RASĀYAN *J. Chem.*
Vol. 17 | No. 3 |1230-1241| July - September | 2024
ISSN: 0974-1496 | e-ISSN: 0976-0083 | CODEN: RJCABP
http://www.rasayanjournal.com
http://www.rasayanjournal.co.in

ASSESSMENT OF MICROPLASTIC POLLUTION IN COASTAL BELT OF CHENNAI, TAMILNADU

Ramesh Somasundaram✉ and Nagalakshmi Radhakrishnan
Department of Civil Engineering, College of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu-603203, Tamil Nadu, India.
✉Corresponding Author: rameshs@srmist.edu.in

ABSTRACT

Microplastic pollution in the marine environment has drawn attention from all over the world due to the potential harm it could bring to both the ecosystem and human health. The aim of this study was to investigate the presence of microplastics in the Adyar and Coovum river estuaries in Chennai by means of water and sediment sample analysis. While soil samples were analyzed using X-ray diffraction, water samples were analysed using FTIR Spectroscopy. Our results show that microplastics are present in sediment and water samples, and their presence is verified by unique diffraction and spectroscopic patterns. This study provides important new information about the level of microplastic pollution in these important water basins. Developing efficient methods to lessen the effects of microplastics requires an understanding of their sources and dispersion. The techniques used in this work offer a strong basis for more research and observational projects. This study highlights the need for sustainable management techniques and adds to a better understanding of environmental concerns by addressing the complicated issue of microplastic pollution in particular geographical places. Our study highlights the need for focused intervention methods and policy frameworks aimed at minimizing the negative effects of microplastic contamination by illuminating the presence of microplastics in Chennai's coastal waterways. Our research highlights the significance of cooperative efforts among stakeholders, policymakers, and researchers to develop efficient strategies for the prevention, monitoring, and remediation of microplastic pollution as we work to preserve the integrity of marine ecosystems and protect human well-being.

Keywords: Sustainable Practice, Marine Pollution, Chennai Coast, Aquatic Environment, Microplastics.

RASĀYAN*J. Chem.*, Vol. 17, No.3, 2024

INTRODUCTION

Plastic contamination is a significant issue for the environment that affects both human health and the ecosystem's capacity to function.[1-4] Because they are resistant to degradation, microplastic plastics with a diameter smaller than 5 mm are a rising hazard in watery environments.[5,6] Stormwater runoff, industrial effluents, and the direct release of plastic garbage are just a few of the ways they can get into the environment.[3] India is one of the main contributors to the pollution caused by polymer trash, and its coastal regions including Chennai are especially sensitive to it because of their close proximity to important metropolitan centers and industrial areas.[6-8] The coast of Chennai is a significant ecological hotspot that sustains a wide variety of marine life and gives many people a living.[9-12] Nevertheless, little is known about how microplastics affect this significant ecosystem.[13-15] Their search's objective is to ascertain the distribution and quantity of microplastics in the watery environment near Chennai's shore.Samples of soil and water from five different places will be collected, and they will be analysed using Fourier transform infrared spectroscopy (FTIR) to identify and quantify plastic particles.The findings of the study might provide insight into the quantity and distribution of microplastics in the aquatic environment close to Chennai's shore. And aid in the development of practical management plans. These discoveries may be useful in developing laws and policies that decrease the negative microplastic's effects on aquatic ecosystems as well as public health.[16,17]

EXPERIMENTAL

Study Area

Chennai is situated with around 50km of coastal belt. Chennai is one of the metro cities in India with rapid industrialization and population as well as industrial growth. Two rivers are most famous in Chennai namely Adyar and Cooum river. Our study mainly focussed on three locations for the presence of microplastics chances as shown in Fig.-1.[18] Samples were obtained in the Adyar Coovum and Kovalam backwaters. Adyar

http://doi.org/10.31788/RJC.2024.1738887

is located on the southernmost point of Chennai, India. The river is flowing 42.5 km in the Chennai city. Along the river inside Chennai city, it has been identified that more than 10 plastic manufacturing companies and 6 cosmetics manufacturing companies were located.[19] And there are many other industries that release fewer microplastics into rivers when compared to the above-mentioned plastic and cosmetic manufacturing companies. One of the shortest designated rivers that empties into the Bay of Bengal is the Coovum.[20]

