sustainability

Review

A Review of the Current State of Microplastic Pollution in South Asian Countries

Lee Tin Sin [1,*], Vineshaa Balakrishnan [1], Soo-Tueen Bee [2,*] and Soo-Ling Bee [3]

[1] Department of Chemical Engineering, Lee Kong Chian Faculty of Engineering and Science, Universiti Tunku Abdul Rahman, Jalan Sungai Long, Bandar Sungai Long, Cheras, Kajang 43000, Selangor, Malaysia
[2] Department of Mechanical and Material Engineering, Lee Kong Chian Faculty of Engineering and Science, Universiti Tunku Abdul Rahman, Jalan Sungai Long, Bandar Sungai Long, Cheras, Kajang 43000, Selangor, Malaysia
[3] School of Materials and Mineral Resources Engineering, Engineering Campus, Universiti Sains Malaysia, Nibong Tebal 14300, Pulau Pinang, Malaysia
* Correspondence: leets@utar.edu.my (L.T.S.); beest@utar.edu.my (S.-T.B.)

Abstract: Microplastic contamination has become a concerning topic of study in recent decades. This review discusses the development of microplastic pollution based on a selection of South Asian countries consisting of Bangladesh, Iran, Philippines, Thailand, India, Indonesia, and Vietnam. The condition of microplastic pollution related to the abundance of microplastic found in various environments as well as the presence of microplastics in food and the air, is covered in this review. Several reports found that drinking water sourced from taps was found to have about 83% of microplastic particles in the year 2017 based on results from 14 nations, and in the year 2018, 260 bodies of water for human consumption in 11 countries were found to have about 93% of microplastic particles. Micro debris pollution in seas and oceans worldwide is predicted to be at an amount of 236,000 metric tons based on a statistical report. A mean value of 30 micro debris per liter of glacier water was recovered from the top of Mount Everest, whereas about 2200 small particles per liter were discovered in the deep waters of the Mariana Trench. The main environments that are severely microplastic-contaminated are water-based places such as rivers, estuaries, and beaches. The presence of microplastics in food items, such as tea bags, sugar, shrimp paste, and salt packets, has been reported. In terms of impacts on the environment, microplastic contamination includes the ingestion of microplastics by aquatic creatures in water environments. The impacts on terrestrial environments relate to microplastics sinking into the soil, leading to the alteration of the physicochemical parameters of soil. Meanwhile, the impacts on the atmospheric environment include the settling of microplastics on the external bodies of animals and humans.

Keywords: microplastics; pollution; contamination; environmental impacts; South Asian

Citation: Sin, L.T.; Balakrishnan, V.; Bee, S.-T.; Bee, S.-L. A Review of the Current State of Microplastic Pollution in South Asian Countries. *Sustainability* **2023**, *15*, 6813. https://doi.org/10.3390/su15086813

Academic Editors: Grigorios L. Kyriakopoulos, Antonis A. Zorpas, Vassilis J. Inglezakis and María Rocío Rodríguez Barroso

Received: 12 November 2022
Revised: 14 February 2023
Accepted: 15 February 2023
Published: 18 April 2023

1. Introduction

Plastics are polymeric materials mainly made up of hydrocarbons that are obtained from charcoal, petroleum, and fossil gas, which can be molded and shaped by utilizing pressure or heat methods. For instance, aerospace industries have been utilizing plastics more than metal alloys for the construction of the interiors of aircraft, structural elements, and navigation components due to the lighter weight of a plastic component than its metal counterparts. For safety aspects, some translucent, lightweight plastic materials have been found to exhibit high impact resistance, and these have additionally helped the aerospace industry in saving fuel costs over the years. Plastics also have other outstanding properties, such as low electrical conductivity, less density, high toughness, and transparency [1]. As such, the utilization of plastic is widely preferred by many industries around the globe, such as automotive, packaging, manufacturing, logistics and freight forwarding, medical and healthcare services, and many more industries. Although plastics have many good properties, plastics decompose in landfills at a rate slower than any other waste, thus leading to a high accumulation of plastic waste, which results in the degradation of plastic materials into macro and microplastics [2]. In 2017, the usage of plastic drastically increased to 350 million metric tons compared with only 1.5 million metric tons in 1950 [3].

Plastics dumped in landfill normally undergo interment in terrestrial areas, and some of these waste plastics have a high probability of reaching aquatic environments. Most plastic waste moves downstream through rivers into marine environments. Research has shown that an approximation of 8 million metric tons to 11.5 million metric tons of plastic were detected in marine environments [2]. The marine debris most commonly found in oceans is known as microplastics, and the plastics vary in shape and size, with a size usually smaller than five millimeters. Plastic products, such as bottles, synthetic clothes, plastic bags, and cosmetics, have been identified as the main contributing sources to the formation of microplastics [4]. Microplastics that degenerate from larger parts of plastic waste into tiny plastic pieces are known as secondary microplastics. On the other hand, microbeads are one type of microplastic consisting of small pieces of polyethylene plastic products commonly used in health and beauty products as exfoliants, such as in toothpaste and facial cleansers, as well as plastic pellets utilized by industrial manufacturers and synthetic textile industries to produce plastic fibers such as nylon [4]. These microbead particles are capable of flowing through water filtration membranes effortlessly from households and subsequently being discharged into marine environments [4–8].

On the other hand, air pollution caused by microplastics occurs in the form of airborne particles and may cause health issues when inhaled. These microplastics are non-biodegradable and thus highly increase the accumulation of these microplastics on land and in marine environments. Marine deposits in seas and oceans that contain microplastics may settle straight into liquid columns or implicitly via tides as well as sediments that are washed into the water from cliffs. According to *The Guardian*, drinking water sourced from taps was found to contain about 83% of small microplastic particles in the year 2017 based on 14 nations, and in the year 2018, out of 260 water bodies used for human consumption tested in 11 countries, about 93% of microplastic particles was reported [9]. At the same time, Sebille et al. [10] reported that worldwide micro debris pollution throughout the seas and oceans is predicted to be 236,000 metric tons based on a statistical report. A mean value of 30 micro debris per liter of glacier water was recovered from the top of Mount Everest, whereas about 2200 small particles per liter were discovered in the deep waters of the Mariana Trench.

Microplastics have been identified in high quantities in about 114 species on land and in water [4]. About 80% of microplastic pollution in the environment has been determined to be from various sources. It has been shown that numerous invertebrate ocean and sea animals, such as crabs and crustaceans, have microplastics in their digestive tracts and tissues. Fish and air species, such as birds, ingest floating microplastics in seas and oceans and from water surfaces at a high rate. These animals misinterpret plastic pieces as food sources. Much of the data have been reported through global analysis, yet statistics related to microplastic pollution in Asian countries microplastic currently remain unknown. With this arising issue, a characterization study on microplastic pollution conditions in South Asian countries is worthy of investigation. In this review, the characterization of the microplastics present in South Asian countries was studied. The conditions of microplastic pollution were analyzed, and the impacts on the environment were further discussed in this review [4].

2. Countries of Study

2.1. Pakistan

According to Dowarah and Devipriya (2019) [11], the Arabian Sea contains approximately 0.2 million tons of polymer waste sent via the Mighty Indus. Pakistan generates roughly 0.6 million tons of polymer. Irfan et al. (2020) [12] reported that polymers are projected to make up almost 6% of the country's overall solid waste, which is above 40 million tons, with most debris discarded in exposed areas. Most of the megacities of the country face significant challenges in fixing the issues related to urban waste. Moreover, the precise volume of polymers in freshwater environments as well as microplastic contamination on surface water, are often overlooked [12]. The Ravi River is one of the rivers that flows by Lahore and is also known as the city's most prominent housing, industrial, and commercial center. The Ravi River accumulates various sorts of polymer waste, and this polymer waste eventually degenerates into microplastics [12]. In addition to the Ravi River, the Arabian Sea has a coastal area in Pakistan that is about 1000 km, where a high amount of microplastics is located [13]. The literature was studied based on the water surface and sediment of the Ravi River and Arabian Sea of Pakistan, where samples collected around the Ravi River originated from a combination of drainage, canals, and wastewater from households, known as sullage [12,13]. The microplastics concentrated on the surface water of the Arabian Sea was an average of 582.12 particles per liter, with a standard deviation of 246.14, whereas at the Ravi River, a mean value of 2074 pieces/m^3, with a standard deviation of 3651 [12,13]. With these results, both the Ravi River in Lahore and the Arabian Seacoast have been deemed to be polluted based on the surface water values. According to Business Recorder (2016) [14], Lahore is a megacity that ranks second as the city with the highest population in Pakistan. The Ravi River has become a severely contaminated waterway as a result of by-products from various businesses and tons of metropolitan wastewater [14].

The shapes of the microplastic identified in both areas of study were fragments, sheets, beads, foams, and fibers, where fragments were found to be the highest, 56.1%, in the Ravi River; subsequently, fibers accounted for 38.6%, and foams, sheets, and beads were found to be below 3% [12]. According to Ahmed et al. [13], fibers were abundantly found in surface water samples from the Arabian Sea, with a percentage of 99.77% and a balanced percentage accounted for by beads, sheets, and fragments [13]. The micro debris, with a size range between 300 µm and 500 µm, was primarily found in the surface water samples of the Ravi River, whereas particles of 55 µm were primarily located in the Arabian Sea specimens; subsequently, 500 µm-sized particles accounted for 35.53%, and there was a balanced percentage for 250 µm-sized particles [12,13]. A significant fraction of the large-dimensioned micro debris floating on the water might relate to the source's vicinity and a decreased time frame for fragmentation to occur [15,16].

The microplastics concentrated in the dregs of the Arabian Sea were, an average, 987.40 particles per liter, with a standard deviation of 617.06, whereas in the Ravi River, there was a mean value concentration of 3726 pieces/m^2, with a standard deviation of 9030 [12,13]. These values also show that the microplastic pollution in the sediment specimens is similar to the pollution levels of the water surface specimens. In the collected sediments, the specimens from the Ravi River, a higher segment of fragments was distinguished, resulting in an amount of 83.1% out of the total microplastics extracted from the dregs; subsequently, fibers amounted to 11.8% and were balanced by other polymers, such as beads and foams [12]. The Arabian Seashore samples exhibited higher fractions of fiber, similar to that of surface water specimens, with a value of 99.24% out of the total 4900 microplastics from the dregs, subsequently below that of the 0.8% of the other shapes, such as fragment forms, beads, and sheets [13]. Microplastics, ranging in size between 150 and 300 µm, were significantly identified in the dregs collected from the Ravi River, whereas the Arabian shore specimens have a greater proportion of micro debris in the size range of 55 µm, with a percentage of 43.98% out of the total microplastics categorized in the sediment samples, and the least was found to be 22.82% for the size of 250 µm [12,13].

From both pieces of research conducted in Pakistan, it is evident that fibers were found in both locations of the Ravi River and Arabian Seashore, with a high amount of fibers found in the dregs and water surface specimens collected from the Arabian Seacoast and Ravi River. The primary driver of fiber microplastics into sewers is the discharge resulting from household chores, such as laundry, which substantially contributes to the amount of these microplastic particles found throughout the river. According to Irfan et al. (2020), the occurrence of a large number of fragmented microplastics in water specimens of sullage may be due to the decomposition of openly disposed plastic wastes dumped in the nearby surroundings [12]. In addition, plastic waste may be flushed into rivers and lakes during monsoon periods when there are massive amounts of waste discarded near drains and canals [12].

2.2. Saudi Arabia

In the year 2019, in the Middle East, Saudi Arabia was known as having one of the largest industries for the production of goods packaging, with an estimated value of USD 8.07 billion and residents using about 40 kg of polymer bags annually. The European Union reported that such usage is approximately twenty times more than the worldwide mean [17,18]. According to Al-Lihaibi et al. [18], Saudi Arabia has an approximate headcount of 34 million citizens. In earlier decades, major increases in the population of countries and industrialization have resulted in massive quantities of solid waste disposal [19]. The improper disposal of non-biodegradable items, such as reusable cans and totes, produces large quantities of hard waste, specifically during the holy periods of Ramadan and Haj. According to the research, only 10 to 20% of the total recyclables were successfully recovered and repurposed [20,21].

According to Pico et al. [22], Riyadh is a prominent economic, commercial, and production industry hub, covering a population of about 7.6 million residents, with many manufacturing companies generating polymer products that are capable of utilizing a great number of plastics. On the other hand, Al-Jubail is also one of the biggest petrochemical production regions that produce polymer resins and synthetic materials [22]. A study based on these two cities was conducted by obtaining surface water specimens. The mean concentrations of microplastics in Riyadh and Al-Jubail were 3.2 $\pm$ 0.2 items per liter and 0.2 $\pm$ 0.1 items per liter, respectively [22]. These mean results indicate that these towns have been contaminated with microplastics. Based on Figure 1, fibers are highly distinguished, accounting for 60% of the total microplastics extracted from the specimens (with only 1% lesser fiber found in Riyadh), subsequently fragment-shaped and spherules microplastics account for 15% each, and the remaining percentage consists of other kinds of minor shapes [22]. Most of the micro debris extracted was between 50 μm and 1000 μm, with the highest percentage of 35% in the group ranging from 50 μm to 100 μm, followed by 25% in the group ranging from 100 μm to 250 μm [22].

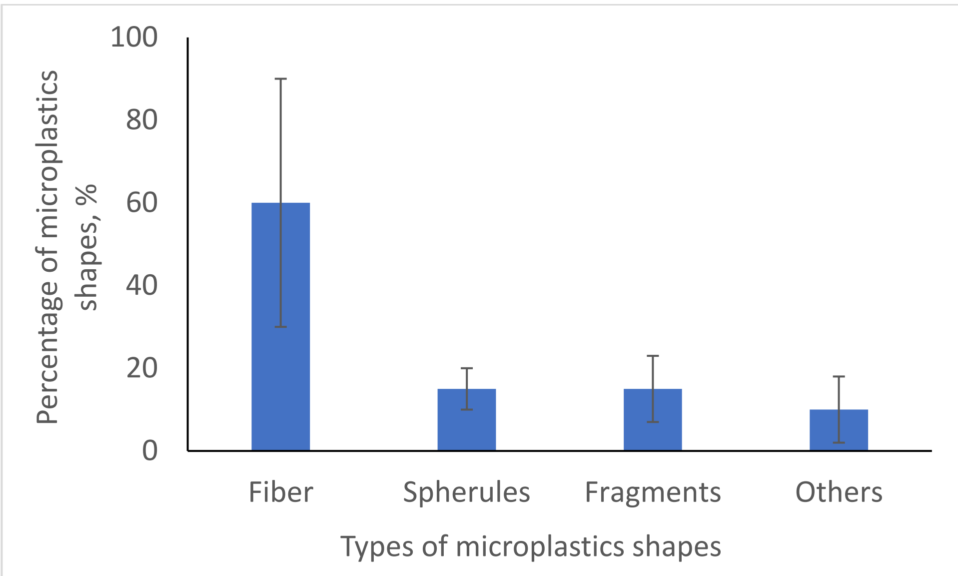

Figure 1. Percentage of microplastic shapes from surface water specimens (re-plot from data of Riyadh and Al-Jubail [22].

