explain the differences in microplastic concentration. The factors such as pollution level, sources, environmental conditions and speices behaviour plays a major role in microplastic ingestion by fish

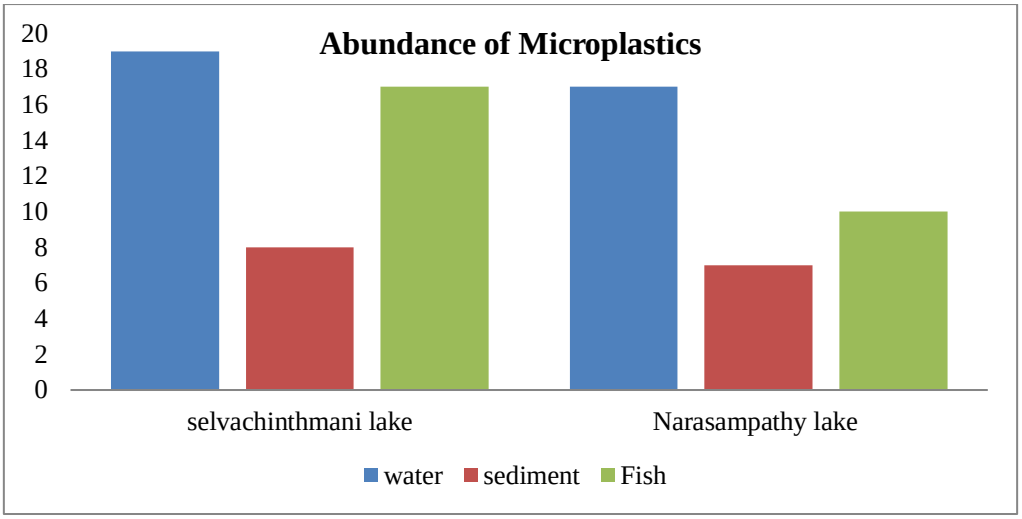

Fig. 7. Abundance of microplastic concentration in Fishes, water and sediment of both lakes

Morphological Characteristics of Identified Microplastics

Microplastics has been observed in all the analysis of water, soil and fishes. The observed microplastics were found to be in different shapes and colour. The observed microplastics distribution is presented in Figure7 & 8. The microplastics were observed to be in four main plastic shapes such as fragments, fibers, films, and pellets. The predominant shapes includes fibres (79.5%), fragments (12.8%), films (3.9%), and pellets (1.2%). Fibre is a dominant type in both lakes but The pellets was not present in both fishes and sediments. Selvachinthamani fish samples mostly contains fibres followed by fragments and films. While the narasampathy lakes contains more fibres than fragments.

Several studies reveals that that fibres are most likely to get attached to the intestinal walls than other type of microplastics (Bilal et al., 2022). The fibre type of microplastics keeps floating on and below the surface more than settling which increases the possibility of being ingested and also exposed to gills via breathing.

The colour of microplastics is plays an key factor in their attraction with aquatic life. Color influences the interaction with aquatic organisms and also impairs the ability of the organisms to distinguish between plastics and natural food. Aquatic organisms misidentified microplastics for actual food due to their size and colour. Microplastic fragments have been found in a variety of species and at all stage of the aquatic food (Nair and perumal,2023)

Red colour(33.3%)is the dominant type and identified mostly in the form of fragments, pellets and fibres. 5.13% particles were transparent or light-colored, likely due to abrasion and fading caused by exposure to water, soil, and other environmental factors. Transparent plastics occurs mostly in the form of films and fragments and were found in both water and sediment. Blue plastics followed closely at 10.26% and were present in all shapes. Green plastics (23.08%) appeared in both fish, water and sediment, while violet colored plastics (6.41%) were observed only in water samples. In fish samples, the dominant microplastic color was red, followed by green and and black.