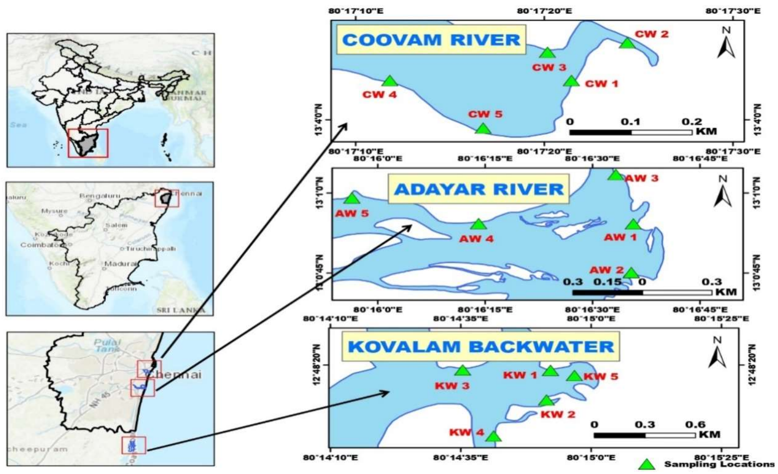

Fig.-1: Study Area Map

This river is roughly 72 km long, of which 32 km flows through Chennai's urban area and the remaining distance through rural areas. Also had identified industries like plastic, chemical and steel manufacturers and metal processing industries and etc. Kovalam Backwater, situated in Chennai, is an important coastal ecosystem that provides various ecological services to the region.[21] However, the backwater system is under threat due to pollution, habitat destruction, and overexploitation of natural resources.[22] Among the pollutants, microplastics have emerged as a serious environmental issue.[23] The primary goal of this research is to determine whether microplastics are present in the water and sediment of the Kovalam Backwater throughout the pre-, monsoon, and post-monsoon seasons. Additionally, fish samples from the backwater have been examined to evaluate the possible effects of microplastics' bioaccumulation in the aquatic food chain and human health.[24]

Proposed Methodology

The following procedures are part of the suggested methodology for examining the effects of microplastics in the coastal waters around Chennai.

Sampling

Sampling is a crucial initial step in determining the prevalence and distribution of microplastics in the marine environment along Chennai's coast. Carefully arranged and carry out the sample procedure to guarantee the data's accuracy and dependability. The locations for the samples will be chosen according to how close they are to industrial areas, urban areas, and additional potential plastic contamination sources.[16] A range of coastal locales, including those with higher and comparatively lower levels of human activity and effect, will be reflected in the five sampling locations. Adyar and Coovum sample sediments are displayed in Fig.-2 and 3.

During the sample-collecting process, it is important to avoid contaminating the sample by using the right tools and techniques. Using a grab sampler, samples of the water and sediment will be collected from each site. To avoid contamination, Prior to usage, the grab sampler will undergo a thorough cleaning and disinfection. To guarantee a representative sample, the water samples were taken around 10 centimeters below the water's surface. A device called a sediment corer is lowered into the dirt up to a depth of around 10 cm and will be used to gather the sediment samples. The time, place, and date of the sampling will be marked on the labels of the clean glass jars in which the sediment and water samples will be collected. To prevent any alterations to the samples' chemical and biological properties, they will be delivered to the lab under closely watched conditions, which will include temperature control, after collection.[25] The samples will be kept in a cool chamber at 4°C until they are analyzed when they arrive at the lab. The aim of this study was to determine the microplastic load's distribution and prevalence in the Chennai coastal area. Using sampling methods and tools, samples of the environment, water, and sediment will be gathered in order to learn more about the existence of microscopic plastic particles in these materials.

Fig.-2: Sediment Sampling Process

Fig.-3: Sediment Sampling Location

Pre-treatment

To guarantee the precision and dependability of the data, the pretreatment stage is a crucial component of the process. Visible materials, such as stones, sand, and leaves, might obstruct the evaluation and make it challenging to locate and measure the microplastics present in the specimens. To eliminate any apparent debris from the samples of water and sediment, several techniques were used in the pretreatment step. First, a pre-filter will be used to remove bigger particles like branches, leaves, and other detritus from the samples of water. The sediment samples were let to settle for a few hours in order to allow the larger particles to drop to the bottom of the container. The samples were decanted into a clean container following pre-filtration or sedimentation, and any leftover material was eliminated with a sieve with tiny mesh or forceps. Take precautions to make sure no sample is lost in the process. After that, the pretreatment samples will be prepared for microplastic analysis and extraction. It is crucial to remember that Care should be taken during the pretreatment process to prevent adding any new pollutants that can impede the analysis. In general, the pretreatment stage is essential to guaranteeing the data's dependability and accuracy. When analyzing the coastal environment of Chennai, the best way to remove apparent debris can reduce interference, improve the identification and quantification of microplastics, and disclose their prevalence and impact.[26]

Microplastic Extraction

An essential aspect of the process for locating and measuring these particles is the removal of microplastics from water and sediment samples. As part of the filtering process, both the sediment and water will pass through a 0.45 mesh filter, which will be utilized to remove microplastics from the samples. The suggested microplastic extractor design's schematic diagram is displayed in Fig.-4. Because microplastics in soil and water samples are often smaller than this pore size, the idea behind, utilising a 0.45-micron pore size filter. While permitting water and other particles to flow through, the filter will collect microplastic particles.[27]After filtering, any leftover organic matter will be removed from the filters by gently removing them from the filtration system and rinsing them with a solvent (methanol or ethanol, for example). This stage is crucial since it guarantees the accuracy and dependability of the data and aids in removing any potential interference during analysis. After the samples have been filtered, the microplastics in them will be identified and measured using a microscope or other imaging methods. The size, shape, colour, and other attributes of the microplastics will be used to identify them. All things considered, the filtration technique works well for removing microplastics from sediment and water samples. Through meticulous implementation of this procedure and the application of suitable imaging methods, the research will yield substantial knowledge of the prevalence and effects of microplastics in Chennai's coastal marine ecosystem.[28]