Based on Figure 2, polypropylene (PP) was the most abundant polymer from the surface water specimens sourced from Riyadh and the second highest in Al-Jubail, with a percentage difference of 6%. While polyethylene was found to be the most significant identified in Al-Jubail, with 24%, and a percentage of 19% of polyethylene was found in Riyadh.

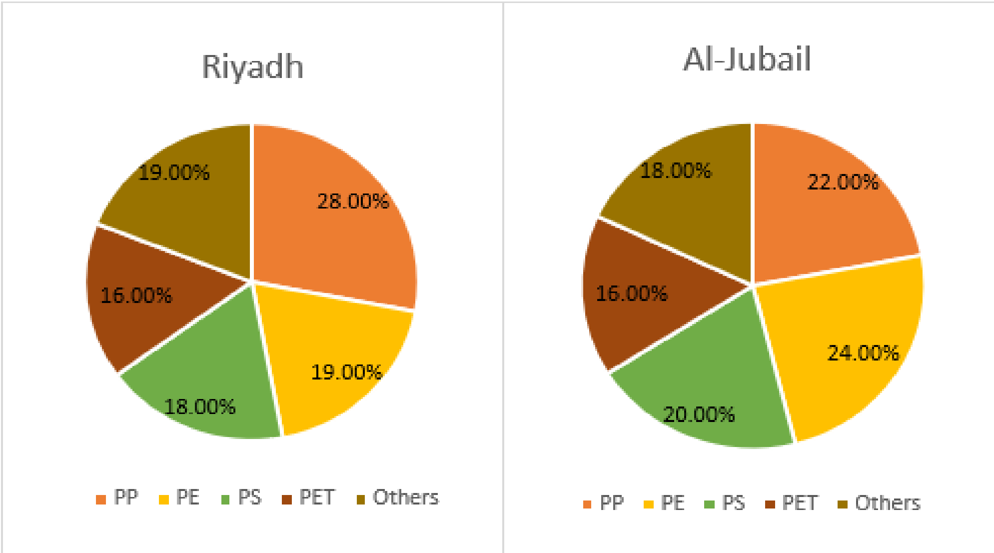

Figure 2. Average percentage of polymers from surface water specimens in Riyadh and Al-Jubail towns (Replot from data in Pico et al. [22].

Jeddah, with a populace of 3.4 million people, is known to be one of Saudi Arabia's biggest towns, and it is situated on the Red Sea's eastern shore. According to Anjum et al. [21], the town generates roughly two million tons of trash per annum. A study on microplastic contamination has been conducted on four different areas linked to the Jeddah shoreline. Sediments were collected from open sandy beaches and wastewater-releasing areas near the surroundings of Jeddah. Overall, the sediment specimens were found to contain approximately 119 particles per kg [23]. The open beaches were found to have a significant number of unevenly shaped fragments and foams, whereas sewage discharge sites have higher numbers of granular and fiber shapes [23]. The presence of granular shapes may be due to the discharge of microplastics in sewage. The polymers that were present in the dregs of both sampling locations are polyethylene terephthalate, polystyrene, polyester, and other minor polymers with percentages of 37%, 12%, 4%, and the remaining 53%, respectively [23]. The remaining proportions of microplastics could not be classified due to the use of low-quality equipment.

In summary, Saudi Arabia is a country facing increasing microplastic pollution; however, limited studies have been conducted to classify the presence and abundance of microplastics in the country. According to Pico et al. [22], the presence and quantity of microplastics can be impacted by the type of industry present in the metropolis and the growth of the town. Therefore, towns may have similar populations yet distinct characteristics, with varying numbers and distributions of microplastics, which is well evident by the greater abundance of micro debris in Riyadh compared to Al-Jubail [22]. In addition, public beaches may be polluted due to tourists and tourism-related events [23]. The high amount of fibrous and granular microplastics at sewage discharge ports may be due to the deposition of sewage at those ports and residues from clothing generated as fibers from laundry emanating via untreated wastewater [23].

2.3. Bangladesh

The characterization of the microplastics present in certain well-known areas in Bangladesh was established and studied. There are two main types of samples collected in this study, sediment and water, based on six locations across the country. Water sampling was undertaken in two different research areas, which were urban lakes and rivers. Lakes are well noted for providing essential ecological amenities, such as providing a place for wildlife habitation, farming, flood defenses, water storage areas, weather regulation, and tourist activities [24,25]. In contrast to natural waterways, several urban lakes are specifically designed to handle urban overflow and collect rainwater, causing it to be vulnerable to anthropogenic contamination, ecological strain, and microplastics, becoming highly prevalent in wetlands due to greater anthropogenic occurrence [26–29].

Water specimens were collected from lakes in Dhaka, a highly populated and fast-expanding megacity area. In this area, microplastic contamination is mainly due to abundant plastic degradation caused by anthropogenic activities. While in another study, samples were taken from Karnafully river, where there are about eight million people residing close to the river situated in Chattogram, Bangladesh's second largest town and a corporate hub. The dominant shape of microplastic in the lake were films, micro pellets, and fragments, with a percentage of 40.91%, 36.36%, and 22.73%, respectively, whereas in the river, with a percentage of 83%, fibers were the most common type of micro debris, followed by fragments [30,31]. More than 50% of microplastics of a size smaller than 1 mm were highly located in the Karnafully river water samples, as shown in Table 1. According to Hossain et al. [30], strong tides, semidiurnal tide motion, and sea transportation could generate sufficient turbulence in the river and shred the plastic materials into tiny particles [30]. In terms of the plastic polymers found in both of the areas, high-density polyethylene (HDPE) was the most abundant found, with 60% in urban lakes, and polyvinyl chloride (PVC) and polycarbonate (PC) were present with equal percentages of 20% [31]. However, there was no information on the polymer types from the river water sample analysis.

Table 1. Characterization of microplastic present in environments of Bangladesh.

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Cox's Bazar	Natural Beach	Beach sediment	Fibers (53%) Films (20%) Fragments (12%) Microbead (9%) Others (6%)	1–5 mm (59%) 0.5–1 mm (27%) <0.5 mm (14%)	-	[32]
Kuakata Beach	Beach	Beach sediment	Fibers (55%) Fragment (15%) Films (14%) Microbead (10%)	1–5 mm (55%) 0.5–1 mm (31%) <0.5 mm (14%)	PET, PE and PP (45.5%)	[33]
St. Martin's Island	Coastal beach	Coastal sediment	Fibers (50%) Films (26%) Foam (14%) Fragment (10%)	1–5 mm (25%) 0.5–1 mm (57%) <0.5 mm (18%)	Rayon (32%) Nylon (17%) PE (16%) PUR (11%) Others (24%)	[34]
Cox's Bazar	Beach	Beach Sediment	Fragment (64%) Foam (15%) Fibers (9%) Bead (6%) Film (6)	-	PP (47%) PE (23%) PS (9%) UD (9%) Others (12%)	[35]

Table 1. *Cont.*

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Karnafully river	River	Surface water	Fibers (83%) Fragment (17%)	1–5 mm (24%) <1 mm (59%)	-	[30]
		Sediment	Fibers (56%) Fragments (34%) Film (6%) Pellets (3%)	<1 mm (39%)	-	
Dhaka	Urban Lakes	Water	Film (40.91%) Micro pellets (36.36%) Fragments (22.73%) Fiber (13.63%)	-	HDPE (60%) PVC (20%) PC (20%)	[31]
		Sediment	Film (33.33%) Fiber (30.55%) Fragment (27.77%)	-	HDPE (42.85%) PC (28.57%) CA (14.28%) PP (14.28%)	

Based on other research conducted on sediment samples, the sediment samples were categorized into various types: coastal sediments, beach sediments, and sediments from lakes and rivers [30,32–34,36]. St. Martin Island is currently the sole coral area in the country, and the number of travelers visiting the island has risen in current times, and tourist industry development plans have also grown, leading the number of ecological contaminants to surge on the island [36]. According to Tajwar et al. [34], many travelers visit St. Martin for its picturesque coral coast. Coastal sediment analysis from this island showed more than 50% fiber-shaped microplastics, similar to the studies from different researchers based on sediment extracted from Cox's Bazar, Kuakata Beach, and Karnafully river, in which fibers were dominant [30,32,33]. Cox's Bazar is also known to be a favored tourist spot due to the mountains and dunes surrounding the beach. An implication that fiber accumulation on the island and Cox's Bazar beach could be due to the utilization of swimwear and UV-protective garments produced from synthetic fibers as well as the traveler's activities in the area [32,34]. However, in another study by Rahman et al. [35], fragments were the highest found, with 64%, and 9% of the beach sediment samples from Cox's Bazar were fibers. This may be due to the sampling location, which was different from that of [32], and the sampling collection time was from august to yearend, including the traveler visiting season.

According to Banik et al. [33], increased fiber might be due to the generation of waste related to the textiles industry, such as apparel manufacturing, household launder released into the rivers, and fishing-related waste in the Bay of Bengal [33]. In the sediment sample from the urban lake, films, fibers, and fragments were almost equally dominant, where films are generated from the breakage of plastic bags and fragments potentially originate from remnants of polymer trash that arise from the direct disposal of solid waste [31,37]. Dhaka city deals with large amounts of pollutants discharged from drains, municipal waste disposal, and the discharge of unprocessed household and corporate effluents [31]. The sizes of microplastic from the sediment samples were mostly 1–5 mm with high percentages, as shown in Table 1; however, Karnafully river sediment specimen microplastics were mostly smaller than 1 mm, which may have decomposed as a result of aging and wear. The decomposition of plastic waste into smaller microplastics was affected by environmental factors and hydrodynamic fluctuations [38].

In addition, Kuakata beach samples were found to consist of polyethylene terephthalate (PET), polyethylene (PE), and polypropylene (PP). The different types of plastic waste were highly extracted from the collected beach samples [33]. According to Banik et al. [33], PET and PP may originate from garments and fabric items as these are vastly utilized. PE is a type of polymer that is frequently utilized in meal packaging sheets and bottles for the products of gels and cleansers [39,40]. This type of polymer was evidently located in Cox's Bazar sediment samples, while the PP-type waste was found to be the highest, 47% [35]. In contrast, regarding St. Martin sampling, rayon followed by nylon polymers were highly found in the island specimens. According to Lebreton et al. [41], the presence of these polymers along the seaside was mainly due to the utilization of hard polymers in meshes and cords, which tend to be produced using these polymers [34,41]. Conversely, the waste from high-density polyethylene (HDPE) was extracted the most, 43%, in the sediment sample analysis from the lakes of Dhaka city, and this observation is mainly attributed to the increased utilization of plastic products made of PE. Subsequently, polycarbonate waste was extracted with 28% from the sediment sample [31].

Microplastic pollution is prevalent in the twain terrestrial and maritime ecosystems of Bangladesh based on the research carried out by professional organizations [42]. The Bay of Bengal is significantly polluted with microparticles from both internal and external sources. The sediments or water stream may have contributed to the emergence of microparticles in the area, according to Browne et al. [43] and Thompson [44]. They mentioned that microplastics can flow easily through filtration units of wastewater and sewerage purification plants [32]. Furthermore, winds may carry microparticles from one section to another section of the Bay of Bengal toward the shoreline and dunes. These three key streams are known as Padma, Meghna, and Jamuna in Bangladesh, and these could perhaps facilitate the transfer phenomenon [32].

The presence of microplastics in sugar, teabags, salt, and environments, such as rivers and islands, has raised alarm concerning the severe pollution conditions of these microplastics in the country. The survival of coral reefs in Bangladesh is a matter of study by researchers; St. Martin is currently the only coral island in Bangladesh and has more than 3000 travelers per year visiting the island. According to Gazi et al. [45], various studies have shown that coral reefs have considerably decreased recently [34]. Coral reefs are the ocean's biggest diverse biome and serve as coastal screens to preserve the shore from the sea's damaging effects, and these corals consume aquatic microorganisms for survival [46]. However, the presence of microplastic pollutants in the sea has affected coral viability as aquatic microorganisms could ingest the micro debris. Eventually, this condition has resulted in reducing the number of coral reefs in the ocean.

In addition, a recent study has shown the existence of microplastics in sugar and teabags based on two different analyses conducted based on five retail sugars and five flavored teabags, including branded packets purchased from various retailers in Dhaka City. These analyses showed a mean of 343.7 ± 32.08 microplastics per kg of sample sugar, with a greater prevalence of small fibers and spherules where the particles were mostly 300 μm in size. On the other hand, the teabag analysis was found to have high amounts of microplastics in unopened tea bags compared with the opened tea bag, with a greater frequency of fibers and fragments [47,48]. Bangladesh's sugar sector contributes significantly to the development of remote area facilities, labor opportunities for villagers, farmer income, forex savings, and quality enhancement to jaggery businesses and waste sectors [49]. Moreover, the country is a huge tea manufacturing nation, producing about 82.13 million kg of tea, based on figures from 2018. They also estimated an increased rate of 1.89% annually for the following years, leading to the country being ranked as the 10th biggest tea manufacturer worldwide [50,51].

Recent statistics on sugar utilization per individual in the country showed a peak in the year 2019, with a mass of 6.18 kg, which was 6% higher than in the year 2018 [52]. With these sugar intake statistics, the continued consumption of sugar containing microplastic contaminants has the possibility to result in a yearly intake of tons of microparticles, on average about 10.2 tons comprising a variety of forms, sizes, and polymer constituents [47]. According to Afrin et al. [48], the release of microplastic particles through tea packets in Dhaka town can result in an estimated microplastic release rate of 10.9 million grams yearly. This high release rate can spread higher amounts of microplastic to various habitats [48]. Furthermore, the presence of microplastics in salts has also become a matter of study in Bangladesh. According to Parvin et al. [53], a mean amount of approximately 2676 microplastics per kg was discovered in retail sea salt purchased from various regional markets and grocery stores. Equally, both the purified and improperly refined salts consist of a significant number of microplastic contaminants [53]. The increased amounts of polymer pollution or microplastic contamination throughout coasts and salt-farming areas may be the reason for the discovery of microplastics in sea salt.