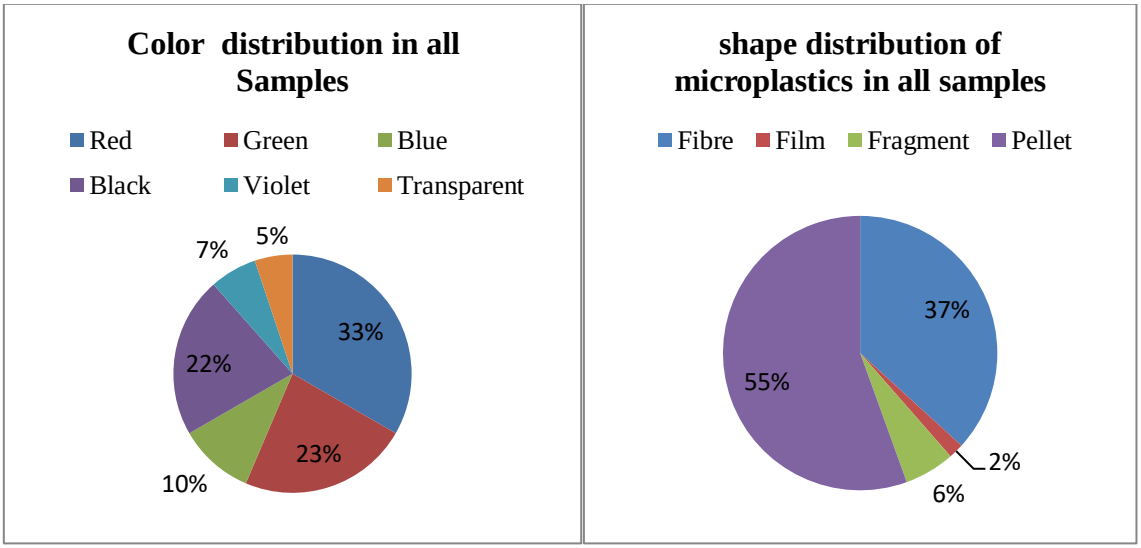

Fig. 8. The color distribution of microplastics in all the samples

Fig. 9. The shape distribution of microplastics in all the samples

In a recent laboratory investigation in five lakes of Coimbatore, researchers noted that fish consumed three times as much plastic when it was presented alongside their food. In Addition, they found that fish tended to ingest colored plastics, particularly those in yellow and blue colored, more frequently than white ones (Nair and perumal,2023). This observation aligns with the findings of our study, where the microplastics extracted from the sampled fish were predominantly blue, green, and red. These findings suggest that factors such as the coloration of natural prey, light conditions in wetland environments, food availability, and the feeding behavior of fish may influence the unintentional ingestion of dark-colored microplastics. The color and shape distribution of microplastics in all the samples were depicted in Fig. 8 and Fig. 9, respectively, and microscopic images of microplastics collected from water, sediment and fish are shown in Fig. 10.

