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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

# Microplastics in surface water of different beaches in Chattogram coastal area of Bay of Bengal in Bangladesh

## Bengal Körfezi (Bangladeş) Çitagong kıyısal bölgesindeki farklı plajlarda yüzey suyundaki mikroplastikler

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**Abstract:** Microplastic (MP) pollution in aquatic systems poses a great threat, as these tiny particles contaminate water, harm marine life, and may eventually enter the food chain, endangering ecosystems and human health. The purpose of this study was to assess the presence of MPs in surface-level water samples taken from Chattogram Coastal Area of the Bay of Bengal in Bangladesh. A total of 20 water samples were collected from four sea beaches, spanning the period from September to December 2023. A total of 452 MPs were enumerated from the collected water samples, with 29% observed in Kattoli Beach, 26% in Patenga Beach, 24% in Anowara Beach, and 21% in Banshkhali Beach. MPs ranging from 1-5mm in size were identified as the most prevalent in the study areas. Anowara Beach exhibited a dominant composition of fibers (53%), Banshkhali Beach was characterized by particles (55%), and Patenga Beach and Kattoli Beach displayed a high abundance of fragments (65% and 56%, respectively). The abundance of MPs at Kattoli Beach was significantly high ($p$<0.05) compared to other beaches. The pollution load index ranged from 1.25-1.49 with the highest index values at Kattoli Beach. The results from this study could be applied as a guide to efficient environmental management for the long-term health of the beaches by reducing the degree of MP load from the coastal and marine ecosystems of Bangladesh.

**Keywords:** Abundance, microplastic pollution, coastal water, aquatic pollution

## INTRODUCTION

Microplastics (MPs) are plastic particles that are smaller than five millimeters in size (GESAMP, 2016; Kawsar et al., 2024). MP figures are present everywhere in the marine ecosystem, even in the most pristine places, like the deep sea, they have raised worrisome concerns about the health of marine life and the ecological balance. Plastic is a desirable material to utilize because of its durability (Barnes et al., 2009). In the surface ocean alone, there are thought to be more than five trillion plastic particles floating about, with over 90% of these particles being categorized as MPs (Banik et al., 2022). MP pollution has evolved into a transboundary, complex, social, and environmental issue of the twenty-first century that threatens not just marine biodiversity but also humankind. MPs have a low density and can be dispersed easily by wind and water, sometimes traveling thousands of kilometers from their point of origin and remaining in the environment for many years (Kawsar et al., 2024).

Even though plastic has many positive social effects, there is growing environmental concern over this valuable resource (Andrady and Neal, 2009). They also function as distributor of pathogens, carrier of heavy metals and other toxic substances that lead to various health problems (Alengebawy et al., 2021).

The primary sources of these MPs were either marine (transportation, fishing, and shipping) or land-based (personal care items and cosmetics, washing of synthetic clothing, tourism, and industrial activities) (Browne et al., 2011; Rillig, 2012). Waste made of plastic contamination is one of the main ways that humans are affecting the environment and causing a huge threat to marine life (Derraik, 2002). Particularly coastal nations produced roughly 275 million tons of plastic waste and about 3–5% of them are estimated to have ended up in the ocean (Jambeck et al., 2015). Bangladesh generates an estimated 16,000 tons of urban waste each day, growing by 7.5% yearly (Bahauddin and Uddin, 2012). River discharges, tourism, industrial effluents, roadway dust (car tires, grease, etc.), sewage disposals (effluents), and nearby hotels, motels, and restaurants are some of the possible sources of plastic debris in the coastline region of Bangladesh (Browne et al., 2011; Achary et al., 2021; Hossain et al., 2022; Kawsar et al., 2024).

Bangladesh is a densely populated country and the northeastern region of the Bay of Bengal is highly susceptible to MP pollution due to its geographical location and the socioeconomic activities of the area. MP concentrations are much higher in this area. There are multiple hotspots of MP pollution in the Bay of Bengal, including the coasts of Chattogram, Cox's Bazar, and the Sundarbans mangrove forest. Marine ecology is threatened by deposition of MPs, which could result in the tropic transmission of MPs. According to research by Achary et al. (2021), MP was commonly observed on beaches around the Bay of Bengal's coastline, indicating that MP could be transported to the bay directly by discharges from coastal activities. According to Hossain et al. (2022) and Rakib et al. (2022), there is also a lot of shipping traffic in the Bay of Bengal, which contributes to MP pollution. Natural reasons also contribute to the increased rate of MP pollution, even if human activity is the primary cause of it. It was discovered by Law et al. (2014) that plastic waste can be carried from land to water bodies by natural disasters like floods, storms, and tsunamis. Coastal erosion and the weathering of plastic debris on beaches were identified by Jabeen et al. (2017) as other significant pathways for the introduction of MPs into the Bay of Bengal. According to Hossain et al. (2022), a daily estimated $61.3\times10^9$ items of MPs are released into the Bay of Bengal through the complex riverine and estuarine systems. MP pollution is rising quickly for a variety of causes, it is imperative to design strict and workable intervention strategies to minimize MP pollution and maintain a secure and healthy marine ecology. However, monitoring of MP abundance and pollution in surface waters on different beaches of coastal regions in Bangladesh has not yet been studied. Hence, the objective of the study was to determine the scenario of MP pollution, types, and abundance, in the most popular coastal beaches of Chattogram in Bangladesh to establish effective management of plastic pollution and monitor progress toward achieving sustainable development goals.