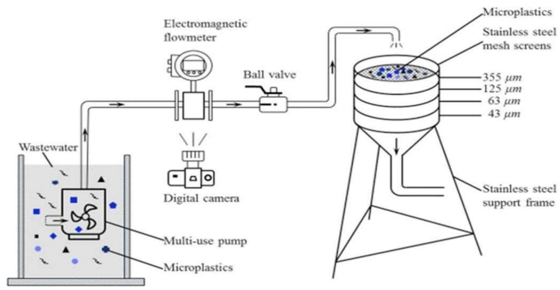

Fig.-4: Schematic Diagram of the Proposed Architecture

Identification

By calculating how much-infrared light its molecules absorb, one can learn more about the makeup of the molecules, FTIR, or Fourier transform infrared spectroscopy, is a helpful instrument for assessing and identifying microplastic particles in water and soil samples.[29] When it comes to microplastics, FTIR analysis uses the molecular structure of the material to determine the particular kind of plastic. The molecular structures of various plastic kinds vary, and FTIR analysis can distinguish between them.[30] The FTIR analysis will take place following a solvent rinse and drying of the filtered samples. For analysis, microplastic particles will either be pressed into a KBr pellet or deposited on a diamond cell. To detect and measure the number of microplastics in the samples, infrared radiation will be directed. After that, specialized software will be used to study the produced spectrum. FTIR analysis is superior to other analytical methods in a number of ways when it comes to detecting and measuring microplastics. Since it does not cause damage, the sample can be examined more than once, enabling a more precise determination of the amount of microplastic.[31] Additionally, because of its extreme sensitivity, microplastics in even the smallest amounts can be detected. This study's application of FTIR analysis will yield important details regarding the kinds and amounts of microplastics discovered in the marine habitat close to Chennai's coast. Planning to lessen the detrimental effects of microplastics on the environment and the health of the general people will require having this knowledge.

Proposed Methodology for Extracting Microplastics in Fish Body

1. Tamil Nadu is blessed with 1,076 km coastal length (13% of country's coastal length).
2. The coastal length of Chennai, is approximately 19 kilometers.
3. The marine fish production is estimated as 5.48 lakh tons during the year 2021-22.
4. The marine fish species which are selected for microplastic investigation are,
    a. Vanjaram/Seer fish - Scomberomorus commerson
    b. Bream fish - Abramis brama
5. The main parts of the fish body where the microplastics are present are Esophagus, Stomach, Intestines.

Sample Preparation

Fish specimens were dissected, and the esophagus, intestines, and stomach were carefully removed to isolate the digestive tract (Fig.-5 and 6). This step ensured the separation of potential microplastic contaminants from the rest of the fish tissue.[32]

Digestion

Add 30 ml of aqueous 4M KOH soln to the container having 0.3mm size of solids
Add 5 ml of 30% hydrogen peroxide.
Then the solution can be kept for five minutes at room temperature and then proceed further.

Vol. 17 | No. 3 |1230-1241| July - September | 2024

Then add the stir bar to the container.
Maintain a temperature of 75 degrees in a warm dish.
Take the beaker off the hotplate and put it in the fume hood as soon as you see gas bubbles at the top, and wait for the boiling to stop. For the next 30 minutes heat up to 75 degrees.
Add 5 milliliters of hydrogen peroxide solution if any organic substance was discovered.

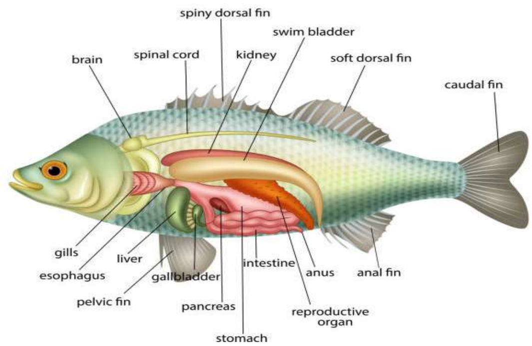

Fig.-5: Fish Anatomy

Filtration

Following digestion, the remaining solution was filtered to separate microplastic particles from the digested organic matter. Filtration methods, such as vacuum filtration were employed to capture and concentrate microplastics for subsequent analysis.[33]

Fig.-6: Internal Parts of the Fish

RESULTS AND DISCUSSION

All the water and sediment samples from Chennai's shore that were subjected to FTIR analysis included microplastics, including polyethylene, polypropylene, polyvinyl chloride, and polystyrene. Between 0.91 and 1.4 g/mL, the industrial zone had the highest concentration, while the more virgin areas had the lowest concentration of microplastic present in those areas. This data collection is tabular and contains measurements of different water quality metrics collected over the course of a year (2022) at a given location (longitude and latitude). Temperature, pH, turbidity, Salinity, chemical oxygen demand (COD), dissolved oxygen (DO), electrical conductivity (EC), total dissolved solids (TDS), and microbiological pollution (MP) are among the characteristics that are assessed. Ten distinct locations (C1 to C10) were used for the measurements, and the data are presented in each Parameter's value at each step in theTable-1.