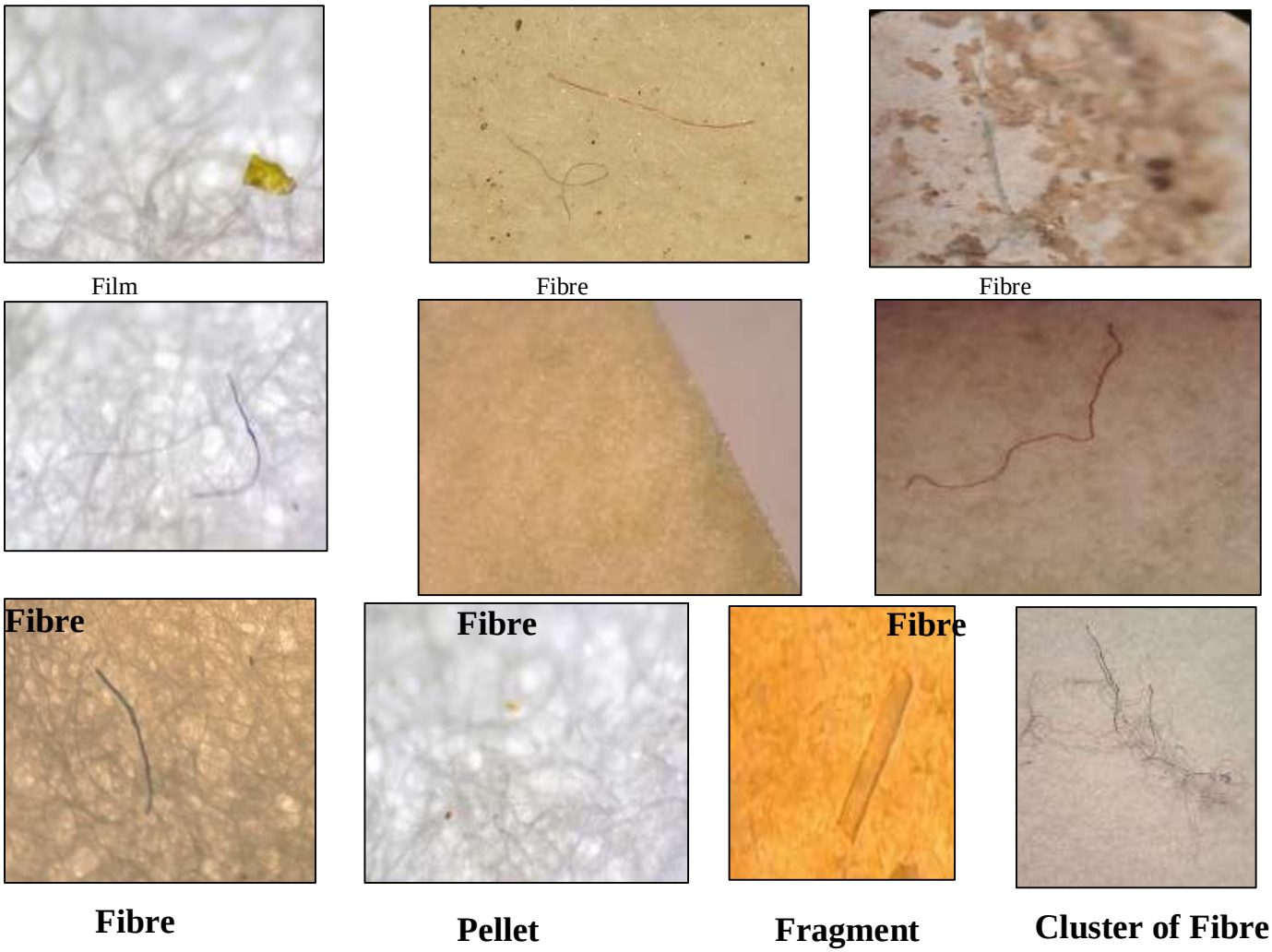

Fig. 10. Microplastics present in Selvachinthamani and Narasampathy lakes of Coimbatore

Polymer Characterisation of Identified Microplastics

Both primary and secondary microplastics enter the environment through various of pathways. During field sampling, a large amount of plastic waste including both microplastics and macroplastics were observed at the sampling locations. To know the nature of Microplastics obtained in the present study, all the microplastics were analysed with FTIR to reveal its type based on bands and functional group. The obtained FTIR peaks were shown in Fig. 11. The poymer type such as Polyureathane, polyvinyl alcohol , cellulose, nylon were present in all samples

Nylon commonly utilized in fishing nets and often linked with fishing activities such as ropes,lines and nets and may also orginate from sources like bristle, textiles and the automotive industry (Nair and perumal,2023). Polyureathane and polyamides are synthetic organic polymers formed by the reaction of of diisocyanates with polyols, and of dicarboxylic acids with diamines and may be introduced through domestic water or industrial effluents, which carry substances from electronics,carpets,synthetic fabrics,adhesives,skate boards and elevator components(Kaviyarasi et al. 2024). Polyvinyl

chloride (PVC), another commonly detected polymer, is typically used in irrigation pipes, electrical and electronic accessories, medical devices such as packaging, catheters, and cannulas and automotive components.

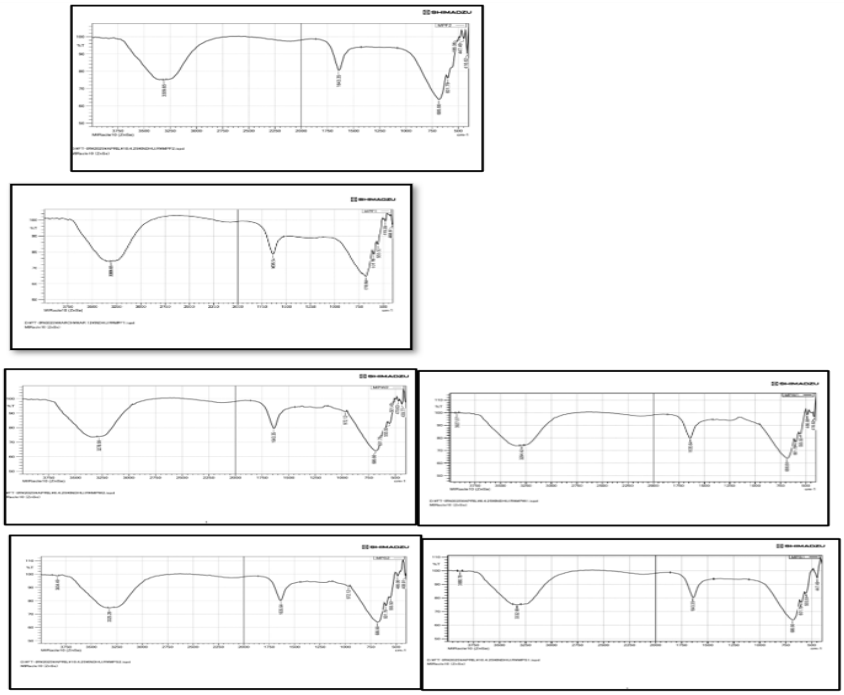

Figure 11. FTIR Spectrum of identified polymers

CONCLUSION

This study highlights the extensive occurrence and distribution of microplastics in the freshwater ecosystems of Selvachinthamani and Narasampathy Lakes in the Coimbatore region. It emphasizes the urgent need for remedial actions to address pollution in these water bodies.The ongoing degradation of these lakes poses a critical threat to aquatic life, public health and ground water quality. The findings stress the critical need to safeguard water quality and quantity for the local populations ecological impacts and mitigation. Awareness should be raised among fisher men and fish vendors regarding the presence of microplastics in fish. Proper cleaning of fish prior to cleaning is essential to prevent the transfer of microplastics. Future research may be focused to assess the risks and impacts of microplastics on fish, the environment, and human health, while also working to increase awareness among the general public and the fishing community.

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