## MATERIALS AND METHODS

### Sampling sites

Chattogram Coastal Area is located on the eastern Bay of Bengal with coastline up to 100 km. It is oriented northeast to southeast. Two major estuarine rivers (Karnaphuli and Sangu) are connected with this coastline. This research was carried out at four sites (Banshkhali, Anowara, Patenga, and Kattoli Beaches) towards the littoral of Bangladesh, primarily in the Chattogram district which are well-known for both recreational activities and the disposal of municipal waste via the Karnaphuli River and other drainage systems (Rahman et al., 2023). The location of the sampling sites and the geographical coordinates are shown in Figure 1. All sampling stations are located near urban areas and harbors. The selection of sampling sites was strategically determined based on their relevance to diverse human activities, encompassing tourism, fishing, urban development, and industry (Table 1). Ship breaking activities are running at this study area near Kattoli Beach (Rahman et al., 2023).

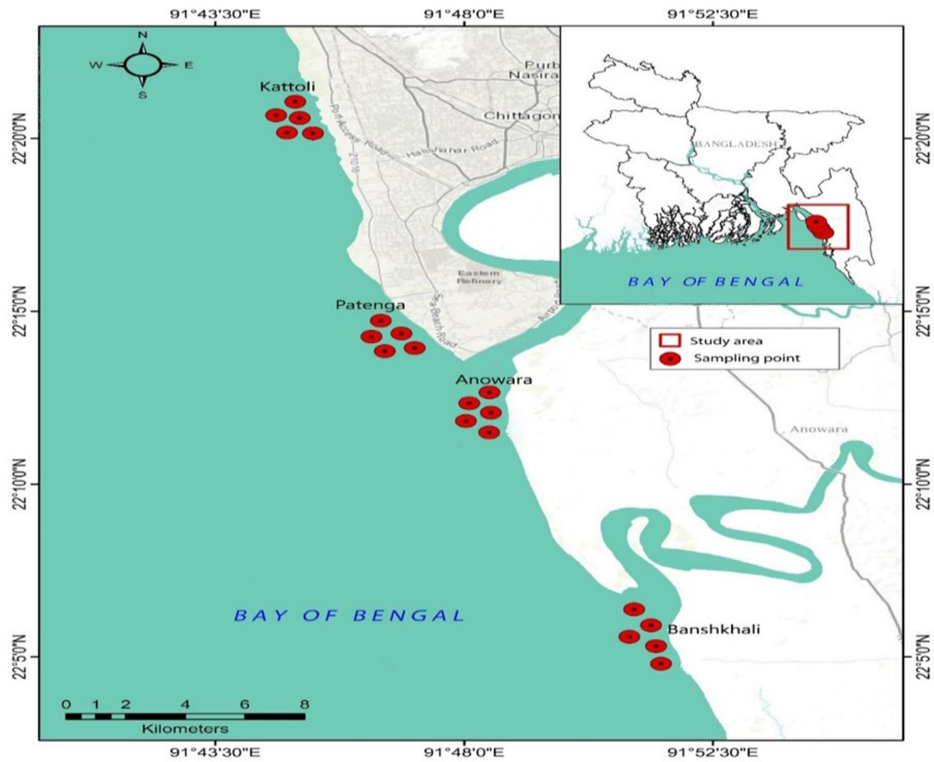


**Figure 1.** Study area map indicating four sampling sites (each circle indicates sampling point)

**Table 1.** Visual characteristics of four sampling sites based on their human and industrial activities

| Site | Geographic position | Characteristics |
|---|---|---|
| Banshkhali Beach | 22°03'27" N, 91°51'06" E | It is the port area with a long sandy beach with various beach activities (tourism). |
| Anowara Beach | 22°10'44" N, 91°47'33" E | The mouth of the Karnaphuli River is one of the most secluded and relatively clean areas of the province, the habitat of many birds and turtles in the province, with mangrove forests, relatively low water wave, mostly muddy and sandy areas. |
| Patenga Beach | 22°13'42" N, 91°46'13" E | Recreational business area, more pollution than the urban type and the traffic of commercial and fishing vessels, no agricultural pollution, high volume of passengers and maritime trade, lack of oil and gas industries. |
| Kattoli Beach | 22°14'46" N, 91°44'55" E | The only international cricket ground in Chattogram is located here. Another name for this beach is Jalepara Beach as it is the supplier of fish and shrimp. It is the commercial vessel traffic area and the majority of the urban area and a relatively suitable index for comparison with the relatively clean area and the highly contaminated area of Chattogram. The ship breaking station is located nearby. |