Based on a study conducted by Rakib et al. [54], microplastics have been detected in sea salt specimens collected from salt pans at Bangladesh's biggest salt-farming region located in the Maheshkhali Channel. They also concluded that the amount of microplastics detected reached an average value between 74.7 and 136.7 particles per kg [54]. In addition to that, microplastics have been discovered in sediment samples from St. Martin Island that amounted to 250 micro debris per kg [34]. Based on the beach sediment analysis conducted at Cox's Bazar, microplastics amounted to an average of 368.68 ± 10.65 particles per kg [32] and 8.1 ± 2.9 microparticles per kg [35]. Both studies conducted by Hossain et al. [32] and Rahman et al. [35] on Cox's Bazar indicate that the differences in values may be inferred from the different sampling points of the sediments and other natural environmental factors, such as the wave-induced transfer of microplastics. The wave-induced transfer could transfer microplastics across a larger distribution area. In addition, based on a recent analysis of one of the river streams in Bangladesh known as the Karnafully stream, this stream was found to consist of micro debris that amounted to a mean of 2.11 ± 1.15 microplastics per liter of top water specimen. Furthermore, the daily load of microparticles flushed into the Bay of Bengal through the river during summer was computed to be 61.3×10^9 microplastics per day [30].

Stream water is utilized for commercial, agricultural, and domestic purposes. However, the river is currently heavily contaminated with hazardous organic and inorganic contaminants [30,55]. The stream absorbs water inflow from numerous channels and tributaries along the way toward the Bay of Bengal and contains significant amounts of particulate and liquid waste originating from corporate, domestic, and rural areas in Chattogram [56]. Furthermore, farmers employ various insecticides and manures to improve yield, and the agricultural residues contaminate the stream water via canal outflows as agricultural works are widespread close to the river [56]. Approximately 750 sectors, such as garments, packaging, recycling, laundry, coating, automotive, heavy machinery, etc., explicitly or implicitly release unprocessed waste or effluent into the Karnafully water stream in which the closest municipal areas to Chattogram discard waste into the stream, significantly contributing to microplastic prevalence [30]. Statistics have shown that as of 2018, the town's municipal waste from different sources reached 2289 tons a day, including plastic items, which amounted to 8.3% [57].

Several potential factors that lead to elevated levels of micro debris include the disposal of defective fish meshes, cords, buoys, and fishing boxes at the Karnafully stream bank. The flow sections of this river along the country's business centers are likewise contaminated with micro debris, which could be a result of inadequate facilities to manage wastewater in urban areas nearby the Karnafully River [30]. The abundance of the microplastics discovered at the shore, beach, and river areas denotes the development of microparticles in the water throughout the Bay of Bengal that eventually build up in sea salts. Moreover, according to Parvin et al. [53], exposure to small plastic debris through salt has been predicted to constitute up to an average of 13088 microparticles annually. These data were computed based on the average quantity of microplastics, about 2676 microplastics per kg, discovered from the sea salt analysis as well as the average per day salt intake level of 13.4 g by the people living in Bangladesh [53,58].

2.4. India

The characterization of microplastic in India was analyzed based on a few environments in India, such as estuaries, city streets, beaches, and coastal areas. Karthikapally and Panmana are situated on a hollow saline liquid lagoon known as the Kayamkulam estuary. The estuary region holds a significant quantity of sediments due to the low slope around the junction, with either backwaters or ponds [59]. A high amount of fiber-shaped micro debris, which amounted to 61.08%, was discovered in the estuarine sample [59], which is in line with analysis conducted at the Vellar estuary. They reported that fiber was predominant in the estuarine sample, 58.46% in the sediment and 79.29% in the estuarine water [60]. The minor form of small particles in the Vellar estuarine sediment were fragments and glitter, with 12.33% and 21.83%, respectively, which is in contrast to the estuarine sediment at Kayamkulam, with filaments and fragments as the minority of shaped microplastics [59,60]. Clay, gault in black, and silt, including alluvial deposits, make up the estuarine cliffs where the deposits affect the estuarine area. The ground of the Vellar estuarine is known to be Tamil Nadu's finest fertile firth [59,60]. The majority of the micro debris range in sizes of less than 1000 μm, as shown in Table 2.

Table 2. Characterization of microplastic present in environments of India.

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Kayamkulam Estuary	Estuary	Estuarine sediment	Fiber (61.08%) Filament (33.94%) Fragment (4.52%)	1000–3000 μm (29.86%) <1000 μm (62.90%) >3000 μm (7.24%)	PE (22.62%) Polyester (42.98%) PP (34.38%)	[59]
Chennai	City Streets	Street dust	Fragment (92.46%) Fiber (7.54%)	-	PVC (24%) Superflex (14%) Microcrystalline (19%) PTFE (14%) HDPE (9%)	[54]
Marina Beach	Beach	Beach sediment	Fragments (33%) Fiber (15%) Foam (12%) Film (10%) Pellet (6%)	0.1–3 mm <2 mm (50%)	PE (29.9%) PP (16.9%) PVC (10.9%) Polyester (9.9%) Nylon (7.9%)	[61]
Karnataka	Beach	Beach sediment	Fragments (46%) Fiber (34%) Films (12%) Pellet (8%)	0.1–1 mm (49%) 1–2 mm (27%) 2–5 mm (24%)	PE (37%) PP (26%) PS (17%) Nylon (9%) Others (11%)	[62]
Puducherry	Beach	Beach sediment	Fragments (56.32%) Fiber (15.85%) Film (13.54%) Foam (8.27%) Others (6.02%)	1000–3000 μm (31.40%) 300–500 μm (34.88%) 500–800 μm (20.93%)	-	[11]

Table 2. *Cont.*

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Vellar Estuary	Estuary	Estuarine water	Fibers (79.29%) Fragments (13.61%)	-	LDPE (58%) PP (36%) Others (6%)	[60]
		Estuarine sediment	Fiber (58.46%) Glitter (21.83%) Fragment (12.33%) Others (7.39%)	-	LDPE (45%) PP (35%) PVC (5%) PVA (4%) Others (11%)	
Odisha Coast	Coast	Coast sediment	Fragments (70.65%) Fibers (27.05%) Spherules (2.30%)	500–1000 µm (27.84%) 250–500 µm (21.11%) 100–250 µm (15.67%) >1 mm (23.90%)	12 Polymers detected (E.g HDPE, PVC, BR, PP, PTFE, SMMA)	[63]
South Andaman Coast	Coast	Coast sediment	Fragments (75.76%) Fibers (21.76%) Spherules (2.46%)	500–1000 µm (39.71%) 250–500 µm (22.67%) <100 µm (28.65%) Others (8.94%)	13 polymers detected (e.g., PP, BR PVC, ABS, Nylon 6)	[63]

PE is the third highest microplastic type found in the Kayamkulam estuarine [60], which contrasts with the sampling conducted in the Vellar estuary, where LDPE was most prominent in both water and sediment estuarine specimens [60]. Polyester-type waste was the majority discovered in the Kayamkulam estuary, amounting to 42.98% [59]. Moreover, based on a study conducted by Venkatramanan et al. [61], a lower percentage of polyester-type microplastics was found in the sediments collected from Marina beach. The beach samples have a large number of PE microplastics, 29.9%, followed by PP microplastics, with 16.9% [61]. This is a popular site in the state that attracts roughly 50,000 people a day for vacation holidays, eventually causing a severe accumulation of plastic litter on the beach. There is a lack of awareness and knowledge of both people and the government related to the detrimental impact of plastic waste contamination on the environment and human health. This may be the main reason that the pollution caused by plastic contamination is not regarded as a severe issue at Marina beach [61]. The predominant presence of PE and PP discovered are similar to the study conducted in Karnataka, where 37% and 26%, respectively, were extracted [62]. Moreover, the presence of nylon in Karnataka and Marina was a result of the utilization of fishing nets in that area.

The main human activities near Karnataka beach, the visitation of travelers, businesses, fishing ports, and touchdown areas, could have contributed to the presence of micro debris in that location [62]. In addition, common forms of microparticles extracted from Karnataka sediment samplings are fragments and fiber-shaped small debris [62], in line with the studies carried out using Puducherry beach sediments [11] and sediment samplings from Marina beach [61], as shown in Table 2. The abundant dimensions of microplastics discovered on all three beaches were between 1 and 3 mm. Furthermore, the significant presence of fibers and fragments was similar to the samplings of sediment from the coasts of Odisha and South Andaman, with more than 90% on both coasts, respectively [63,64]. Both Odisha and South Andaman coasts had 27.84% and 39.71%, respectively, of microplastics sized between 500 and 1000 µm [63,64]. In terms of the polymer types, both coasts had a few similar polymers discovered, such as PP, PVC, and BR, with no percentages to indicate dominance in both analyses. In another analysis based on Chennai Road dust, various types of polymer waste were observed, such as PVC, which is the major micro polymer with 24%. Subsequently, microcrystalline waste was found with 19% to be the second highest, followed by PTFE and Superflex 200, both 14%, respectively [65].

PVC waste may have originated from the extensive utilization of item packaging, powerlines along the streets, and automobile wear-offs that end up on the street [65]. According to Thomas [66], ductwork and bottles used to store volatile chemicals and caustic substances frequently include PTFE. PTFE is mainly utilized in the production of cookware and kitchen utensils, serving as a non-stick layer [65]. Microcrystalline products serve as important elements in various industries, such as food, where they are utilized as stabilizing agents, especially in the soft drink industry, to serve as emulsifiers. Microcrystalline products are also used in beauty products as thickeners [65]. In the road sample, fragments and fiber were the major micro debris detected, which is similar to the beach sediment and coast sample sediment analysis conducted in certain places in India, as shown in Table 2. The urban cluster in Chennai has a population of around 10.9 million people living in the town based on figures from 2020. As a result, compared to nearby coastal towns along the country's East Coast, Chennai residents utilize plastic in significantly greater quantities [61]. The small plastic debris discovered on the streets is one of the concerning factors as these small particles could potentially enter land and marine habitats through several routes facilitated by automobile movement, snow, rainfall, and wind.

In an evaluation, roughly 85% of the polymer waste in the country is improperly handled and has the propensity to enter the ecosystem, particularly surface water networks [67]. According to CPCB (2018) statistics, 62 million tons of municipal waste were produced in the country in 2015. They also found that 82% of the waste was collected, and the remaining percentage was discarded as waste [68]. In addition, based on Joshi and Ahmed [69], a continued reliance on landfill as a disposal pathway for municipal solid waste treatment by urban government authorities may lead to an upsurge in municipal solid waste accumulation of nearly 300 million tons annually by the year 2051. This is because of the significant population growth that contributes to the generation of plastic waste [69,70]. Additionally, according to Jambeck et al. [71], approximately 0.24 million tons of polymer waste are dumped into the sea each year; India is fourth in the world in terms of the improper management of polymer waste [72]. In a recent study conducted by Yadav, Sethulekshmi and Shriwastav [73], the probability of susceptibility to micro debris through some major sources, such as consumer water, food, air, etc., was conducted by collecting samples from respective sources [73]. The predicted daily vulnerability in consuming water, breathing air, and consuming food were estimated to be around 382 ± 205, 594 ± 269, and 1036 ± 493 microplastics, respectively, per individual [73]. These results are based on conjecture and presumption. However, the actual findings could be considerably higher than the predicted approximations.

In addition, Yadav, Sethulekshmi and Shriwastav [73] reported that the existence of friction while handling, packaging edge-cutting, storage processes, and shipping could lead to the breakdown of the wrapping materials into smaller pieces. This source of microplastic contamination is considered secondary micro debris present in prepared meals. In addition, small particles have been reported to be present in salt based on a few salt specimen studies. The majority of coastal areas in India produce salt, such as Gujarat and Tamil Nadu, which are known as the largest salt producers in India. Generally, salt pans utilize sea or estuary water as their basis for the generation of salt, although there are certain salt pans that still employ groundwater [60]. In research conducted by Nithin et al. [60], approximately 3.67 to 21.33 nos/10 g microparticles were detected in the salt. In this area of study, brine liquids via the Vellar estuarine were employed for the salt pans as a basis for the generation of salts [60]. Nylon and LDPE microplastic were the predominant polymer types discovered in the salt [60], which is relevant to the Vellar estuarine. LDPE-type microplastic was the major polymer found in the water and sediment specimens. It can be deduced that LDPE microplastics may have settled in the salt as Vellar estuarine fluids are utilized as a source for the generation of salt. In addition, another salt pan analysis at Tuticorin, where the salt is generated through the utilization of marine and borewell liquids, showed the presence of approximately 54 ± 13.4 and 12 ± 9.5 particles per kg, respectively [74].

With the obtained data, the researchers inferred that an individual might consume 216 and 48 particles annually from marine salt and bore well salt, respectively. On average, it is predicted that individuals consume 5 g of salt per day [74,75]. Seth and Shriwastav [76] deduced that the presence of micro debris might be due to the notion that marine salt is the direct output of shore liquids. Furthermore, based on CPCB yearly statistics, Gujarat is one of the top three areas for generating plastic waste, as reflected in its ecosystem, corresponding with the findings concerning an analysis of Gujarat fine salt, where about pieces of 1075 small debris were discovered [77]. Moreover, a mean amount of fewer than 700 microplastics per kg was extracted from retail salt packets [78]. The utilization of marine liquid, bore well liquid, and brine liquid originating from the estuarine showed that the presence of microplastics in water or sediment samples has a direct influence on the presence of microplastics in salt. Additionally, river streams that contain microplastics have a high possibility of transferring the micro debris to lakes that mainly receive water via river streams. One such lake in India that receives water via two different rivers, Vadavaru and Sengal, is known as Veeranam lake.

Veeranam lake is among the oldest and biggest basins in South India [79]. In the analysis, sediment specimens were collected from the lake's bottom, and it was revealed that there was an average amount of 309 microplastics per kg of sediment [79]. In addition to the transfer of micro debris via river streams, fishing activities have also contributed to microparticle abundance, as a significant quantity of worn-off plastic polymers from fishery equipment might seep into the lake. Additionally, to further explain the situation related to microplastics in India, in mid-August 2021, a news article was released stating that residential faucets exhibited the presence of microplastics in faucet water samples [80]. A test conducted by obtaining faucet water specimens and water purification facilities in Goa showed about 288 microparticles consisting of 26 kinds of plastic polymers [81]. Moreover, *The Hindustan Times* [82] stated that water purification facilities might moderately lower the number of small particles in water; however, they are not completely removed. This statement was justified with a report based on an analysis conducted by NIO in which purified water from the treatment facilitates showed the presence of microplastics in the range of 1 to 3.8 small particles per liter of water [82]. These microplastics in tap water can be hazardous to humans if ingested; however, there is no research or proof to show ingestion by humans or the related risk factors in India to date.