Table-1: Parameters of Samples of Coovum

Sample	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Longitude	80.291	80.285	80.281	80.276	80.273	80.271	80.276	80.288	80.283	80.2811
Latitude	13.062	13.068	13.066	13.070	13.074	13.078	13.079	13.059	13.074	13.070
Temperature^{0}C	26.4	26.2	26.5	26.6	26.7	26.2	26.4	26.9	26.2	26.8
pH	7.09	7.31	7.42	7.45	7.2	7.08	7.33	7.86	7.81	6.7
EC	29300	31400	32600	33860	34900	31560	34580	32320	31260	32310
Turbidity(NTU)	13	17	15	18	12	11	16	17	14	19
TDS (mg/L)	16640	17954	17360	16640	17680	17850	17680	17865	17870	17980
DO (mg/L)	6.1	6.3	6.5	6.8	6.9	7.2	6.6	7.9	7.2	7.7
BOD (mg/L)	6	9	7	9	8	9	7	6	9	7

COD (mg/L)	73	86	88	83	93	81	76	75	84	82
Salinity (ppt)	15.85	17.78	17.47	17.46	17.85	17.84	16.93	17.39	17.28	17.58
MP (number/L)	243	367	783	880	1113	795	750	946	847	378

Analysis of Samples

Twenty water and twenty sediment samples (Table-2 to 13) are taken from Marina Beach's coastal region, most especially from the Adyar estuary. The top 5 cm layer of the sand is collected using a 0.5 square meter frame to create the sand samples. After being dry-sieved at 90 degrees for 24 hours, a few samples revealed signs of plastics. All samples were examined for microplastic particles with a diameter of 0.3–5 mm. Three of the thirteen samples that were taken from Adyar had microplastic residues in them, suggesting a 60% chance of occurrence. FTIR spectroscopy is used to determine the quantity and properties of the plastics. The transmittance values for each sample vary at different wave numbers, as shown in Fig.-9, which also indicates the concentration and presence of plastic components.

Table-2: Microplastics in Pre-Monsoon Adyar Water Samples

MONTH	SEPTEMBER				
SAMPLES	A.W.S 1	A.W.S 2	A.W.S 3	A.W.S 4	A.W.S 5
LATITUDE	13°68'01"N	13°68'07"N	13°68'08"N	13°70'72"N	13°78'62"N
LONGITUDE	80°90'29"E	80°85'72"E	80°81'08"E	80°76'88"E	80°74'55"E
MP number/50ml	15	22	10	0	10

Table-3: Microplastics in Pre-Monsoon Adyar Sediment Samples

MONTH	SEPTEMBER				
SAMPLES	A.S.S 1	A.S.S 2	A.S.S 3	A.S.S 4	A.S.S 5
LATITUDE	13°63'08"N	13°63'03"N	13°63'05"N	13°72'68"N	13°76'71"N
LONGITUDE	80°27'34"E	80°24'51"E	80°27'43"E	80°26'94"E	80°27'55"E
MP number/100g	24	26	18	28	16

Table-4: Microplastics in Pre-Monsoon Coovum Water Samples

MONTH	SEPTEMBER				
SAMPLES	C.W.S 1	C.W.S 2	C.W.S 3	C.W.S 4	C.W.S 5
LATITUDE	13°54'11"N	13°53'16"N	13°54'13"N	13°59'09"N	13°50'22"N
LONGITUDE	80°16'03"E	80°18'12"E	80°09'11"E	80°03'07"E	80°14'09"E
MP number/50ml	12	14	0	19	0

Table-5:Microplastics in Pre Monsoon Coovum Sediment Samples

MONTH	SEPTEMBER				
SAMPLES	C.S.S 1	C.S.S 2	C.S.S 3	C.S.S 4	C.S.S 5
LATITUDE	13°78'79"N	13°79'29"N	13°79'00"N	13°74'83"N	13°70'24"N
LONGITUDE	80°27'48"E	80°27'99"E	80°28'49"E	80°28'49"E	80°28'01"E
MP number/100g	21	0	19	23	0

Table-6: Microplastics in During Monsoon Adyar Water Samples

MONTH	DECEMBER				
SAMPLES	A.W.S 1	A.W.S 2	A.W.S 3	A.W.S 4	A.W.S 5
LATITUDE	13°68'01"N	13°68'07"N	13°68'08"N	13°70'72"N	13°78'62"N
LONGITUDE	80°90'29"E	80°85'72"E	80°81'08"E	80°76'88"E	80°74'55"E
MP number/50ml	26	18	15	9	21

Table-7: Microplastics in During Monsoon Adyar Sediment Samples

MONTH	DECEMBER				
SAMPLES	A.S.S 1	A.S.S 2	A.S.S 3	A.S.S 4	A.S.S 5
LATITUDE	13°63'08"N	13°63'03"N	13°63'05"N	13°72'68"N	13°76'71"N
LONGITUDE	80°27'34"E	80°24'51"E	80°27'43"E	80°26'94"E	80°27'55"E
MP number/100g	32	24	12	23	28