### Collection and preservation of MPs from water samples

MPs from water were taken from the Chattogram Coastal Area by using Neuston net sampler with a mesh size of 50 μm following Zhang et al. (2020) which is laboratory methods for the analysis of MPs in the marine environment from the surface water of all sites. Water samples from the coastal water were collected with a haul time of 0.5 to 1 h and an average hauling speed of 2 knots at about 5-10m depth with a local engine boat. Water samples were collected from September to December 2023. For the purposes of this investigation, a total of 5 specimens of each site were utilized. As a result, 20 surface water samples were taken from 4 sampling sites. Every sampling point was maintained at a distance of roughly 1 to 1.5 kilometers for each site. For one specimen, three replications were performed. A rigorous random sampling approach was applied to increase the authenticity and dependability of the investigation outcomes by reducing bias and increasing the possibility of a sample that is representative of the larger population. Following collection, each intense MP sample was put into a 500 ml glass bottle, which had been filled with distilled water and washing solution after being cleaned three- or four times using sample water. Every sample was gathered all day long. The sample vial was then taken to the lab for additional analysis after being correctly labeled with the name of the site, the time, and the date. A 50 μm mesh steel sieve was used to filter each sample. To prevent contamination, distilled water was used to wash every residue that remained on the sieve after sieving. The protocol is summarized in Figure 2 according to Masura et al. (2015).

### Wet peroxide oxidation (WPO)

The analysis of plastic debris as suspended solids in water samples obtained using a surface net can be done using this method. Hard plastics, soft plastics (such as foams), films, line, fibers, and sheets are examples of plastic materials. To isolate the proper-sized solid material, the method entails filtering the solids collected in a 0.335 mm surface sampling net (such as a manta net for surface water tows) through 5.6-mm and/or 0.3-mm sieves. To find the sample's mass of solids, the material that had been sieved was dried. To break down labile organic matter, the solids were put through wet peroxide oxidation (WPO) with a Fe (II) catalyst present. Plastic waste remained consistent. Density separation in NaCl (aq) was applied to the WPO mixture to separate the plastic debris by flotation. A density separator was used to separate the denser undigested mineral components from the floating solids. To find the concentration of MPs, the floating plastic debris was gathered in the density separator using a specially made 0.3-mm filter, allowed to air dry, and then the plastic material was taken out and weighed (Masura et al., 2015).

### Flow diagram for the analysis of MPs

According to Masura et al. (2015) the flow diagram was maintained during the study period to identify the MPs in the water samples.

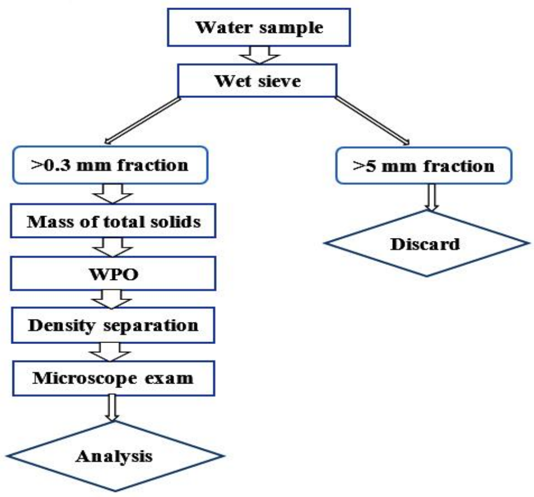


**Figure 2.** Diagram showing the flow for analyzing MPs in aquatic samples

### Categorization of MPs

Biological Binocular Microscope Xsz-107bn Classical Model for laboratory was used to study total count and MP characteristics in each sample after filtration. The objects were evaluated visually, with descriptions provided based on their maximum dimensions, color, and shape (Hidalgo-Ruz et al., 2012; Lusher et al., 2013). According to Hossain et al. (2019), MPs were classified into three sizes in this study, i.e., 0.5mm, 0.5mm to 1 mm, and 1–5 mm. Seven distinct colors were used to categorize MPs: Red, Green, Blue, Black, Yellow, Brown, and White. Five distinct shapes were identified for MPs: irregular, round, angular, elongated, and filamentous. This study categorized MPs into three types: fiber, fragment, and particle followed by Li et al. (2015).

### Quality control

In MP analytics, contamination from airborne particles and reagents is a concern. MPs can cause difficulties with quality assurance because they can be found in reagents used in the digestion of organic matter, laboratory equipment, the laboratory environment, and distilled and ultrapure water (Barrows et al., 2017; Prata et al., 2021). Throughout the entire study, including the collection of water samples, their transportation to the laboratory, and their preservation, care was taken. The laboratory was cleaned, and any necessary lids or covers were put over the samples. For sampling, dissection, preservation, alkaline digestion, and filter paper analysis, only glass and stainless-steel equipments were utilized. 70% alcohol that had been prefiltered was used to clean the laboratory. Before being used, filter papers were checked under a microscope for any airborne contaminants.