Furthermore, India is known to be the second highest flood-prone nation, with many areas of the country susceptible to flooding [83]. The microplastic issue in certain areas of India is severely impacted by the heightened occurrence of floods, together with the large volume of improperly handled plastic waste [84]. In fact, such a situation has caused top waters, sediments from deep waters, and beach areas to accumulate almost double the amount of an overall average of 246 to 506 microplastics after floods, as landed in Kerala in the year 2018, which was one of the five most severe flood occurrences in the country, as stated by World Meteorological Organization [84]. The after-flood sample study showed that the mean amount of microplastic in the top water was 174,016 ± 103,470 particles per kilometer and 28 ± 7 and 68 ± 19 particles per kg in deep water and shore sediment specimens, respectively [84], which were considerably higher after the floods. Commonly, after flood occurrences, strong waves overrun shores, inducing buried small particles to be swept toward sea waters, generating an overabundance of microplastics throughout seawaters.

2.5. Indonesia

Based on water and sediment sample analysis, foams were dominantly discovered from a few places in Indonesia, such as at Surabaya, which involved a few sampling spots: bays, beaches, and shore water specimens, with a percentage of 58.44% [85], sediment from wildlife reserve mangrove with an abundance of 13.33 ± 8.54 particles per kg [86] and Bantan bay sediments with a percentage of 30.4% [87]. The emergence of foams is caused by pieces or shards of Styrofoam [87]. Surabaya serves as a hub for maritime transit, fishing, as an attraction site, and as a home for fisherman [87]. The water specimen analysis from a few spots of Surabaya showed fragments. They are the second highest type of small particles extracted, and large amounts of particles, ranging between 300 and 1000 µm from the overall microplastics, accounted for 94.02% [87]. The river water of Surabaya at different depth zones showed the highest number of fragments located at the top and mid-level of the water. Whereas films were the highest at the low level of the river, with the greatest abundance of large microparticles in all three depth zones, as shown in Table 3 [88].

Table 3. Characterization of microplastics present in Indonesia.

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Northern Surabaya	Bay, Beach and Coastal	Water	Fibers (3.32%) Foams (58.44%) Fragments (34.51%) Granule (3.73%)	500–1000 µm (48.54%) 300–500 µm (45.48%) >1000 µm (5.86%)	PS (58.44%) PE (18.42%) PP (18.80%) Polyester (2.40%)	[87]
Makassar City	Tamangapa landfill	Dug well water	Fiber (72%) Fragments (28%)	<2 mm (86%)	-	[89]
Muara Angke Wildlife Reserve	Mangrove	Sediment	Foams Fragments	<1000 µm	PS (44.62%) PP (29.23%) PE (15.38%)	[90]
Surabaya	River	Surface water, Middle water and Bottom water	Film, Fragments Foam Pellet Fiber	LMP SMP	LDPE PP PS PE PET	[88]
Banten Bay	Bay	Sediment	Foam (30.4%) Fragments (26.5%) Granule (24.4%) Fiber (18.7%)	500–1000 µm (53%) 100–500 µm (17%) 1000–5000 µm (23%)	CP PET PP PE	[86]
Majalaya	Ciwalengke River	Sediment	Fiber (91%) Fragments (9%)	LMP > SMP	-	[20]
		Water	Fiber (65%) Fragments (35%)	SMP > LMP	-	
Surabaya	Jagir estuary and nearby Wonorejo Coast	Sediment	Fiber (57%) Film (36%) Fragment (7%)	LMP (68%) SMP (32%)	Polyester (56.7%) LDPE (24.6%) PP (18.8%)	[91]
Jakarta	Bay	Sediment	Fragments Fiber Film	-	PE PP PS PA	[92]
Bali	Benoa Bay	Surface water	Fragments (73.19%) Foam (17.02%) Fiber (6.38%) Granule (3.40%)	500–1000 µm (37.9%) >1000 µm (35.7%) 300–500 µm (22.1%)	PP (17.6%) PE (17.6%) PS (17.6%) Others (38.3%)	[93]

In another analysis, Surabaya town, related to an estuarine named the Jagir estuary and the Wonorejo coast, sediment sampling showed that fibers are the majority form of microplastic pollution, followed by films (Firdaus et al., 2020). According to Firdaus et al. [91], it was deduced that the presence of fibers may be due to expanding laundry industries, in which above 50% of industries lacked proper water effluent purification facilities. This predominance of fiber is in line with another study of the Ciwalengke River [20], where both water, as well as sediment, contain significant amounts of fiber micro debris, followed by fragments. In addition, large microplastics were majority extracted in the sediment specimens compared to smaller-sized micro debris and vice versa, as discovered in the water test. The Ciwalengke water stream is bordered by areas where people work in the fabric industry and impoverished families that reside in the slums with improper waste disposal facilities, which may have led to microplastic accumulation [20]. The presence of similarly shaped microplastics was also discovered in dug well liquids at the Tamangapa landfill, with a significant predominance of particles dimensions below 2 mm, which was more than 80% [89]. Makassar is a highly populated town where the waste from the town is discarded at the Tamangapa landfill [89], and it is possible that the liquids from landfills have seeped into the groundwater, eventually into dug wells, leading to microplastic contamination. While public activities close to the dug well could have contributed to the contamination as well.

The dominance of foam-shaped microparticles in the sediment at Bantan Bay [86] was in contrast to research conducted at Jakarta Bay, where fragments were extracted mostly from the sediments [92], as well as in the Benoa Bay water analysis, with a percentage of 73.19% of fragmented microplastics [92]. Bantan Bay is known to obtain water via waterways and rivers that might have possibly accepted a significant inflow of household waste, particularly Styrofoam, causing an abundance of foam in the area [86]. Benoa Bay is utilized by people that reside close to this area for aquaculture activities and crab and fish production, leading to the existence of PP, PE, and PS as the major plastic polymers [93]. Indeed, similar kinds of polymers were discovered in Jakarta Bay sediment specimens [92], mangrove sludge specimens that accounted for a cumulative percentage of more than 80% [90] as well as water specimens from three different sampling spots at northern Surabaya that accounted to a cumulative percentage of 96% [87]. In addition, LDPE was discovered at the Jagir estuarine as the second-highest pollutant, followed by polyester, the leading plastic polymer [91]. LDPE was discovered in different depth zones of Surabaya River stream analysis, in which the author deduced that the presence of LDPE in the lower depths of water may be due to the formation of biofilms over time through biofouling that may vertically disseminate microplastics to lower depths of the river [91].

In Indonesia, there are roughly 925 polymer factories that have the capacity to manufacture 4.68 million t of plastic items per year. As of the past 5 years, there has been an increment of 5% in overall yearly manufacturing [91]. According to Jambeck et al. [71], statistical data were obtained that showed, solely in the sea environment, 4.8 to 12.7 MMT of polymer waste dumped into the sea each year, leading to Indonesia becoming the second-largest contributor of plastic waste in oceans, raising concern among the federal and provincial government of the country. Mangrove forests could become a hub for the buildup of micro debris, which was verified with the large abundance of small plastic particles in non-moist sediment specimens taken from the Muara Angke Wildlife spot, which totalled 28.09 ± 10.28 microplastics per kg. The downstream of a river stream in Muara Angke regularly collects enormous amounts of municipal waste, notably plastic waste [94], whereas the upper section of the river stream is a large city known as Jakarta with remote areas, causing solid waste disposal to become a huge burden [90].

According to Syakti et al. [95], the country is a rising nation with an increasing populace; however, solid waste handling is inadequate, causing it to become a major issue. Based on statistical data from 2020, the predicted quantity of the yearly utilization of plastic drinking containers totaled 971,000 metric t [96], wherein residential households produce the majority of solid waste disposal, 39.8%. Surabaya city improperly manages solid waste disposal, with roughly 37.1% of the waste being mismanaged out of an overall amount of 1562.2 t [91]. Moreover, a statement suggested that solid waste production may grow to 76% by the year 2025, with more than 13% of the waste comprising polymers, which may result in worsening microplastic contamination in the coastal areas of the country via rivers [91]. This statement has become partially true, as in one study based on the Surabaya water stream, microplastic contamination was high, with an average of 22.29 particles/m^3 [88]. The channels to the river stream that drain waters may serve as a conduit for microparticle contamination in the Surabaya River via households and commercial inputs [97].

In addition to that, other environments, such as northern coastal areas as well as the Jagir estuarine polluted with microplastics, accounted to a mean of 0.49 items per liter of water and a range of 92 to 590 microplastics per kg of sludge, respectively [87,91]. The abundance at the estuarine is related to improper solid waste management due to inadequate systems and facilities. Furthermore, public participation in reducing solid waste is minimal, causing concern. The residents living in the Tenggilis Mejoyo region stated that 63% of people do not minimize or isolate household solid waste at the source [98]. As a result, significant amounts of solid waste are discarded into river streams, leading to the estuarine at Jagir that runs through heavily populated urban areas becoming a dumping site, according to World Bank Group [99], and solid waste facilities are only partially available [91]. Further, one of the spots, Banten Bay, was also contaminated with micro debris, which accounted for a maximum amount of 431 pieces per kg of dry sediment. Bays are other prominent sites where a significant quantity of household waste might enter the area via river streams and nearby ports [88]. Importantly, slum zones are defined as dwellings without fixed rooftops, limited personal restrooms, and inadequate drains.

Another river known as Ciwalengke has numerous sorts of small-sized plastic particles that amount to a concentration of 5.85 $\pm$ 3.28 items/liter and 3.03 $\pm$ 1.59 items per 100 g of both river liquid and sediment specimens, respectively. From this, it can be deduced that the close proximity of the slums, characterized by inadequate sanitary infrastructure, waste disposal, and open washing, to the nearby river stream, could have caused the pollution to occur [20]. Moreover, the raw water supply and purified water were contaminated with microplastics that amounted to 26.8 to 35 and 8.5 to 12.3 items per liter of liquid, respectively, in Surabaya [100]. Surabaya is known to provide water for consumption by purifying the raw water obtained from the town's river, supplying roughly 92.5% of the people living in the town. Films were retrieved from the purified water, although films were absent in the raw water specimens [100]. In addition, the microplastic contamination in the country currently seems to have higher links to the COVID-19 pandemic due to the large production and utilization of PPE. Based on a recent study conducted in Jakarta Bay, water specimens from the upstream of rivers that enter Jakarta contain microplastics, with a mean value of 9.02 $\pm$ 4.68 item/m^3, comprising a significant number of fiber-dimensioned particles [85]. This was deduced after a clear indication of where the secondary microplastics originated from by a separate source that showed a rise in percentage from 3.33% to 30% between the months of March and December 2020 [85]. The assumption that PPE, specifically face covers, could have contributed to the fiber microplastics was in line with research that showed waste from face covers made up 9.83% of small particles in most of the rivers of Jakarta in the month of March 2020 [85].

In order to further explain the conditions of microplastic contamination in Indonesia, a study revealed that micro debris was detected in specimens of human excrement as well as everyday goods retrieved from an agricultural population of an upland village. Micro debris amounted to between 6.94 and 16.55 μg/g and was discovered in human excrement, with a predominance of polypropylene (PP)-shaped microparticles that accounted to 10.19 μg/g [101]. Microparticle pollution was absent in both daily water consumption and the main meals of the individuals chosen for the study [101]. The water used for daily consumption was known to be obtained via natural springs that did not contain micro debris pollution [101]. However, a traditional food known as tempeh was filled with micro debris, containing 11.08 μg/g, presumably caused by the wrappers [101]. Moreover, high levels of microparticles were discovered in toothpaste as well as the salt utilized for cooking by the populace, with mean concentrations of 2.06 µg/g of PP, which was predominantly detected in the human excrement samples [101].

2.6. Vietnam

In Vietnam, the characterization of microplastics was carried out based on environments such as beaches, ponds, roads, and rivers. One of Vietnam's largest and most important coastal towns is Da Nang. Based on a beach sediment study at this location, about 745 microplastics in the beach sediment were found, with fiber-shaped particles being detected as dominant, with a percentage of 99.2%, with the remainder being fragment-type pollutants. Both shapes were primarily found to have sizes between 300 and 2100 µm [102]. Such microplastic pollution may have originated from industrial effluent discharge comprised mainly of that from the clothing and fabric sectors [42]. The presence of fiber and fragment shapes was similar to that of another study conducted in the Tien Giang region, a beach where these two shapes totaled a cumulative percentage of 88.6%, dominantly composed of PE and PP, which amounted to percentages of 44% and 47%, respectively [103].

However, contrasting findings were obtained from the beaches of Vung Tau and Can Gio, where granules and pellets, respectively, were abundant [103,104], however, these were totally absent on Da Nang beach. The granule-shaped microplastic, primarily composed of PS polymer [103], were caused by Styrofoam and divers, as commonly, pool accessories, including pull buoys and kickboard containing Styrofoam release pieces during utilization. Polymer PE and PS accounted for a cumulative percentage of 78% in Vung Tau [103], whereas in Can Gio, sediment specimen. Meanwhile, an additional polymer of PP can be observed at a percentage of 32% [104], with the remaining 68% comprising PE and PS. Several rivers tend to transport internal waste and debris from mangrove swamps that converge near Can Gio, wherein the area is affected by ocean tides [104]. In terms of size, Can Gio beach specimens have larger microplastics of 2.8 to 5 mm, which amounted to 71.46% [104] compared to the beaches in Vung Tau and the Tien Giang region, where 42% were much smaller particles of 0.5 to 1 mm [103]. They are relatively reduced in size compared to the Da Nang sediment specimens, as shown in Table 4. This may be caused by the collection of samples during different seasons for the three research studies, as commonly, microplastics further degrade into smaller pieces during summer seasons and when exposed to high tides.

Table 4. Characterization of microplastic at certain environment in Vietnam.