Table-8: Microplastics in During Monsoon Coovum Water Samples

MONTH	DECEMBER

SAMPLES	C.W.S 1	C.W.S 2	C.W.S 3	C.W.S 4	C.W.S 5
LATITUDE	13°54'11"N	13°53'16"N	13°54'13"N	13°59'09"N	13°50'22"N
LONGITUDE	80°16'03"E	80°18'12"E	80°09'11"E	80°03'07"E	80°14'09"E
MP number/50ml	16	22	11	0	24

Table-9: Microplastics in During Monsoon Coovum Sediment Samples

MONTH	DECEMBER				
SAMPLES	C.S.S 1	C.S.S 2	C.S.S 3	C.S.S 4	C.S.S 5
LATITUDE	13°78'79"N	13°79'29"N	13°79'00"N	13°74'83"N	13°70'24"N
LONGITUDE	80°27'48"E	80°27'99"E	80°28'49"E	80°28'49"E	80°28'01"E
MP number/100g	0	34	23	0	18

Table-10: Microplastics in Post-Monsoon Adyar Water Samples

MONTH	MARCH				
SAMPLES	A.W.S 1	A.W.S 2	A.W.S 3	A.W.S 4	A.W.S 5
LATITUDE	13°68'01"N	13°68'07"N	13°68'08"N	13°70'72"N	13°78'62"N
LONGITUDE	80°90'29"E	80°85'72"E	80°81'08"E	80°76'88"E	80°74'55"E
MP number/50ml	28	31	11	17	6

Table-11: Microplastics in Post-Monsoon Adyar Sediment Samples

MONTH	MARCH				
SAMPLES	A.S.S 1	A.S.S 2	A.S.S 3	A.S.S 4	A.S.S 5
LATITUDE	13°63'08"N	13°63'03"N	13°63'05"N	13°72'68"N	13°76'71"N
LONGITUDE	80°27'34"E	80°24'51"E	80°27'43"E	80°26'94"E	80°27'55"E
MP number/100g	21	26	25	4	7

Table-12: Microplastics in Post-Monsoon Coovum Water Samples

MONTH	MARCH				
SAMPLES	C.W.S 1	C.W.S 2	C.W.S 3	C.W.S 4	C.W.S 5
LATITUDE	13°54'11"N	13°53'16"N	13°54'13"N	13°59'09"N	13°50'22"N
LONGITUDE	80°16'03"E	80°18'12"E	80°09'11"E	80°03'07"E	80°14'09"E
MP number/50ml	23	17	5	12	29

Table-13: Microplastics in Post-Monsoon Coovum Sediment Samples

MONTH	MARCH				
SAMPLES	C.S.S 1	C.S.S 2	C.S.S 3	C.S.S 4	C.S.S 5
LATITUDE	13°78'79"N	13°79'29"N	13°79'00"N	13°74'83"N	13°70'24"N
LONGITUDE	80°27'48"E	80°27'99"E	80°28'49"E	80°28'49"E	80°28'01"E
MP number/100g	28	30	10	13	21

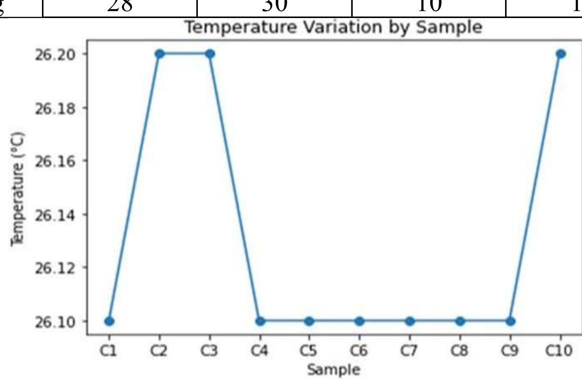

Fig.-7: Presence of Plastics in Samples by Transmittance Values

Presence of Microplastics in Fish Species

The identification of the level of contamination in marine biota (Table-14 and 15) and its possible effects on human health depend heavily on the examination of microplastics found in fish samples. Fish samples from Chennai's Adyar and Coovum estuaries were examined in this study to determine the bioaccumulation of microplastics. Fish that contain microplastics demonstrate how plastic pollution spreads across the marine food web. To obtain a representative sample, a total of five heavily frequented fish markets inside the city were chosen as sampling locations. Figure-8, 9 and 10 represents FT-IR graph of microplastics from water samples for pre, during and post monsoon, establishing polyethylene, polypropylene and polyvinyl chloride. Also Fig.-11, 12 and 13 represents FT-IR graph of microplastics from sediment samples for pre, during and post monsoon establishing polyethylene, polypropylene and polyvinyl chloride.