### Interpretation techniques

Li et al. (2021) stated that PLI (Pollution Load Index) can be used to evaluate the degree of contamination generated by the occurrence of MPs in environmental samples. The contamination factor (CF) for every sampling site needs to be determined using the following Shekoohiyan and Akbarzadeh (2022) formula to estimate the PLI.

$$CFi = \frac{Ci}{Coi}$$

Where $C_i$ is the abundance of MP at each sampling point, Coi is the background value estimated as the lowest mean (59.71 particles/kg) MP abundance from the published literature. The MP-PLI can be calculated using the following equation:

$$MP\text{-}PLI = \sqrt{CF}$$

### Statistical analysis

SPSS version 22 was used in the study for statistical analysis. When doing statistical analyses, the data distribution was taken into consideration. As the dataset exhibited a normal distribution (assessed through Shapiro-Wilk test, $p>0.05$), a one-way analysis of variance (ANOVA) was used to determine whether there were any variations in the abundance of MPs in different beaches and also that were statistically significant ($p<0.05$) or not statistically significant ($p>0.05$) followed by Tukey post hoc test.

## RESULTS

### Spatial distribution of MP abundance

The sampling beaches were Banshkhali, Anowara, Patenga and Kattoli. A total of 452 MP items were quantified from the study area. The highest MPs were found at Kattoli Beach (29%) and the lowest was at Banshkhali Beach (21%) (Figure 3). The abundance of MPs was significantly higher ($p<0.05$) in Kattoli Beach, followed by Patenga, Anowara, and Banshkhali Beach (Figure 4).

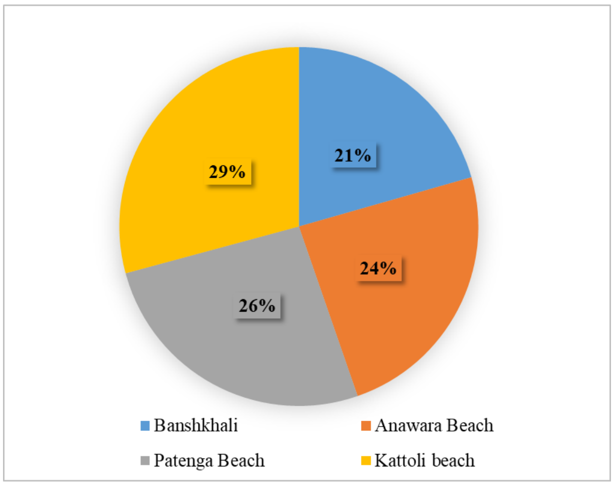


**Figure 3.** Distribution of total MPs (%) quantified from the water of selected study area

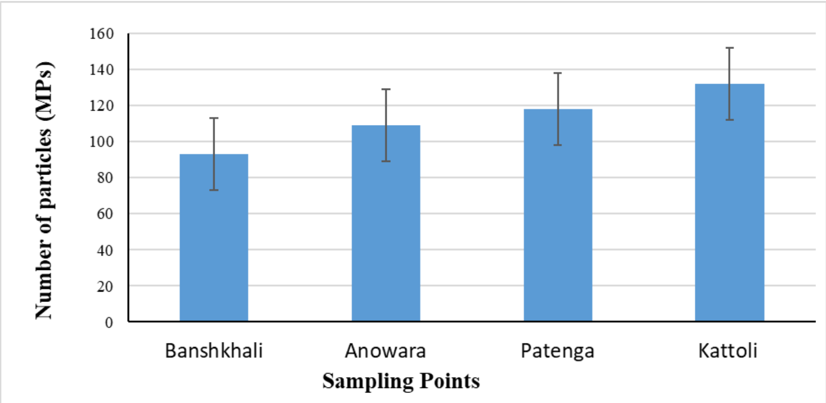


**Figure 4.** Abundance of MPs in the different areas

### Type, shape, color, and size of MPs

Among the samples, three different morphologies of MPs were recorded where 47% fragment, 32% fiber, and 21% particle were noted. Fragment type was dominant in Patenga Beach and Kattoli Beach composing 65% and 56% respectively in these two sites, while fiber was recorded maximum at Anowara Beach (53%), and particle was the highest groups at Banshkhali Beach (55%) (Figure 5-A). Shapes and sizes both were highest in Anowara Beach and lowest in Kattoli Beach. Dominant MP shapes were elongated (35.75%) and sizes were 1-5mm (62.25%) (Figure 5-B and 5-D). Among the collected water samples, white color were dominant (40.5%) followed by brown (28%), red (12%), both green and black (5.75%), blue (5.25%) and yellow (2.75%) (Figure 5-C).