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Da Nang	Beach	Sediment	Fiber (99.2%) Fragment (0.8%)	300 to 2100 µm (76.1%)	-	[102]
Northern Vietnam	Red River Delta and Tien Yen Bay	Mangrove sediment	Fiber	0.3–5 mm	PE, PP, PS, PET, PA	[105]
Tien Giang (TG) Region and Vung Tau (VT) Town	Beach	Sediment	TG: Fragments and Fibers (88.6%) VT: Granules (72%)	0.5–1 mm (42.1%) 1–2.8 mm (30.0%) 2.8–5 mm (27.9%)	TG: PE (44%) PP (47%) VT: PS (40%) PE (38%)	[103]
Ho Chi Minh town	Saigon river	Surface water	Fiber Fragment	50–250 µm	Polyester PE PP PS	[106]

Table 4. *Cont.*

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Hanoi City	Aquaculture pond 1 and pond 2	Sediment	Pond 1: Fiber (62%), Fragment (38%) Pond 2: Fiber (81%) Fragment (19%)	-	PE (40%) PP (50%)	[107]
Da Nang	Road	dust	-	100 µm–5 mm (4.1 ± 3.5 pieces/g dry weight)	PE, PP, PS, PET	[108]
Da Nang	Phu Loc drainage canal	Surface water	Fiber (77.2%) Fragment (21.1%)	Fiber (1335.6 µm in average) Fragment (163,285 µm^2 in average)	PE (24.4%) PET (22.0%) PP (22.0%)	[109]
		Sediment	Fiber (86.1%) Fragments (12.4%)	Fiber (840.1 µm in average) Fragment (74,225 µm^2 in average)		
Ho Chi Minh town	Can Gio Beach	Beach sediment	Pellets (41.31%) Fragment (38.5%)	0.5–1 mm 1–2.8 mm 2.8–5 mm	PP (32%) PE (25.69%) PS (42.31%)	[104]

Based on the latest analysis, a drainage canal in Da Nang was polluted with microplastics, primarily with fibers and fragments [109], which amounted to a cumulative percentage of 98.3% in a top water sample of the canal and 98.5% in a sediment specimen. Phu Loc canal is known to be crucial in the transport of sewage out of congested housing zones, passing into Da Nang Bay [109]. A cumulative percentage of 68.4% was ascribed to PE, PET, and PP polymers from both types of specimen sampling. This presence implied that smaller streams, including Phu Loc, tend to accumulate a greater quantity of microplastics than bigger streams, particularly in situations where the river serves as a drainage conduit in heavily populated urban districts [109]. A similar presence of the polymer types in the Phu Loc canal was observed from street dust obtained from the Da Nang metropolis, with sizes that varied between 100 µm and 5 mm [108]. This implied that the reduced size might be due to the disintegration of microplastics on the street over a lengthy period as the streets are incompletely paved [108]. Moreover, based on the river stream, approximately 10% of the urban sewage generated is managed using activated sludge; hence the majority of the town's effluents are dumped straight into streams of the Saigon River as well as its waterways [106].

Generally, microplastics were detected throughout the surface water of the Saigon River, primarily fibers, followed by fragments, where the fibers mostly comprised synthetic forms of fiber, with a percentage of 92% [106]. This is in line with a study conducted on the Red River Delta and Tien Yen Bay, where fibers were dominant in mangrove sediment, accounting for a maximum cumulative of 4253 particles per kg [105]. Microplastics of a size range between 0.3 and 5 mm were spotted, and this may be due to plastic degradation as well as the minimal dynamic conditions within the mangrove swamps [3,105]. Additionally, an aquaculture pond located in Hanoi showed a significant abundance of microplastics, comprised of recurrent fiber-shaped particles that accounted for a cumulative percentage of 143% based on two different sampling ponds and fragments accounted for 57%. According to Le et al. [107], the production and grade of fishery products may be impacted by the liquid and sediment conditions of an aquaculture lake. The sediment analysis of this lake showed the predominance of PE and PP, accounting for 90% of the total microplastics extracted. Both lakes may be contaminated due to the polluted Nhue streams that enter the lake as well as the human activities surrounding the lake [107].

In Vietnam, roughly over 3000 islets of different sizes have been discovered around the country, providing many opportunities for growth related to marine industries, including aquaculture, tourism, and maritime transportation [110]. Approximately 8 million tons of polymer waste are dumped in the marine area annually, causing the country to be ranked as having the highest global polymer waste dumping rate [111]. A substantial volume of plastic waste is generated per day, mainly consisting of plastic wrappers that are difficult to decay. The plastic waste is mainly produced by over 2000 polymer factories, of which 450 produce wrapper materials [112]. The country has experienced substantial growth in plastic production; as in 1990, the utilization of plastic was 3.8 kg per individual, drastically surging to 41.3 kg per individual in 2018. That information is congruent with the fact that residential solid waste comprising plastic escalated to 13.9% in 2017 compared to 2019, with a percentage of 5.5% [113,114]. According to the government, based on the year 2019, statistics showed more than 2 million tons of polymer waste produced in Vietnam, of which a significant percentage was found to be circulating in streams, ponds, estuaries, and wetlands.

Moreover, based on a study, it was revealed that each home in the country utilizes roughly a mean value of 10 polymer bags per day and a monthly base consumption of 1 kg [114]. According to Lahens et al. [106], the frequency of micro debris differed between 10 and 223 microplastic/m^3, as sampled from various sites of Saigon streams [106]. This means that approximately over 200,000 tons of plastic waste are released yearly via Ho Chi Minch City, where roughly 40,000 tons are interred, and the remaining amount is recovered or released into the ecosystem [111]. The author also claimed that the plastic recovery equipment utilized in the country's largest towns is both inefficient and unsafe for recycling [111]. In addition to the statistical reports, the conditions caused by microplastic contamination are further explained with the detection in salts and wastewater purification facilities. Vietnam's salt production is based on the protracted drying of moisture and salt precipitation retrieved via saltwater due to the unavailability of salt mines [115]. Foods containing salt consumed by Vietnam individuals are increasing, reaching approximately 10 g per day, as salt is a primary ingredient in a majority of the country's spices [116].

The utilization of processed salt for everyday dishes has become increasingly prevalent, whereas unbranded finer salts are manually made at home or by local industries [115]. Unbranded salt packets from Can Gio have the lowest number of microparticles compared to the suburban regions, which were much larger, amounting to 56.98 $\pm$ 23.81 and 402.52 $\pm$ 168.43 microplastics per kg, respectively, in which both locations have an abundance of PET-type polymers [115]. The author deduced that the presence of this type of polymer might be due to the settling and staying of PET on salt throughout crystallization, as the polymer has a greater density [115]. Moreover, processed salts contain roughly 140 microplastics, which may be due to crushing as well as refining [115]. In another study, market salt packets showed an average amount of 340 $\pm$ 26 particles per kg, whereas pure salt contained an average of 878 $\pm$ 101 particles per kg [117]. According to the WHO, the individuals in the country ingest two times more salt than suggested, 10 g per day, meaning that this double salt intake rate can cause individuals in Vietnam to consume 637 to 1270 particles annually [117,118].

Furthermore, micro debris pollution from atmospheric fallout is another situation occurring at the Phuoc Hiep depot. In this analysis, micro debris was observed that amounted to 1791 particles comprised of fibrous and fragmented shapes [119]. Based on the concentration value, the amount was higher by a factor of two during the summer season, accounting for 1801.2 particles/m^2 per day, compared to the wet season, accounting for 912.5 particles/m^2 per day [119]. It was deduced that the reduced amount in the wet seasons could possibly be caused by rain, which provides a limiting effect on the number of air contaminants [119]. In addition, in terms of the extent of microplastic contamination, the beach spots of Da Nang showed roughly 745 particles in the sediment [102]. According to the Nguyen et al., [102], more than 30570 dwellings and visitor lodgings located around Da Nang's 16 shore districts are partly linked to the town's sewage network, where domestic effluents of purified and non-purified liquids are released straight to seashores [102]. The overflowing of effluents at coastlines frequently occurs, particularly during the monsoon period, and the peak number of travelers could possibly further lead to the accumulation of microplastics around the beach. The above-mentioned observation unfolding on Da Nang beach was in line with another study related to shore sediment in two different areas, the Tien Giang region and Vung Tau, which showed mean concentration values that varied between 2.5 and a maximum of 44.6 particles per kg of non-moisture beach sand [103]. Moreover, the Da Nang study related to road dust and a drain canal of Phu Loc also revealed serious contamination of microplastics in a range of 1.78 to a maximum of 9.65 g dry road dust/m^2 [108] and to a mean of 1482.0 $\pm$ 1060.4 particles/m^3 on the top of the water as well as a greater abundance of 6120 $\pm$ 2145.7 particles per kg in the canal [109].

2.7. Iran

The socioeconomic shifts have caused an increased utilization of plastics and polluted important coastal and marine environments with microplastics. One such place is Chabahar bay, a well-known tourist attraction of great commercial significance [39]. A microplastic characterization study was conducted based on surface water and sediment samples collected from this bay. In the sediment specimen analysis, microplastic fragments, pellets, and fibers were identified that accounted for a cumulative percentage of 85.85% in the top water sample. In fact, fibers were predominant, followed by fragments and films, which amounted to a cumulative percentage of 89.44%. The fibers may have been prevalent due to the presence of grill nettings in wastewater that comes from households and recreational areas [120]. In Qatar, about 1.5% of fragments out of overall microplastics were discovered on the surface water; however, in Chabahar bay, the percentage of fragments was higher, about 42.54%, implying that microplastics in Chabahar have eroded over time [39].

Microplastics with a size of less than 1 mm were predominant and primarily contained PE and PET plastic polymers, comprising 67% of the total microplastics extracted from both sediment and water specimens. This was suggested to be due to the fact that the sample collection spots were near populated, industrial, and tourism areas [39]. The abundance of microplastics less than 1 mm in size was in line with another study conducted in the Caspian Sea, where 66% of the coastal sediment specimens were microplastics smaller than 1 mm [121], as shown in Table 5. This sea is known to be a significant maritime ecosystem that is susceptible to a variety of commercial, shipping, and oil spill contamination events [121]. The analysis showed high amounts of fibers, followed by fragments [121], which accounted for 98% of the total number of microplastics. The shapes discovered in the Caspian Sea coast are in line with studies conducted on the Aras River, where fibers were dominant in both water and sediment specimens, amounting to 52.6% and 54.4%, respectively, followed by fragments [122]. Estuarine sediment from the Qarasu estuary amounted to 98% fibers, followed by fragments [123], and in the Hashilan wetland, primarily fibers, in both the top water and sediment, were found in the specimen analysis [124], as shown in Table 5.

Table 5. Characteristics of microplastic in Iran at various environments.

Location	Environment	Type of Sample	Dominant Shape	Size	Dominant Polymers	Reference
Oman Sea	Chabahar Bay	Sediment	Fragments (32.22%) Pellet (27.37%) Fiber (26.26%)	<1 mm (61.32%)	PE (38%) PET (29%)	[39]
		Surface water	Fiber (42.54%) Fragment (28.66%) Film (18.24%)	<1 mm (42.35%)		
Mazandaran Province	Caspian Sea coast	Coast Sediment	Fragment (43.30%) Fiber (54.75%)	250–500 µm (43%) 500–1000 µm (23%)	PS PE	[121]
Hormozgan Province	Bandar Abbas beach	Sediment	Foam (64.01%) Fragment (30.96%)	LMP (67%) SMP (33%)	EPS, PE, PET, PP	[125]
Northwest Iran	Aras River and Reservoir	Sediment	Fiber (54.4%) Fragment Film Foam	0.1–5 mm 3–4 mm 1–2 mm	PE (37%) PS (30%) Cellophane (24.4%)	[122]
		Surface water	Fiber (52.6%) Fragment Film Foam			
Gorgan Bay	Qarasu estuary	Estuarine sediment	Fiber (72%) Fragment (26%)	1–2 mm (33%) 0.5–1mm (41%)	PP (33%) PE (24%) PA (21%)	[123]
Kermanshah Province	Hashilan Wetland	Sediment	Fiber (95.77%)	<100 µm (38.03%) 100–250 µm (29.58%)	PP, PS, PE	[124]
		Water		<100 µm (33.33%) 100–250 µm (25%)		

It has been suggested that the main causes of the significant concentration of fiber-shaped microplastic in the examined Caspian Sea coast specimens were probably residential sewage intake through waterways and intensive fishing practices [121]. In the Aras River and reservoir, the larger plastics tend to erode more, showing higher amounts of disintegrated microplastics, leading to fiber abundance [122]. Moreover, the Aras River is also one of the primary contributors of fiber and fragments to the ocean environments of the Caspian Sea due to the Aras River flowing into this sea. For the Qarasu estuary, the abundance of fibers in the Qarasu stream estuarine and, consequently, the Gorgan Bay, may be the result of residential sewage entering the streams, contributing to the microparticles present in the Caspian Sea because the Qarasu River is connected via a similar estuarine and flows into the sea [123]. Wetland ecotones are known to be important components of ecosystems that support the rapid transfer of gases, sediments, groundwater, and adjoining soils [124]. In the Hashilan Wetland, the prevalence of microfiber pieces is presumably transported into the research area by the air due to the low density of the environment [126].

In terms of sizes, most of the studies, as shown in Table 5, revealed microplastic sizes of less than 1 mm; however, in the beach sediment of Bandar Abbas, the number of large microparticles was much higher than the number of small microparticles [125]. This study demonstrated a contrasting microplastic shape, predominantly foams, with a percentage of 64.01%, followed by fragments [125]. The province of Hormozgan is a focal point of key industries in the town. The metropolis is established both regionally and globally due to its huge docks, including Rajaee as well as Bahonar, along with important sectors, notably shipyards, petrochemical factories, aluminum production, and electricity plants. The type of polymer found in this Bandar Abbas beach was primarily expandable polystyrene (EPS), leading to presence of foam-shaped microplastics. They originate from fragile shipment items, protective food packages, hot beverage drinking cups, and feeders for costly materials and machines [125]. However, this is in contrast to the Caspian Sea, which has an abundance of PS and PE [122], the Aras River with PE and PS, which accounted for 67% [122]. While in the Hashilan Wetland, PS, PE, and PP [126], and the Qarasu estuary, has a cumulative of 78% of PE, PP and PA [123].

Sewage originating from ships, lighthouses, and water-balancing equipment is a substantial cause of maritime ecosystem contamination, leading to microplastics in Chabahar Bay [39]. The Caspian Sea exhibited about 1830 microparticles, with a mean of 107.6 pieces per kg of sediment from the coast due to moist weather patterns and the shoreline attributes of the Caspian beach attracting intense increased tourist visitation [121]. According to UNEP [127], areas near towns with larger populations and tourists tend to have increased marine debris surrounding Iranian shores [127]. Moreover, in another study on the coast of Bandar Abbas, roughly 195,000 microparticles provided a mean of 3252 ± 2766 particles/m^2 [125]. In addition, the Qarasu estuary and Aras River, connected to the Caspian Sea, had an average of 217.8 ± 132.6 microplastics/kg in the sediment and 12.8 ± 10.5 microplastics/m^3 in the top waters collected from the Aras River, whereas the Qarasu estuarine had 182 ± 111 microplastics/kg in the sediment [122,123].