Table-14: Number of Microplastics Present in Vanjaram Fish

Fish species	Sampling place	Samples	Weight	Microplastic count
Vanjaram	Ennore	sample 1	1 - 1.5 kg	7
		sample 2	1 - 1.5 kg	9
	Kasimedu	sample 1	1 - 1.5 kg	0
		sample 2	1 - 1.5 kg	13
	Pattinapakkam	sample 1	1 - 1.5 kg	16
		sample 2	1 - 1.5 kg	0
	Vettuvankeni	sample 1	1 - 1.5 kg	0
		sample 2	1 - 1.5 kg	4
	Kovalam	sample 1	1 - 1.5 kg	6
		sample 2	1 - 1.5 kg	11

Table-15: Number of Microplastics Present in Bream Fish

Fish species	Sampling place	Samples	Weight	Microplastic count
Vanjaram	Ennore	sample 1	1 - 1.5 kg	12
		sample 2	1 - 1.5 kg	15
	Kasimedu	sample 1	1 - 1.5 kg	0
		sample 2	1 - 1.5 kg	3
	Pattinapakkam	sample 1	1 - 1.5 kg	17
		sample 2	1 - 1.5 kg	8
	Vettuvankeni	sample 1	1 - 1.5 kg	6
		sample 2	1 - 1.5 kg	21
	Kovalam	sample 1	1 - 1.5 kg	5
		sample 2	1 - 1.5 kg	14

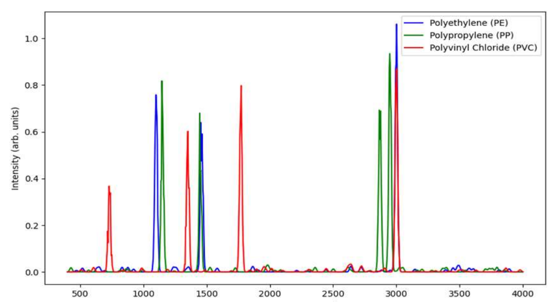

Fig.-8: FT-IR Graph for Pre Monsoon Water Samples

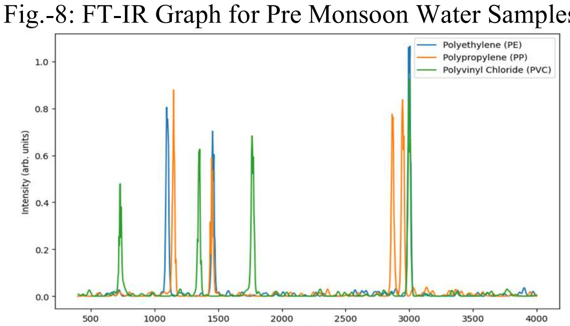

Fig.-9: FT-IR Graph for during Monsoon Water Samples

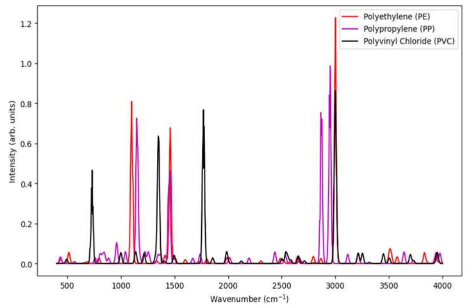

Fig.-10: FT-IR graph for Post Monsoon Water Samples

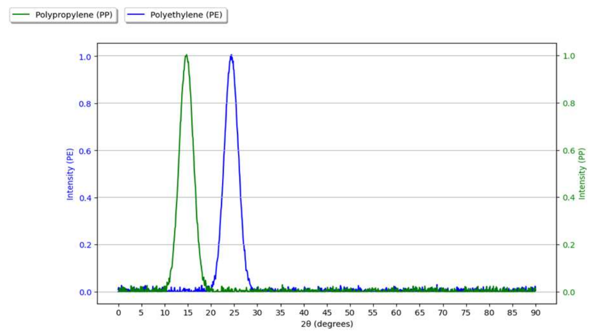

Fig.-11: XRD Graph for Pre Monsoon Sediment Samples

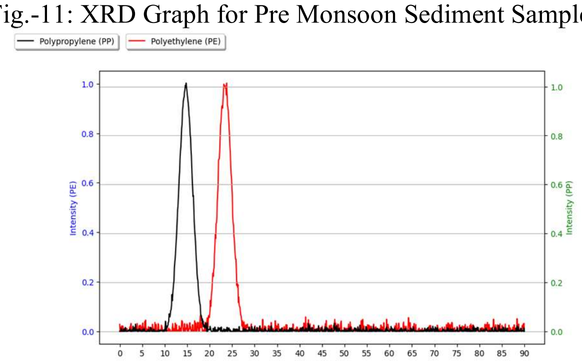

Fig.-12: XRD Graph for during Monsoon Sediment Samples

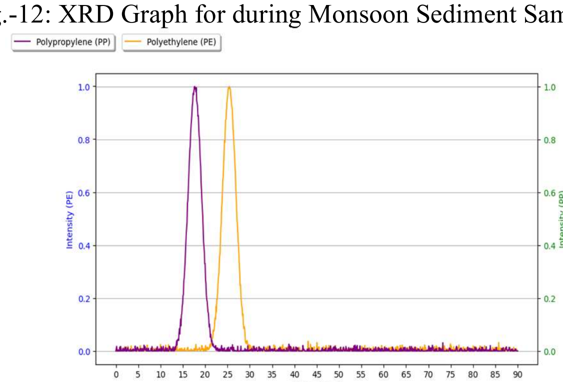

Fig.-13: XRD Graph for Post Monsoon Sediment Samples

The findings of this research indicates that human activitiesinfluence the occurrence of microplastics in the coastal environment in Chennai region.There was polystyrene, polyethylene, and polypropylene, most of the microplastics were less than 1 mm. This is concerning because marine life may consume smaller microplastics, which could harm bigger particles could entangle and block their digestive systems, endangering their health. Reducing the use of single-use plastics, enhancing waste management procedures, and increasing public awareness are some of the steps that must be taken to address this problem.