### MPs pollution load index (MPs-PLI)

The PLI can be used to determine the extent of MPs pollution in various situations. In the surface water samples, the MPs-PLI standards for the sampling locations vary from 1.25 to 1.49. According to Table 2, Kattoli Beach had the highest PLI, followed by Patenga, Anowara, and Banshkhali Beach. When the PLI value is less than 10, MP pollution is regarded as having no risk (level I), and when it is between 10 and 20, MP pollution is regarded as having minimal risk (level II) (Gholizadeh et al., 2024). All PLI values in the study sites were below 10, indicating that the area is not currently at risk.

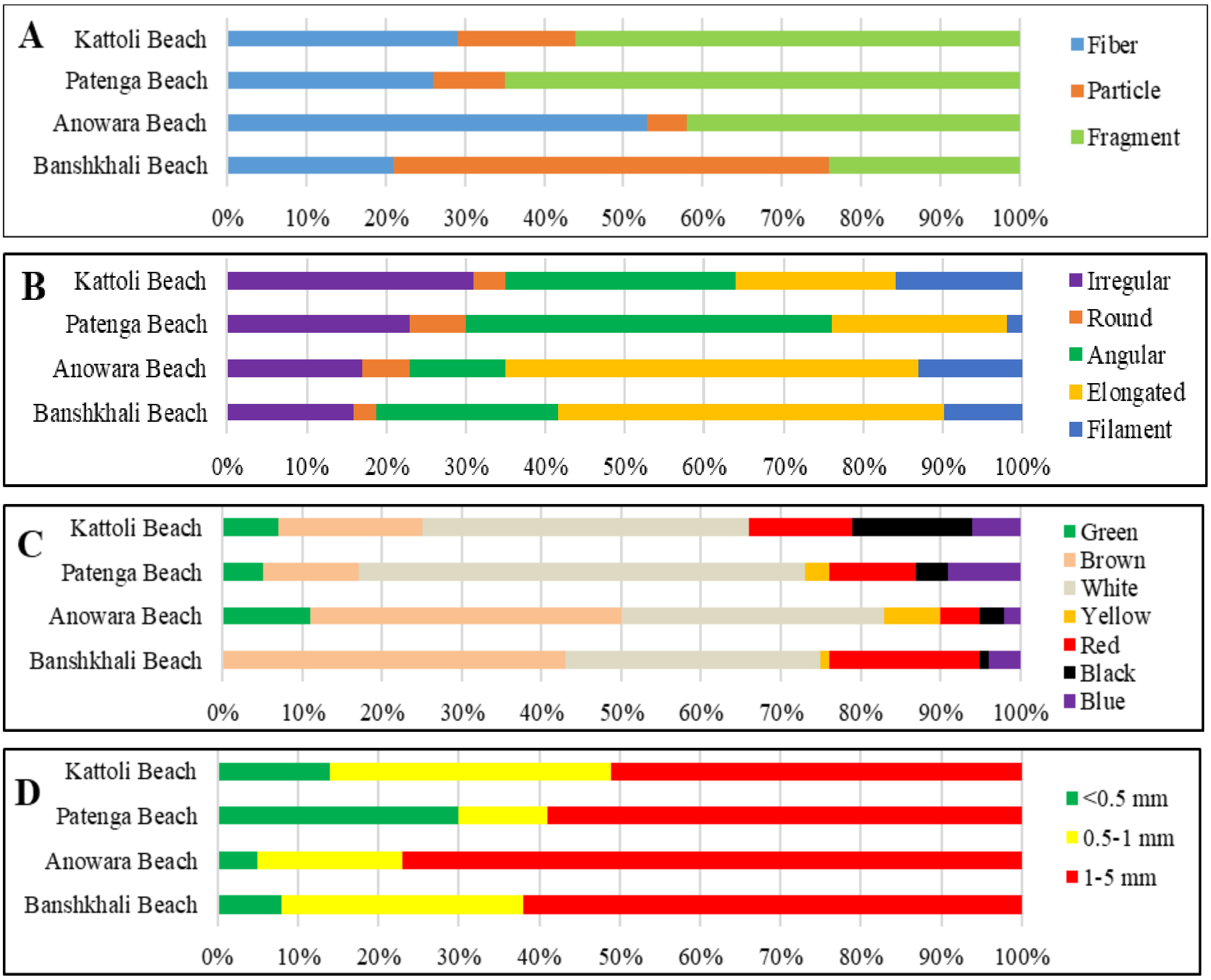


**Figure 5.** Percentages of types (A), shapes (B), colors (C), and sizes (D) of MPs in water of Chattogram Coastal Area

**Table 2.** Findings from the risk assessment for MPs in beach water samples

| Sampling sites | CF | PLI |
|---|---|---|
| Banshkhali Beach | 1.56 | 1.25 |
| Anowara Beach | 1.83 | 1.35 |
| Patenga Beach | 1.98 | 1.41 |
| Kattoli Beach | 2.21 | 1.49 |