The Aras stream is known as the primary supply of irrigation for many industrial facilities as well as farming regions, passing through various metropolises before reaching the Caspian Sea [122]. The microplastics in this stream could have been contributed from urban tributaries that access the stream, carrying a significant quantity of microplastics toward the Aras stream [122]. According to Li et al. [128], micro debris contamination tends to adopt a comparable trend similar to clay deposits, which are lightweight and transferred throughout aquatic waters from greater energy habitats with larger current rates to lesser energy conditions. Hence, this could have led to a greater number of microparticles in Qarasu estuarine sediment with its increased clay content [123]. In another study, a mangrove jungle close to the Bidkhoun urban region showed significant microparticle pollution, amounting to a mean of 416 particles/m^2, which was considered to be due to inadequately processed sewage water as well as nearby urban developments [129].

To further explain the current conditions of microplastics in Iran, in a recent study, microplastics were discovered in the atmosphere at Ahvaz town, with levels varying between 0.002 and 0.017 microplastics/m^3 and primarily fiber-shaped [124]. A slightly higher concentration of micro debris was located in Asaluyeh County, varying between 0.3 and 1.1 microplastics/m^3, which was predominantly composed of fibers [130]. The Ahvaz site is close to housing and commercial sectors, which indicates that the local origins of the fiber particles are significant due to fewer signs of degradation [131]. Fiber-shaped microscopic atmospheric particles have the ability to travel large distances and directly contaminate crop soils as well as water sources when the particles are rinsed off by rain or other factors. According to the US EPA estimation, with a mean of 100 milligrams per day of atmospheric particle absorption for adults and 200 milligrams a day for adolescents, roughly a maximum of 50 and 100 microplastics per day may be taken in from atmospheric dust by adults and adolescents, respectively [130].

Furthermore, 3459 pieces of micro debris were discovered in wastewater runoff in Iran with a mean value of 70.66 ± 14.12 microplastics per liter of liquid, which revealed fibers as the dominant particle shape [132]. The intended and unintended release of household polymer waste that enters the Gulf waterways are projected to rise due to the growing volume of humans brought about by industrialization and huge constructions. Bandar Abbas sewage management facility's effluent discharges have an estimated volume of 2040 particles/m^3, in which presumably about 120 million microplastics are released throughout the Persian Gulf on daily basis [132]. A dense solid substance called wastewater sludge is generated during the purification of sewage [133], wherein the sludge contains large amounts of nutrients that are utilized in woodlands as well as for agricultural purposes as soil manure or enhancer [134]. Micro debris was located in the sludge of the Sari purification plant that varied between 129 ± 17 and a maximum of 238 ± 31 particles per gram of non-moisture sludge [134].

Most of micro debris is removed in water treatment facilities and captured in sludges for application on crop soils and woodlands, which may result in the potential accessibility of microplastics to rivers, lakes, and marine ecosystems via rain wash-off, wind, or irrigation. The purposeful intake of organic geosolids, such as soil, slit, ground stones, and ant pile earth, is known as geophagy [135]. Several modern indigenous people are still engaged in geophagy at times for nutritional or cleansing reasons. Human geophagy may have developed covertly as a result of the utilization of soils in cooking, such as red ochre sediment, which has been applied for ages to enhance meals, acting as a spice in Iran [135]. Soil is combined with salt that is either used in the preparation of seafood or in suspension in freshwater to produce loaves or food dressings [135]. This has become a concerning matter, as based on a current study, a mean value of 0.05 microplastics per gram has been detected in the soil obtained from Hormoz island, with an abundance of fiber-shaped particles [135].

The abundance was suspected to be due to the accumulation of locals or visitors that wore garments made from fabrics or linens, air precipitation during the mid of collecting and wrapping [135]. The yearly intake of micro debris is estimated to be roughly 200 with a daily highest presumptive use of salt by one standard individual of about 5 g or equivalent to per day absorption of spices obtained from the soil at Hormoz islet [135]. The presence of microplastics in marine environment can be related to the occurrence of dust storms in Iran that happened in 2018. Dust storms entail a huge variety of effects on ecosystems, meteorology, and the climate; for instance, excessive dust volumes may influence atmospheric warmth, cloud creation, and convectional movements and have been suggested to transport iron and various minerals toward marine environments [135,136]. With a presumed content of microparticles inside soils that serving as the origin, dusts that are approximately 0.02 particles per gram may contain roughly 2 trillion microplastics suspended by storms, dropping about 1.5 trillion microparticles locally as well as 150 billion pieces of micro debris across the marine environment [135,137].

Around 40 trillion microplastics may be transferred and mobilized into the atmosphere each year as a result of dust cyclones [137], in which dust cyclones may act as substantial intermediates for micro debris dispersion throughout marine and terrestrial ecosystems. Flakes of snow are big, low in density, and move at slower terminal speeds compared to rain, causing the flakes to absorb small atmospheric particles and settle on the ground [138]. In Northern Iran, where snowfall occurs, microplastics were obtained and studied that showed the presence of micro debris, which amounted to a total of 348 microplastics, which were primarily in the form of fiber, with a percentage of more than 90% [138]. An implication is that this could have occurred due to airborne microparticles that fell to the ground during the rainfall season, settling deep into the snow; additionally, travelers, as well as mountaineers, might directly contribute substantially to the amount of small plastic particle pollution.

Another major issue when the snow melts is related to the fact that micro debris contaminants are conveyed toward water bodies through runoff from impermeable areas, soil, aquifers, as well as various vegetated surfaces [139]. Moreover, dust in the classrooms of schools and indoor buildings was recently found to be contaminated with microplastics. Epidermal skin, pet fur, plant residue, food remnants, microbes, fabrics, ashes, building debris, acrylic flakes, soil particles, and sprays are among the diverse as well as heterogeneous components that make up indoor dust [140,141]. A few samples taken from Shiraz secondary school classrooms showed the presence of 188566 microplastics in the dust of a classroom floor, with a high proportion of fiber-form particles [142]. It has been suggested that the presence of these microplastics may be due to access via windows, open classroom doors, and being transported under footwear or on garments from the outside environment [142]. The other relevance of this pathway is probably influenced by local geology, the closeness of the school to roadway congestion and factories, and the level of interior airflow inside the classrooms.

A teenager may be exposed to an estimated daily amount of 113 pieces of micro debris, assuming that a teenager occupies 40% of their time in lesson rooms and ingests 40 milligrams of debris [142]. In annual terms, teenagers are vulnerable to roughly 40 thousand microparticles in lesson rooms alone [142]. In various internal buildings, dust specimens taken from the Bushehr area and Shiraz showed micro debris contamination that amounted to 1212 and 1362 microparticles, respectively [143]. Some of the sample collection locations were a children's playschool and a mosque, from which it can be reasoned that it could be due to being worn off from children's toys as well as mosque ground rugs that may accumulate dirt and fiber-shaped microplastics. Based on the authors, the utilization of air conditioners and chiller devices throughout the year could result in elevated amounts of micro debris in the dust of internal buildings, especially in summer towns, such as Bushehr and the Shiraz metropolis [143].

2.8. Thailand

Based on the beach sediment analysis conducted in Rayong province in Thailand, microplastics were detected, predominantly fragments, accounting for 50% of those present in the sand [144], which was in contrast to the beach areas surrounding the Phuket coast, where fiber was significantly the most accounted for, with a percentage of 85.6% [145]. However, the Rayong province water specimen study showed more fibers than fragments, amounting to 80% of the total, and it was suggested that this was due to the fact that fishing operations produce fiber particles through the use of nets that contain nylon fibers utilized for catching fish [144]. Phuket Province, with one of the country's biggest shorelines, is tremendously popular for travelers, with an estimated 13 million people traveling there each year [145]. The increased levels of visitors to the beaches of Phuket could be regarded as a possible source of fiber abundance, as the fibers may have worn off from the garments worn by travelers.

The prevalence of microparticles was noticeably larger at beach spots that serve as docks or departing locations where intense shipping activities could result in greater concentrations of microplastic waste, which amounted to 188.3 $\pm$ 34.48 particles per kg of sediment specimen [145]. The polymer types found in Phuket were PET, PS, and PP, which were larger in number. The presence of PET was due to the close vicinity of the site to a boat yard and traveler visitation [145]. However, PET was not discovered at the Rayong Province sampling spots, but PP and PS were similarly found with more abundance than PE, accounting for more than 70%. This was suggested to be due to the fact that PE may have arisen from the recent growth of the fishing and leisure industries [144]. Additionally, fragment-shaped microplastics are highly found in river and estuary combined areas, such as the Chao Phraya River and estuarine area, having an abundance of fragments in water and sediment specimens [146]. The sampling points of the river and estuarine combination of the internal Gulf of Thailand yielded the same shape of microparticles in liquid specimens [147]. The decreased number of fibers at the CPRE was because of fewer sewage purification facilities surrounding the area [147].

The internal bay of Thailand was one of a location that received an influx of Chao Phraya River drainage, which was concluded due to the similarity of dominant microplastic shapes in the water specimens of both locations. Both river estuary sediment as well as water yielded the same dominant types of polymers, PE and PP, as shown in Table 6. The larger amounts of these two polymers at CPRE was assumed to be due to the large discharge into Thailand [148]. For the internal bay of Thailand, the abundance of microplastics was different during the rain period and summer period. During the monsoon season, the waterways carry micro debris into the marine environment from the ground due to the rising freshwater flow, causing microplastic pollution [147]. Fragments amounted to being the most dominant form in the Bandon Bay water specimens, accounting for a maximum of 77.1%, with more PP polymer [149]. However, in the previous year, water and sediment specimens obtained from Tapi-Phumduang, which flows into Bandon Bay, predominantly contained fibers with greater amounts of Rayon [150].

Some of the sampling points in Bandon Bay are considered fishing sites and places for rearing aquatic animals, particularly clams and prawn farming spots [151], and these practices have led to a significant amount of fishing gear being abandoned at the bay [149]. The prevalence of fragments from studies conducted by Ruangpanupan et al. [149] suggested that weaved poly bags are frequently utilized, particularly at sampling points where aquaculture was prominent for bundling manure, prawn feed, and shellfish field border poles to prevent tidal detrition. In order to conceal the border poles, which are about 100 in numbers, more than one sack is utilized per pole in which these weaved poly bags disintegrate into micro debris when in contact with environmental elements, such as breeze attrition and UV rays from the sun, that will eventually cause the accumulation of microplastics in the vicinity [149]. Moreover, fibers were found in beach sediments surrounding the shore of Phuket, the Bay of Thailand, and Bang Yai estuarine sediment with a prevalence of films [3,145,152]. The majority of the microplastics found in various environments in Table 6 were below 1 mm in size.

Table 6. Characteristics of microplastics at various environment in Thailand.

Location	Environment	Type of Sample	Dominant Shape	Major Size	Dominant Polymers	Reference
Rayong Province	Beach and river estuary	Beach sand	Fragment (50%) Fiber (41%)	100–500 µm (58%)	PE (75%) PP (12.0%) PS (13%)	[144]
		Surface water	Fiber (80%) Fragment (19%)	100–500 µm (46%)	PE (73%) PP (17%) PS (10%)	
Coast of southern Thailand	Tapi-Phumduang River and Bandon Bay	Surface water and sediment	Fiber Fragment	<1 mm	Rayon, PP, PE, PET	[150]
Gulf of Thailand	Bandon Bay	Surface water	Fragment (66–77.1%) Foam	0.5–1 mm (22–23.4%) <2 mm (61.13%)	PP (57%) PE (30%)	[149]
Pak Nam, Samut Prakan	Chao Phraya River Estuary (CPRE)	Surface water	Fragments Fiber Films	-	PP PE	[146]
		Sediment	Fragments	0.05–0.3 mm	PE (50%) PP (21%) PS (7%)	
Phuket Province	Bang Yai canal	Estuarine sediment	Fiber (80%) Films	0.1–5 mm	Polyester PP PE PET	[152]
Gulf of Thailand	Coast	Sediment	Fiber	0.1–0.5 mm 0.5–1 mm Both 71%	Rayon Polyester	[3]
Inner Gulf of Thailand	River estuaries and coastal sea	Water	Fragment Film Fiber	1000–5000 µm	PP PE	[147]
Phuket Coastline	Beaches surrounding Phuket Coastline	Sediment	Fiber (85.6%) Film (3.3%)	20–300 µm (max 56.7%) >300 µm (max 50%)	PET PS PP PVC	[145]

The high volume of travelers touring Phuket province has induced an upsurge in textile washing, possibly causing the Bang Yai estuarine specimens to be contaminated with fibrous microparticles. Rayon microplastics were visibly present at two locations in the country: the Bay of Thailand and the Tapi-Phumduang stream ([3,150]. However, contrasting findings were seen in different environments, which showed a higher abundance of PE, PP, and PS polymer types, those which are commonly derived from food wrappers, as shown in Table 6.

Thailand holds a significant position in the worldwide plastic sector, ranking as the 11th largest plastic manufacturer globally and the second largest based in the Asian region [153]. Based on studies and statistics from 2020, the issue of Thailand's maritime has been exacerbated, causing the country to be classified as the 6th largest worldwide emitter of plastics into the sea [154]. Rayong province is a popular vacation spot, with a record of drawing up to 7.7 million people in 2018. However, based on the current analysis, the location contaminated with microplastics amounted to a mean of 338.89 $\pm$ 264.94 particles per kg in sand specimens, and a much higher mean of 1781.48 $\pm$ 1598.36 microplastics/m^3 in the top water of the sea [144]. Another study based on water and sediment obtained from the Tapi-Phumduang river yielded micro debris with a maximum value of 2.81 particles per liter of water [150]. The authors concluded that this river obtains water from Ratchaprapa reservior and the reservoirs' downstream watershed is surrounded by extensive palm and rubber plantations [150]. The river water enters Bandon Bay, passing through towns that could be a source of microplastics and tributaries, which may serve as microparticle-holding networks [155]. Evidently, cockle picking entails bottom dredging, which may revitalize sediments, leading them to move and enter the surrounding water and possibly shifting formerly deposited microplastics inside the bay [150]. Further investigations shed light on microplastic movement from the river channel into the bay, particularly during the monsoon period, which was thought to account for the majority of the influx of particles from land entering Bandon Bay. As studies have shown, the number of micro debris is three times more during large tidal cycles [151]. The movement of microplastics from rivers such as the Tapi-Phumduang stream into Bandon Bay has definitely caused an abundance of microplastics in the bay; where in a recent study, the bay contains 7899 detected based on water specimen analysis [149].