CONCLUSION

The marine environment near the Chennai coast contains microplastics, according to the FTIR spectra study. The fact that many kinds polystyrene, polypropylene, and polyethylene among other plastic polymers, were found in the soil and water samples suggests that these pollutants are present throughout the ecosystem. Concerns have been raised about the effects of microplastics on aquatic life since they might be consumed by marine biota and ultimately ascend the trophic hierarchy, posing a health risk to humans. The properties, both chemical and physical, of the sediment can also be modified by the buildup of microplastics in the sediment, which could have significant effects on the ecosystem's general health. The study's findings demonstrated how crucial it is to properly dispose of and recycle plastics to lessen their detrimental effects on the environment and general public's health. The study's FTIR approach is a useful tool for determining the kinds of plastics contained in sample materials and can help with the creation of mitigation plans for their harmful effects.

Future studies on the effects of microplastics in the marine ecosystem along Chennai's coast could take many different forms. Several possible avenues for further investigation consist of:

- Examining the origins and modes of microplastics' transportation in the coastal environment, including maritime activity, industrial facility discharge, and runoff from cities.
- Evaluating the environmental consequences of microplastics on the development, survival, and reproduction of marine biota.
- Analysing how microplastics move up the trophic ladder in the food chain from basic producers, as well as assessing any possible health hazards to people who eat tainted seafood.
- Creating novel approaches to sample collection, preparation, and analysis in order to identify and measure microplastics in the environment.
- Evaluating the efficiency of the policies and procedures in place for waste management in terms of lowering the amount of microplastics released to the ecosystem and pointing out areas for improvement.
- Examining the viability of both artificial and natural remediation techniques, such as bioremediation, phyto-remediation, and the use of biodegradable polymers, to remove microplastics from the environment.
- To fully comprehend the scope and gravity of this pollution and to create practical mitigation plans, more investigation into the consequences of microplastics in the aquatic environment is necessary.

ACKNOWLEDGMENTS

We would like to sincerely thank SRMIST management and the head of the civil engineering department for giving us the chance to complete this task. We also appreciate the assistance and wisdom provided by the Environmental Engineering Lab team at SRMIST.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

AUTHORS CONTRIBUTION

All the authors contributed significantly to this manuscript, participated in reviewing/editing and approved the final draft for publication.The research profile of the authors can be verified from their ORCID ids, given below:

Ramesh Somasundaram http://orchid.org/0000-0003-0061-8292
NagalakshmiRadhakrishnan http://orchid.org/0000-0002-3549-0244

REFERENCES

1. Q. Khuc, V. Dang,T.Tran,M. Nguyen, D. T. Nguyen,T.Pham, and T. Tran, *Urban Science*, **7(1)**, 20(2023), https://doi.org/10.3390/urbansci7010020