## DISCUSSION

### Abundances and characteristics of MPs in water

The presence of MPs in water is now a significant environmental concern leading to various negative impacts on biota, ecosystems, and potentially entering the food chain, posing risks to human health (Kawsar et al., 2024). According to Coyle et al. (2020), marine plastic pollution is an artificial material that originates from two sources: either land sources, which contribute to 80% of marine waste, or coastal practices such as accidental loss or illegal dumping by fishers while fishing or other activities. MPs are a growing contaminant on Bangladeshi beaches and coastal areas (Mia et al., 2024). It is known to be a delayed material in sediment and water. According to this study, the average MP concentration was 22.60 items/m$^3$. The Kattoli Beach area had the largest number of MPs in the water samples (26.40±1.44 items/m$^3$), while the Banshkhali Beach area had the lowest number of MPs (18.60±0.69 items/m$^3$). The following is a sequence of the total concentration of MPs in water samples of coastal beaches in Chattogram: Banshkhali < Anowara < Patenga < Kattoli. The MP concentration was found to be less than the values reported in the Asa River (130±27.84 items/L) and the Awano River (132.80±15.3 items/L) in Japan (Kabir et al., 2021). A comparison of the abundance of MPs in surface water from different samples around the world is shown in Table 3.

**Table 3.** An assessment of research on the abundance of MPs in water in the world

| Study Site | Sample Type | MPs Abundance | References |
|---|---|---|---|
| Bohai Bay, China | Water | 788.0±464.2 items/m$^3$ | Wu et al. (2019) |
| Sürgü Dam Reservoir, Türkiye | Water | (106.63 to 200) items/ m$^3$ | Turhan (2021) |
| Guangdong Coastal Areas, South China | Water | 850 to 3500 items/L | Li et al. (2021) |
| Chabahar Bay, Iran | Water | 218±17 particles/L | Hosseini et al. (2020) |
| Persian Gulf, Iran | Water | 1.67×104 particles/km$^2$, | Gholizadeh et al. (2024) |
| KarnaphuliRiver, Bangladesh | Water | 2.11±1.15 items/L | Hossain et al. (2022) |
| Saint Martin Island, Bangladesh | Water | 0.074–0.181 items/m$^3$ | Al-Nahian et al. (2022) |
| Pashur River, Bangladesh | Water | 2.66×103 particles/L | Nawar et al. (2023) |
| Coastal Beaches, Bangladesh | Water | 22.6±3.27 items/m$^3$ | Present study |

The first sampling was done at the area of Banshkhali Beach which is a remarkably busy area as it is one of the longest sea beaches after Cox's Bazar and tourists come from various regions to visit the beach and appreciate its prettiness At this sampling site, we found the least number of MPs (18.60±0.69 items/m$^3$) in water trials due to the high tidal action and it is also indicating that the MPs capacity in this region can change rapidly due to wind, wave, current and bottom settlement of MPs (Mia et al., 2024). At Anowara Beach, the second sampling location, a relatively higher abundance (21.80±0.86 items/m$^3$) was detected. This area is moderately polluted because of both anthropogenic activities and tourism related activities. Moreover, the wave action is also low in this area. Urban discharges coming through the Karnaphuli River is the major evident of domestic plastic pollution. The third and fourth sampling sites which were selected at the Patenga Beach and the Kattoli Beach areas, respectively which had significantly greater concentrations ($p$<0.05) of MPs in water than the other two sites. The abundance of MPs in these two areas was 23.60±1.36 items/m$^3$ and 26.40±1.44 items/m$^3$, respectively. The most polluted region was identified in Kattoli Beach mainly because of waste from the port and fishing activities which are thrown into the surrounding areas at random. The rural fishers use plastic nets to catch aquatic animals (fish and shrimp). The concentration of MPs in this sampling site is heightened by the tiny plastic particles and broken nets (Ta et al., 2022). Both locals and visitors are unaware of the harmful effects of plastic. As a result, they make use of polyethylene, plastic bags, and other readily available and affordable plastic materials which cause pollution. Ineffective trash management at this sample location led to an increase in pollution through MPs. Ship breaking activity is another prominent cause of MP pollution in this area. Most of the ship breaking activities are performed in the open beach sediment from where the plastic particles enter into ocean water and pollute the water body. The four polymers (polyurethane, nylon, polystyrene, polyester, and glass wool) were identified in extracts from sediments in the Alang-Sosiya ship-breaking yard, India (Reddy et al., 2006). Less tourism and more fishing, along with a ship breaking station, results in a significant volume of waste being dumped in that area.