Currently, Bandon Bay is at risk of degradation due to the growth of commerce and population, leading to excessive resource utilization as well as a significant volume of waste being generated [156]. According to Ruangpanupan et al. [156], the surface tide moving counterclockwise could transport microparticles from the north of the bay to the midsection and move to the southern point. With the utilization of typical concentrations of micro debris in liquid over a tide cycle, the load of small-sized plastics in the bay was computed to be 22.4 billion particles on a daily basis during the monsoon period [149]. Moreover, estuarine areas were also contaminated, such as the Chao Phraya River Estuarine (CPRE), which is a primary saline aquaculture spot, generating roughly 7105 tons of fish per year. It showed an overall total of 2704 microplastics in the estuary's water specimens collected [3] and the estuarine sediment obtained at the Bang Yai channel, which flows starting from Kathu falls, traveling through huge segments of Phuket metropolis and ending at Thailand's west side coast, yielding 463 microplastics [152].

At CPRE, some of the collection points were close to large freight ships, which frequently navigate near the estuary's midsection and where bow waves are produced, dispersing water across two banks [146]. The Bang Yai channel receives huge amounts of water coming from both household and factory effluents, causing the canal to be a contributor to the numerous microplastic contaminants present in the sea [157], and the canal inlet is in close proximity to a sewage purification facility as well as landfill [152]. In addition to that, the Bang Yai canal was found to have considerably greater amounts of microplastics than the specimens obtained from the shore of the Gulf of Thailand that amounted to a maximum of 362.5 particles per kg of sediment [3] In a recent study based on the inner gulf of the country, the numbers amounted to only 21.29 $\pm$36.21 items per liter of top water specimens [147]. This gulf of the country's environment is susceptible to human activities close to this environment [158], from which a hypothesis can be made that runoff transports a significant volume of sediment containing a large amount of plastic, primarily originating from aquaculture practices.

In addition, a significant number of micro debris tends to be left behind as the sea widens, reducing hydrodynamic pressure; hence, sediment within the confines of the sea is more likely to collect and accumulate microplastics [3]. For instance, in the inner gulf, top water movement could have caused the dispersion and lodging of particles [147]. The quantity of secondary micro debris is predicted to have a maximum value of 79140.8 tons annually, permeating into various ecosystems in Thailand [159]. To further explain the condition of microplastics in Thailand, microplastic contamination has been discovered in shrimp paste, amounting to between 6 and a maximum of 11.3 items per 10 g of paste [160]. One of the goods that the country's fishermen pursue is shrimp paste, as various Thai dishes depend heavily on this paste, particularly chili dips [160]. An implication is that the micro debris could have arisen during the making of the paste with other ingredients, such as salt, source of water, and krill that was already contaminated with particles [160]. Furthermore, wastewater purification facilities have accumulated microplastics between 77 ± 7.21 and 10.67 ± 3.51 items per liter of wastewater [161].

In the year 2020 alone, roughly 6300 tons of polymer waste were manufactured per day in the country. The sizes of the micro debris in the sewage purification facility were highly prevalent in the 0.05 to 0.5 mm range [161]. According to the authors, the percentage of microparticles rose significantly in an aeration unit, up to 40.7%, in which the debris becomes trapped in sludge and not entirely removed from the purification plant [161]. The micro debris is then redispersed after the sludge has been recirculated and placed back into the aeration unit [162]. The estimated leak of microplastics from purification plant effluent day into nearby freshwater habitats is 1280 ± 421 million pieces per [161]. In the sludge, roughly 26.3 ± 12.6 thousand microplastics per kg may be retained in the non-moisture sludge [161], which is then applied to farming and could eventually adversely affect flora as well as wildlife due to the presence of microparticles in the soil.

2.9. Philippines

Based on coastal environments, sediments obtained from the shores of Negros Oriental yielded major amounts of fiber-shaped microplastics [162]. This was in line with specimens obtained from the Cayagan de Oro shore, with a predominance of fibers followed by fragments [163]. However, in terms of polymer types, rayon, PET, and PVC were discovered at Negros Oriental, which is in extreme contrast to the Cagayan de Oro area, which showed the predominance of LDPE, HDPE, and PP [162,163]. The fiber presence at the Cagayan de Oro area shore situated at Macajalar Bay was explained to be due to the fact that household sewage drainage released into streams probably transported the particles to the shore [163]. However, certain specimen collection spots in the seaport zone showed lower counts of fibers and a greater number of fragment-shaped microplastics. It was concluded that the transfer of fiber or any form of microplastic from the land to the ocean might have been hampered by the constructed environment of the harbor and the constrained water movements [43,163].

Based on river habitats, as shown in Table 7, fragments, films, and pellets were commonly located in the top water and sediment specimens obtained from five different rivers [164] and the Metro Manila stream [165] where both are situated in Manila Bay. High counts of fragments consisted of PP-type polymer, whereas films were more prevalent at stream entrances, which are encircled by large housing communities and where open disposal and pervasive waste discarding are noticed [164]. Pellets were collected from the Meycauayan stream top-level liquid where the potential cause is spillage from polymer production sectors that are in close proximity to this stream [164,165]. A line that was located in the sediments of Manila Bay [164] may be attributed to the number of angling practices, aquaculture, and docks for kayaks, which are present near the sample collection sites. Lines could also be present from straws, cords, and catchment netting from kayaks that are stationed close to seafood shops around the stream's entrance [164]. The types of polymers found in both research studies were PP and PE [164,165], and this was in line with an analysis conducted at the Molawin watershed [166] and Cayagan de Oro shore sediment analysis [43], as shown in Table 7.

Table 7. Characteristics of microplastic in various environments at Philippines.

Location	Environment	Type of Sample	Dominant Shape	Major Size	Dominant Polymers	Reference
Negros Oriental	Coastal of Negros Oriental	Coastal sediment	Fiber	<2000 µm (majority 1000 µm)	Rayon PET PVC	[162]
Manila Bay	Canas River, Meycauayan River, Pasig River and Tullahan River	Surface water and Sediment	SW: Films Fragment Pellets S: Line	SW: 1–2.36 mm S: 2.36–5 mm	PP PE	[164]
Manila Bay	Baseco Port	Bay Sediment	Fragment (84.1%) Fiber (4.1%) Pellet (4.1%) Film (3.1%)	1.6 ± 1.4 mm (average)	-	[167]
Makiling Forest Reserve, Los Banos, Laguna	Molawin Watershed	Sediment	Fragment Fiber	100–200 µm	PP PE	[166]
Macajalar Bay	Cagayan de Oro Coast	Coastal sediment	Fiber Fragment	-	LDPE HDPE PP PE	[163]
Manila Bay	Metro Manila River	Surface water and sediment	Fragment Film Pellets	-	PP PE PS	[165]

Molawin creek yielded a predominance of fragments, followed by fiber, amounting to 71.33 pieces and 20 pieces per 100 g of non-moisture sand specimens, respectively, where both were majorly discovered on the lower bank of the watershed [166]. Microplastics that are larger than 2 mm were majorly found on the upper section of the bank, and a decreased number of particles with sizes greater than 2 mm was discovered in the middle section of the stream, followed by the lower section of the bank [166], which could be due to temperature differences between the upper and lower sections of the bank, as higher temperatures may lead to the faster disintegration of polymers. In addition to that, similarly shaped microplastics were discovered at Baseco port, where the sediments yielded fragments and fibers [167] that amounted to a cumulative percentage of 88.1%. Smaller counts of pellets and films were also found in the environment of the study. Baseco port is a harbor that is well-noted as a place where unofficial immigrants reside [168]. Overcrowding and the shortage of urban spaces have ultimately resulted in an unclean and disorganized colony [169], becoming a major driver of the improper handling and dumping of waste. Approximately 550 waste bags were gathered from the Baseco region during a communal cleaning [170]. The port of Baseco showed more microparticle pollution in rising water sediment specimens [167], which can be explained by the area's proximity to an overcrowded populated area.

3. Impacts to Environment

The impacts on the environment due to microplastic pollution in South Asian countries are related to mainly three environments: the marine environment, terrestrial environment, and atmospheric environment. In the marine environment, the main impact is the ingestion of microplastics by aquatic organisms due to the high number of microplastics in the sea as well as the aquatic organisms misinterpreting the microplastics as food for consumption. In the terrestrial environment, the impacts mainly relate to the sinking of microplastics into soils that are mainly used for growing crops or agriculture purposes, causing changes to the physicochemical properties of the soil. In terms of the atmospheric environment, the direct impact of microplastics in the atmosphere is the settling of these particles onto the human body, such as skin, hair follicles, and a few other receptors.

3.1. Bangladesh

The impacts on the environment due to microplastic pollution in Bangladesh are related to mainly two environments: the marine environment and the terrestrial environment. Based on the marine environment, studies from researchers have shown microparticle intake by sea fish as well as microparticle presence in dried fish in Bangladesh. Based on a study conducted by Parvin, Jannat and Tareq [171], microparticles were detected in the gastrointestinal (GI) tracts of commercial fish acquired from two fish selling spots known as Ashulia and Savar situated in Dhaka town [171]. The occurrence in the fish samples is related to the presence of high amounts of microplastics that have been discovered in Dhaka lakes [31], and these fish selling spots sell fish obtained from streams, waterways, and lakes around Dhaka, which are then delivered straight to regional shops [171]. Based on a few studies, an analysis of fish samples purchased from the Kuakata fish selling market [172], caught from Jamuna stream [70] as well as Hilsa Shad of an anadromous migrating breed that are prevalent and numerous throughout the Bay of Bengal [173], showed the presence of microparticles in the GI tracts of the species.

The fish species' feeding spots, known as demersal, benthopelagic, and pelagic, have an influence in terms of the number of microplastics taken in by the fish in the specified zones. According to Pauly [174], fish species that reside and eat close to the bottom of the sea's column are called demersal fish species, whereas benthopelagic fish species are found slightly beyond the bottom of the sea's column, and pelagic fish eat near the wide surface area of the sea's column [171]. In most of the studies conducted based on commercial fish samples in Bangladesh, the demersal eating area of fish tend to have a higher number of microplastics present in the digestive tracts compared to the other two feeding spot fish samples. In the research conducted by Parvin, Jannat and Tareq [171], compared to fish species from benthopelagic and pelagic feeding areas, one of the demersal fish species known as *Mystus vittatus* has a substantially greater frequency of small particles, amounting to 9 ± 1 micro-particles per fish [171]. This statement is in line with analysis carried out on demersal-type fish from Jamuna stream, *P. hammur* [70] and Wallago attu obtained from Kuakata [172], with an abundance of 3.8 and 3.5 ± 1.93 microplastics per species, respectively.

According to Siddique et al. [173], about 19.13 ± 10.77 microplastics per individual Hilsa Shadfish were discovered due to misunderstanding microparticles as feed; furthermore, the particles may gather during the filtration of marine food, such as plankton [173]. Moreover, small particles have also been extracted from dried fish, with about 41.33 particles per gram in a Bombay duck species and 46 micro debris per gram in a ribbon fish species [175]. Bangladesh's financial economy has relied heavily on its dried fish industry for many years. In Bangladesh, marine fish curing has indeed traditionally been performed for a lengthy period of time, and it is predicted that approximately close to 50% of the overall sea fish catchments are dried [175]. Micro debris could impair food flow or obstruct swallowing organs, eventually covering the GI tract; as further evidenced by Parvin, Jannat and Tareq. [171] upon the intake of micro debris by fish, the species tend to experience tiredness and loss of appetite. However, these health effects stated are based on other countries and research based on effects on fish health and physical changes to the body after the intake of microplastics in Bangladesh is still a matter of study.

One of the impacts on the terrestrial environment in Bangladesh is the microplastic in soils, wherein microplastics tend to reduce the effectivity of the soil used for agriculture. According to Jung et al. [176] and Schroter et al. [177], soils serve as a medium for several functions, including carbon isolation and the biogeochemical cycle, as well as boosting biodiversity [178]. Small particles may alter the physio-chemical characteristics of the soil, which could exert a negative effect on biodiversity as well as a range of soil functions, including the rate of organic waste decomposition in the soil. In a study conducted by Afrin, Uddin and Rahman [178], microplastics were detected from soil specimens taken at an urban landfill spot in Dhaka [178]. The moisture content of the soil is indeed a crucial factor. The permeability properties of the soil may be affected in situations of excessive moisture content in the soil, which may impact the soil's shear strength [178]. In this research, the soil specimens have percentages between 15.48% and 56.54%, much greater than the ideal limit, as shown in Table 8, with an inference that it may cause changes to metabolic functions as well as erosion [178].

Table 8. Standards for physicochemical compositions of soil.

Compositions	Standard
Moisture content	10–45%
pH	7 ± 1
Electrical conductivity	200–1200 μS/cm
Alkalinity	6.5–7.5
Total organic carbon (TOC)	<0.5%
Data obtained from Afrin, Uddin and Rahman [178]	

In addition, the electrical conductance of the soil and soil alkalinity acts as key parameters of the environmental health of the soil. As per the research, the electric conductance and alkalinity in the soil was 0.1 μS/cm to 2.43 μS/cm and 6.7 μS/cm to 14.33 μS/cm, respectively [178]. Both values obtained were far from the optimum limits, where an electrical conductance below 200 μS/cm and high alkalinity values imply low fertility in the soil and fewer nutrients in the soil for intake by crops [178]. The total organic carbon in the soil may affect several physical, as well as chemical, properties of the soil, including the ability to store nutrients and the sturdiness of soil, prospective soil color, and nutrient cycling. From the research soil sample, the total organic carbon was between 0.18% and 1.09%, a little more than the norm, as shown in Table 8 [178]. Huerta Lwanga et al. [179] inferred that the presence of micro debris in soils might affect structural features, including the raising of porosity, altering the solid form, and also equalizing with soil aggregates, wherein these modifications may influence the microbial behavior of the soil [179].

3.2. India

In India, the impacts of microplastics on the environment are significantly related to the marine environment in which the ingestion of microplastics by aquatic biotas, such as shrimp, mussels, clams, and fish is largest and these are commonly consumed by the residents of India. In a study conducted by Daniel, Ashraf and Thomas [84], "*Fenneropenaeus indicus*", with the local name of white shrimp, were obtained from Cochin, a heavily industrialized and crowded town where fishing is a significant industry and the presence of small particles was found in the supple tissue of shrimp [84]. The shrimp analysis showed a mean amount of about 0.39 ± 0.6 small particles per white shrimp, roughly a percentage of 30.9% [84], which is currently still closely consistent with a study conducted in 2018 at a different location in India; for instance, on the Northwest Coast, where about 31.7% of small particles were extracted from the intestines of crustaceans [72]. White shrimp are known to reside and forage in muddy depths, where microplastics commonly build up, thus causing the crustacean to be vulnerable to small plastic debris [72].