2. Y. Deng, J. Wu, J. Chen, and K. Kang, *Journal of Environmental Science and Health,Part A*, 1-11 (2023), http://doi.org/10.1080/10934529.2023.2190715
3. Y. Cho, W. Shim, S. Ha, G. Han, M. Jang andS.H. Hong, *Science of The Total Environment*, 161318 (2023), https://doi.org/10.1016/j.scitotenv.2022.161318
4. A. Prabawati, E. Frimawaty and J.T. Haryanto, *Sustainability*, **15(5)**, 4278(2023), https://doi.org/10.3390/su15054278
5. A. Ashokan, and V.S. Bharti, *Arabian Journal of Geosciences*, **16(1)**, 73(2023), https://doi.org/10.1007/s12517-022-11155-6
6. P. Roy, S. Pal, R. Chakrabortty, I. Chowdhuri, A. Saha, and M. Shit, *Journal of Environmental Management*, **330**, 117187 (2023), https://doi.org/10.1016/j.jenvman.2022.117187
7. Y. Sun, X. Li, N. Cao, C. Duan, C. Ding, Y. Huang, and J. Wang, *Journal of Hazardous Materials*, **439**, 129610 (2022), https://doi.org/10.1016/j.jhazmat.2022.129610
8. R. Silori, V. Shrivastava, P. Mazumder, C. Mootapally, A. Pandey, and M. Kumar, *Environmental Pollution*, **320**, 120978, (2023), https://doi.org/10.1016/j.envpol.2022.120978
9. D. Pradhap, K.S Gandhi, K.Radhakrishnan, N.S. Magesh, P.S. Godson, S. Krishnakumar, and P. Saravanan, *Total Environment Research Themes*, 100024, (2023), https://doi.org/10.1016/j.totert.2023.100024
10. CH.V. Saikrishna, L. Vaikunta Rao, and D. Mallikarjuna Rao, *Rasayan Journal of Chemistry*, **17(1)**, 28(2024), http://doi.org/10.31788/RJC.2024.1718704
11. P. Goswami, N. Selvakumar, P. Verma, M. Saha, V. Suneel, N.V. Vinithkumar, and J. Nayak, *Science of The Total Environment*, **864,** 160876, (2023), https://doi.org/10.1016/j.scitotenv.2022.160876
12. S.Chung, S.Selvam, K. Sivakumar, G.R. Soundhariya, H.E. Elzain, and M. S. Bhuyan, *Marine Pollution Bulletin*, **176**, 113409, (2022), https://doi.org/10.1016/j.marpolbul.2022.113409
13. K. Dhineka, M. Sambandam, S.K. Sivadas, T. Kaviarasan, U. Pradhan, M.R. Murthy, *Frontiers of Environmental Science and Engineering*, **16**, 1(2022), https://doi.org/10.1007/s11783-021-1444-0
14. M. Ranjani, S. Veerasingam, R. Venkatachalapathy, T. P. S. Jinoj, L. Guganathan, M. Mugilarasan, and P. Vethamony, *Environmental Pollution*, **305**, 119315, (2022), https://doi.org/10.1016/j.envpol.2022.119315
15. Sri Vishnu Prasanth B. R. and R. Sivakumar, *Rasayan Journal of Chemistry*, **17(1)**, 21(2024), http://doi.org/10.31788/RJC.2024.1718346
16. T. S. Galloway, *Marine Pollution Bulletin*, **62(8)**, 1596(2011), https://doi.org/10.1016/j.marpolbul.2011.05.030
17. J. Imhof, C. Laforsch, P. Schmid, and C. Laforsch, *Environmental Science & Technology*, **50(23)**, 12530(2016), https://doi.org/10.1021/acs.est.6b03045
18. C. M. Rochman, "The Complex Mixture, Fate and Toxicity of Chemicals Associated with Plastic Debris in the Marine Environment," in Microplastic Pollutants, Elsevier, pp. 117-134(2017), https://doi.org/10.1007/978-3-319-16510-3_5
19. Lusher, M. McHugh, and R. C. Thompson, *Marine Pollution Bulletin*, **67(1-2)**, 94(2013), https://doi.org/10.1016/j.marpolbul.2012.11.028
20. S. Andrady, *Marine Pollution Bulletin*, **62(8)**, 1596(2011), https://doi.org/10.1016/j.marpolbul.2011.05.030.
21. N. S. Fisher, *Marine Pollution Bulletin*, **113(1-2)**, 8(2016), https://doi.org/10.1016/j.marpolbul.2016.07.006
22. T. C. Galloway and M. Cole, "Microplastics as Marine Pollutants: A Review," in Marine Anthropogenic Litter, Springer, pp. 325-345 (2015), https://doi.org/10.1007/978-3-319-16510-3_11
23. H. H. Ahmad1, A. Nurdradjat1, H. Johanes, A. D. Hariyanto, *Rasayan Journal of Chemistry*, **15(3)**, 1772(2022), http://doi.org/10.31788/RJC.2022.1536894
24. E. R. Zettler, T. J. Mincer, and L. A. Amaral-Zettler, *Environmental Science & Technology*, **47(13)**, 7137(2013), https://doi.org/10.1021/es401288x
25. R. Gregory, *Philosophical Transactions of The Royal Society B: Biological Sciences*, **364(1526)**, 2013(2009), https://doi.org/10.1098/rstb.2008.0265

26. J. P. Giesy, A. A. Kannan, and K. C. J. Blumenstock, "Compounds of Emerging Concern in the Environment: Introduction and Overview," in Handbook of Environmental Chemistry, Springer, pp.1-10 (2017), https://doi.org/10.1007/698_2016_20
27. M. Claessens, S. De Meester, L. Van Landuyt, K. De Clerck, and C. Janssen, *Marine Pollution Bulletin*, **62(10)**, 2199(2011), https://doi.org/10.1016/j.marpolbul.2011.06.030
28. L. M. Galloway, "Micro- and Nano-plastics and Human Health," in Microplastic Pollutants, Elsevier, pp. 135-152 (2017), https://doi.org/10.1016/B978-0-12-809406-8.00007-2
29. Y. Sun, X. Li, N. Cao, C. Duan, C. Ding, Y. Huang, and J. Wang, *Journal of Hazardous Materials*, **439**, 129610(2022), https://doi.org/10.1016/j.jhazmat.2022.129610
30. Y. Deng, J. Wu, J. Chen, and K. Kang, *Journal of Environmental Science and Health, Part A*, **58(4)**, 1(2023), http://doi.org/10.1080/10934529.2023.2190715
31. Y. Cho, W. Shim, S. Ha, G. Han, M. Jang andS.H. Hong, *Science of The Total Environment*, 161318(2023), https://doi.org/10.1016/j.scitotenv.2022.161318
32. J. Bautista-Ruiz, J. Sánchez-Molina, and J.V. Sánchez-Zúñiga, *Rasayan Journal of Chemistry*, **14(2)**,712(2021), http://dx.doi.org/10.31788/RJC.2021.1425900
33. M. Yusuf, N. Dari, R. Siregar, D. P. F. Amne, *Rasayan Journal of Chemistry*, **15(3)**, 1634(2022), http://doi.org/10.31788/RJC.2022.1536673

[RJC-8887/2024]