### Categories of MPs

In this study, three distinct groups of MP sizes were found. Among them MPs sizes smaller than 0.5 mm being the most typical. A total of 249 MP particles were recognized in the water sample with 1-5 mm size (Figure 5-D). The least number of MPs were found in <0.5 mm size which was 57 particles in total. The analysis's findings are in line with those of prior research (Zhao et al., 2019) that discovered that surface waters primarily contain smaller sized MPs. However, numerous hydrodynamic features such as wind, current, wave, and tidal action, as well as upright mixing of the aquatic environment can reason the bigger MPs elements to break down into small pieces, leaving the smaller ones fluctuating in the surface water (Yang et al., 2023).

Diverse types of MPs were observed in the samples of beach areas (Figure 6). In the current investigation, three dissimilar types of MPs were isolated from water. Fragments were mostly found (46.75%), followed by fibers (32.25%) and particles (21%). Most fragments were found in the Patenga Beach. This indicates that the number of fragments in water is increasing because of both anthropogenic and tourism related activities. Numerous investigations revealed that surface water had a large number of fibers and fragments (Aliabad et al., 2019; Nabizadeh et al., 2019). Fragment particles are the result of the decay of plastic particles (Khaleel et al., 2023).

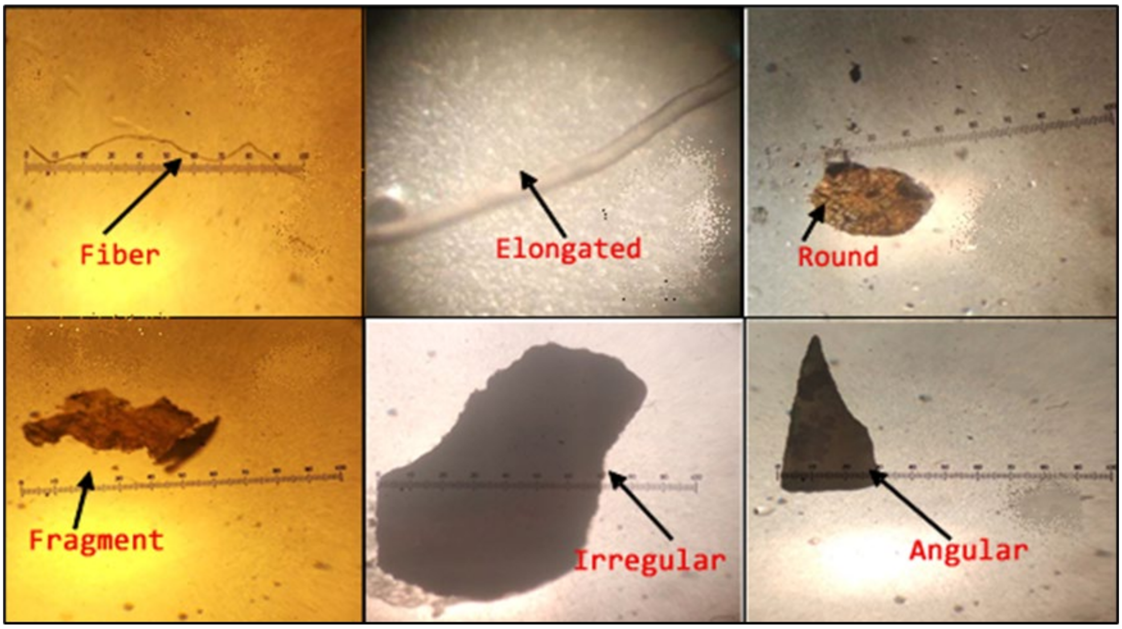


**Figure 6.** MPs images of different shapes and types

They are often produced from clothing which are made of synthetic materials and from the tearing of fishing nets and ropes (Jaini and Namboothri, 2023). Numerous studies on MPs in Tamil Nadu, India's water have shown similar kinds of results, with the primary causes of the high concentrations of MPs being associated with a range of manufacturing, fishing, and tourism-related activities. According to Jeyasanta et al. (2020), there is a direct link between the quantity of synthetic garbage produced and the quantity of fishing and entertaining actions. Numerous secondary MPs with asymmetrical shapes are released from various packaging materials, including trash, polybags, milk cans, and plastic bottles (Wang et al., 2019). Detected MPs were mostly elongated at Banshkhali Beach (49%) and Anowara Beach (52%) followed by irregular, round, angular and filament shape. At Patenga Beach, angular shape was recorded maximum (46%), and irregular shape was recorded maximum at Kattoli Beach (31%) (Figure 5). The percentage of different shapes of MPs are sequenced as follows: elongated>angular>irregular>filament>round.

Water samples from several sites showed a varied blend of colors. Most of these come in shades of brown, red, yellow, black, and green. Even still, the majority of colors in each sample were white and brown. 40.5% of MPs were determined to be white, and 28% to be brown. According to numerous other investigations, fragments are primarily white in color (Al-Nahian et al., 2023). Most of the trials were clear, but there were also those that had nearly the same percentage (5.75%) of green, black, and blue. In the samples, a fraction of less than 3% of the color yellow was discovered. The third most prevalent color, red, was at 12%. According to some studies, plastic particles can be categorized as "colorful" or "non-colorful". Some of the researchers discovered that most of the colors in MPs were white or transparent, others observed that blue and red colors were more prevalent (Deng et al., 2021; Duong et al., 2023). The particles may originate from rinses used in fishing gear, crafts, and wrapping, as well as synthetic belongings, polyethylene, and other plastic ingredients that tourists may have discarded (Aliabad et al., 2019).

Although there have been efforts to study the abundance and pollution of MPs, there are still many scientific questions that need further investigation in subsequent studies. Plans for environmental management that address MPs and related pollutants must be implemented for the Bay of Bengal's coastal beaches. Additionally, they must set up an extensive, long-term monitoring system. To protect the ecosystem and marine biodiversity, however eco-friendly structures and methods must be developed. Future research should focus on separating and identifying MPs in sediment and soil. For a detailed understanding of the prevalence and nature of pollution, characterization of MPs is essential. Future studies must concentrate on the identification and determination of the specific polymer types that make up MPs. This would enable researchers to identify the precise substances causing MP pollution in coastal areas and provide important latest information about the origins and possible dangers of these polymers. The effects of MPs on sediment, water, human health, biota, and the marine ecosystem must be thoroughly examined. Future studies ought to concentrate on decreasing plastic usage, enhancing disposal techniques, and lowering the number of MPs that enter the marine environment to reduce MP pollution at its source. Although concerns about marine pollution are increasing, little attention has been paid to the possible effects of nanoplastics on marine ecosystems. To effectively investigate the effects of nanoplastics on these crucial environmental regions, new, eco-friendly methodologies must be developed to achieve the Sustainable Development Goals.

### Research gap

To assist the policymakers in making decisions regarding the prevention of plastic pollution in Chattogram's well-known beach areas, the current study was designed. The abundance of MPs indicates the problem, but to fully comprehend the fate of these particles and their effects on human health and marine life, proper characterization of plastic polymers is necessary. MP ingestion and its effect on aquatic biota, fish, mammals, waterbirds, and plankton, particularly suspension filter-feeding species (lungworms, mussels, and sea cucumbers) are becoming increasingly concerning (Sussarellu et al., 2016). Furthermore, detrimental polymers specific to an animal or even an organ can be identified via polymer identification. On the other hand, monsoon-related increases in rainfall will effect on the estimated monthly inflow of plastic from rivers into the ocean. According to research by Weideman et al. (2020), the average concentration of MP was slightly greater during the wet season (2.1±6.9 particles/L) than it was during the dry season (1.3±2.5 particles/L). However, collecting data from a single season is insufficient to accurately depict the seasonal fluctuations in concentrations. To better understand the scope and effect of MP pollution in Bangladesh and to guide the development of effective mitigation approaches, it is imperative to solve the research gap.

## CONCLUSION

The presence of MPs in the Chattogram Coastal Area of the Bay of Bengal is evident, with significant variations in abundance among the beaches. The high abundance of MPs, particularly at Kattoli Beach, highlights the urgent need for targeted interventions to mitigate plastic pollution in these areas. The fluctuating composition of MPs observed in different beaches underscores the diverse sources and pathways of plastic debris entering the marine environment. The pollution load index values suggest that the beaches in the Chattogram Coastal Area are experiencing low level of plastic pollution, but have a potential threat to marine ecosystems. To address this issue, reducing plastic use, promoting recycling, and increasing awareness are essential steps. Government initiatives and community involvement are crucial in protecting the coastal ecosystem for future generations. These findings emphasize the importance of continued monitoring and management efforts to safeguard the health and integrity of coastal and marine ecosystems in Bangladesh.

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## AUTHORSHIP CONTRIBUTIONS

Rimu Das: Conceptualization, Methodology, Writing- Original draft preparation; Debasish Pandit: Data analysis, Validation, Writing- Review and editing; Md. Wahidul Alam: Investigation, Writing- Review and editing; Md. Shah Aziz: Project administration, Writing- Reviewing and Editing; Joyanta Bir: Validation, Writing- Reviewing and Editing; Md Mehedi Hassan: Writing- Reviewing and Editing; Mohammad Rokan Uddin: Resources, Writing- Reviewing and Editing; Md. Habibur Rahman: Supervision, Funding acquisition, Writing- Reviewing and Editing. Ismot Zereen: Writing- Reviewing and Editing.

## STATEMENTS AND DECLARATIONS

I declare that the authors have no competing interests as defined by the journal, or other interests that might be perceived to influence the results and/or discussion reported in this paper. The results/data/figures in this manuscript have not been published elsewhere, nor are they under consideration by another publisher.

## ETHICAL APPROVAL

No specific ethical approval was necessary for this study.

## DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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