These presences are highly concerning as crustaceans have a strong market demand both locally and internationally due to being a desirable and nutritious seafood that considerably supports the country's seafood industry [84]. Oysters and fish on the coast of

Tuticorin are also vulnerable to microplastics, wherein small plastic debris was detected in an average amount ranging from 0.1 to 1.73 microplastics per gram of oyster tissue specimens from the Tuticorin coast with significant amounts of fiber-shaped microplastics [8]. While based on another study, the micro debris detected in the fish samples amounted to a mean of 1.49 microplastics in the GI tracts per fish, predominantly fiber and fragment small particles [75]. These findings are relatable, as based on a sediment specimen analysis conducted in Tuticorin, microplastics with an average concentration of 83 ± 49 microdebris/m^2 with a predominance of fiber micro debris [180] were discovered. These sediments were collected from various points near the coast of Tuticorin, in which it can be inferred that the microparticles from the sediment might have transferred to the water of the coast induced by the action of the waves.

Tropical and subtropical areas are home to large populations of oysters that are known to be benthic organisms that live in close proximity to the coast, deeps seas, estuaries, as well as lagoons; additionally, oysters are filter-feeding species that exclude debris in water in order to feed [8]. The consumption of microplastics by oysters is highly probable, as according to Patterson et al. [8], food intake from the feeding method of oysters is through a suction force produced by its protractile jaw to increase effectiveness when hunting prey. In terms of the fish sample analysis, epipelagic fish that reside in deep waters have greater particle numbers in their GI tracts compared to mesopelagic fish that reside closer to the surface of coastal water [74]. Moreover, based on another alien fish sample study, wherein the species was known to have entered the Vembanad pond in the course of huge floods that hit Kerala in 2018, microplastics were extracted from the species with an overall count of 69 pieces [72], which was in line with a sediment specimen inspection conducted on Venbanad lake that was contaminated with microplastics accounting to 252.8 debris pieces/m^2 in mean [72].

Based on these findings, it can be deduced that the prevalence of small plastic debris in the intestines of an alien species, which provides a clear indication of the level of pollution in the pond water, might have ingested the plastic debris via land inputs as well as river streams that drain liquids into Venbanad ponds. In another piece of research, seafood, such as shrimp, squid, and crabs that are marketed as a source of food for humans, was analyzed in Kerala to evaluate the abundance of microplastics ingested by the crustaceans and squid. The crustaceans and squid showed a microplastic count with a mean value of 0.07 ± 0.3 small particles per shellfish, whereas the consumable tissue specimens of the shellfish had a mean of 0.0027 ± 0.012 microplastics per gram of tissue sample [181]. According to Daniel et al. [181], in crabs, the route for small plastic waste to enter their body is via ventilation, whereas, for squids, cephalopods migrate vertically throughout the daylight and nightfall, congregating toward deep sea depths during the day and rise to the surface of the sea after nightfall, leading the cephalopods to ingest a greater abundance of small particles as a result of exposure due to persistent movement through various sea zones.

Daniel et al. [181] author inferred that the prevalence and nonexistence of microplastics inside the consumable tissue of shrimp depend on the gut holding period and stomach elimination mechanism, which act as major drivers, as a longer holding period in the stomach may disintegrate plastic waste into microplastics that can move into the consumable tissue of the shrimp. Fragments were the dominant shapes located in the consumable tissue parts of the crustaceans and cephalopods [181], which is similar to a few studies conducted on the beaches and coasts of India, as shown in Table 2. Again, fragments were highly accounted for in the sediment specimens in which there are possibilities for the transfer of fragments from sediment to the waters of the coast and beaches due to wind and sea waves. Furthermore, in a recent analysis of yellow clams, mollusks that feed through filtering pieces of organic materials as well as planktons floating in liquid and that dwell continuously on a substrate by submerging to rough and thin sand bottoms, it was found that they were contaminated with microplastics, with 19,826 extracted pieces and an average of 138.61 ± 94.74 items per yellow clam in Maharashtra [182]. This emphasizes the fact that when clams expand and open their mouths wider, these clams sieve a larger body of water, causing the clams to ingest a greater amount of the micro debris present in the water [182]. According to FAO, a predicted amount of 4.9 kg of shellfish is consumed yearly per individual worldwide; taking this into consideration with a mean of 2.7 ± 12 microparticles per kg in the tissue of these specimens, an individual may roughly ingest 13 ± 58 microplastics yearly through the consumption of shellfish alone [181].

According to a survey of bivalve intake conducted across local households, a mean value of 120.59 g bivalve tendons is consumed each meal per individual; by taking this into consideration, approximately a mean of 3917.79 ± 144.71 microplastics are ingested per person annually [181]. Moreover, annually, refrigerated squid alone could transfer 776.5 million small particles outside of India through international trade (Daniel et al., 2021). Attributed to their ability to function as a carrier of substances that might threaten the security of seafood, microplastics are thought to be a gateway for hazards carried by seafood [181]. Raw and cured kinds of white shrimp are commonly served in meals. For raw shrimp, the top layer exoskeleton is eliminated to lower the chances of the human ingestion of micro debris. On the contrary, humans are likely subjected to some level of micro debris from the consumption of shrimp hindguts that have not been extracted, particularly in the case of mini shrimp [84]. According to statistics from the Government of India (2018), an approximated amount of 4584 tons of cured shrimp is produced yearly in the country [81]. As a preliminary estimation, around 733.44 million small plastic particles are assumed to be transferred via the intake of cured shrimp cycle alone based on an estimated mean amount of small plastic particles in shrimps of 16 per 100 g [84].

In a recent study based on the terrestrial environment, soils were particularly impacted by microplastic contamination in urban areas because of increased anthropogenic activities and the fact that the soils of urban areas could potentially serve as sinking sites for micro debris [183]. The collected soil specimens in this research were soils mainly used for agricultural activities. The soil exhibited physicochemical changes from standard crop soils due to microplastic pollution. Based on the analysis, the soil has a lower bulk density and followed by a moderately lesser pH in soil specimens, which was an average of 5.84 [183] compared to the standard 7 ± 1 [178]. In addition, the soil specimens showed greater soil organic and nitrogen contents, closer to the threshold level, and the author inferred that a greater level of nitrogen in soils might result in leaching [183]. Various forms of plastic particles have the tendency to accumulate in urban soils that may potentially disintegrate into tiny particles, leading to detrimental consequences for soil flora as well as fauna.

3.3. Indonesia

In Indonesia, the ingestion of microplastic by fish is prominent in the country's marine environment. One of the fish, *Gambusia affinis*, was polluted with small-sized particles. According to Rautenberg et al. [184], this species is an ecological stabilization species due to its broad range and biological significance in the human food cycle. The digestive area and gills of the species were filled with micro debris. Both of the studied organs are relevant to the sampling location, where the sampling points with the highest microparticle concentration of about 5192.59 items/m^3 contained fish with greater amounts of micro debris in their gills and digestive tracts, which amounted to 2861.11 items per gram and 4125 items per gram, respectively [185]. According to Buwono, Risjani and Soegianto [186], micro debris in the gills tends to build up during the filtration operation at the point of respiration and feeding, whereas the deposition of small particles in their digestive tracts is assumed to be due to the species' jaw opening that allows the entrance of both large and minute pieces [186,187]. Large amounts of residential waste that are generated by densely populated areas reach the marine habitat, increasing the composition of micro debris in the water.

In addition, according to McCauley [188], fish are a widespread species that contribute significant ecological and economic value that can act as stress monitors in marine environments [186]. *Gambusia affinis* are regarded as foreign, aggressive fish in the country as they can rapidly breed with a high level of adaptability to different environments [189]. In a study, an oxidative stress test in relation to the microplastics showed that the species had positive feedback to the test, which was due to the consumption of microparticles. According to Jabeen et al. [190] and Movahedinia et al. [191], microparticles may be caught in the gills, leading to hypoxia strand cracks, reduced respiratory capacity, and the destruction of the gills, which may eventually raise the risk of illness in the species [192]. Furthermore, microplastic contamination has affected marine urchins and seagrass, with small particles detected that amounted to 23.7 $\pm$ 2.99 particles per sea urchin and a cumulative of 0.34 $\pm$ 0.07 particles/cm^2 of seagrass at Barranglompo islet [193]. This island is polluted due to extensive human activity and poor waste handling, particularly plastic waste, which is dispersed over various portions of the area, leading to the entrance of degraded microplastics into deep marine seagrass habitats. These particles may further travel to sea creatures, mainly those that feed on seagrass, as particles may become attached to the fronds of seagrasses.

Marine urchins are known to be significantly consumed by the local residents of the islet due to their considerable economic and rich mineral content [194]. This organism is known to be a generalist feeder that can intake large amounts of microplastics from seawater, particularly from the unintentional consumption of sediments from the bottom of the sea or sea grass fronds [193]. Similar to sea urchins, another substantial food in the country of economic value is Skipjack tuna due to the prevalence of this fish throughout the whole maritime territorial environment, and the country holds the rank as one of the top breeders and suppliers globally [195]. However, this species was found to be filled with micro debris, amounting to a mean of 76.72 g in the GI tract alone [195]. Moreover, the accumulation of particles in sandfish was revealed to amount to 2.01 $\pm$ 1.59 pieces per species. This species ingests a huge number of sediments that could be filled with microorganisms, phytoplankton, and shellfish [196], and due to their inability to filter-feed the particles, the species might ingest microplastics. This species is captured for regional human consumption but also farmed in industrial fish cultures [196]. The country is known to be a significant place for sandfish species, and there has been a surge in the sandfish market [197].

Additionally, a mean particle concentration of 1.97 items per species of blue panchax was discovered at Ciliwung estuarine, as debris has accumulated at the estuarine due to tourism-related activities as well as dumping from resorts and eateries in close proximity [198]. In addition, microplastic contamination in water can cause physicochemical changes to water standards. Based on a study related to Brantas river water, the physicochemical changes of the water were analyzed. The analysis showed that the temperature of the stream was 21 °C in the upper section of the stream and 31 °C in the lower section [186], lower than the standards shown in Table 9. The growth of flora that safeguards the upper section of the stream could have caused the temperature of the upper section to be lower than the standards. Next, the overall suspended solids (TSS) measurements varied between 39.0 and 750.1 mg/L, whereas the overall dissolved solids (TDS) showed readings between 195.3 and 375.0 mg/L [186], and the TDS is within the standards shown in Table 9. Increased amounts of TSS downstream may be a result of larger quantities of soluble salt, high pesticides and urban waste, sewage waste, decaying vegetation, and riverbank degradation. According to Risjani et al. [199], the streams genotoxicity could have been mediated by the elevated TSS levels, which are produced through sediment inflow into the Brantas river [186].

Table 9. Standards for physicochemical parameters of water.

Parameters	Standard	Reference
Temperature	25–32 °C	[200]
Total suspended solids (TSS)	<400 mg/L	[186]
Total dissolved solid (TDS)	<1000 mg/L	[186]
pH	6–9	[186]
Dissolved oxygen (DO)	>4 mg/L	[186]
BOD	1–8 mg/L	[200]
Nitrate	<10 mg/L	[186]
Phosphate	<1 mg/L	[200]

In terms of pH, the scale read between 6.8 and 7.6 [186], and these readings are within the standards shown in Table 9 and are ideal for the survival of the species in the river. The DO varied between 1.4 and 8.1 mg/L [186], in which certain sampling points had values of more than 4 mg/L, above the standard established by Supenah et al. (2015) as deduced by the organic contaminants predominant in pollution, especially domestic waste from household chores [201]. Lastly, the BOD values ranged between 5.9 and 20.8 mg/L [186], and the lower section of the river showed a maximum BOD of 20.8 mg/L, relatively higher than the standards. According to Widodo et al. [202], the BOD of water is important in measuring the amount of available oxygen needed by organisms to break down organic matter under aerobic conditions. The greatest BOD content was located in the lower section of the stream, which could be due to pollution from organic waste associated with the close-to-high level of nitrate, which varied between 1.7 and 9.2 mg/L, as well as the moderate level of phosphate, which varied between 0.4 and 1.2 mg/L [186].

3.4. Vietnam

In Vietnam, the studies that had been conducted to investigate the impact of microplastics pollution on marine environments were limited. One of the impacts is ingestion by clams, wherein clams collected from the Ban Sen community showed the presence of microplastics that amounted to a range between 0.25 ± 0.16 and a maximum of 0.67 ± 2.98 items per clam [203]. Ban Sen contains roughly 150 families and about 2.6 million clam cages, where, in 2020, roughly 2.250 tons of aquatic resources, including clams and oysters, were produced [203]. Based on two different sampling sites, Quang Ninh and Nam Dinh, the authors stated that juvenile clams from Quang Ninh contain a greater number of microparticles in their tissue compared to mature clams and vice versa at Nam Dinh [203]. The species has an abundance of pellet-shaped microplastics, contrasting with many studies conducted based on different environments where fibers and fragments are more prevalent.

This country is an attractive site for fishing and seafood sector growth [204]. Mollusks are significant trade and nutritional resource for the people in the country, contributing greatly to economic growth, and according to VASEP, mollusk cultivation in 2020 alone yielded an overall total of 375,000 tons. Oysters obtained from Da Nang growing bay accounted for 445 microplastics overall and an average amount of 18.54 ± 10.08 pieces per oyster sample [204]. The authors deduced that this abundance might be attributed to the generation of domestic waste, leading to shellfish capturing areas being highly polluted [204]. Da Nang is very much contaminated with microplastics in various environments, such as in drainage canals [109], street dust [108], and beaches [102]. Microplastics with fragmented shapes were located in the oysters [204] significantly more than fibers, which were predominantly seen in several studies in Da Nang, and it has been suggested that the limited specific surface area of the fragment-shaped particles could have caused them to settle and concentrate in deep waters [205], leading to a higher number of microplastics in oysters.

Polymer types, such as nylon and MUF, were identified in the oysters, and it was deduced that the greater density of these polymers could have led to them sinking into deep waters [204]. MUF is a prevalent thermoset resin for producing wood compounds as well as varnishes to enhance waterproofing [204]. Oysters are cultivated specifically around seaside regions in structures dug into the seabed or on strings dangling on rafts, and these species are more susceptible to consuming small-sized particles that are deposited in freshwater in situations when there is insufficient feed for the oysters [204]. Additionally, in another bivalve analysis, the species showed roughly 2.60 pieces per bivalve, with a predominance of PP and polyester [206].

3.5. Iran

The presence of microplastic contamination in Iran has impacted waterbodies and terrestrial and atmospheric environments. Based on the water environment, one of the impacts was micro debris ingestion by fish species at a wetland called Anzali, which is located close to the Caspian Sea, which has a significant role in sustaining the welfare of the community through leisure and angling activities. The fish species captured from this wetland showed about 358 microplastics in the bodies of the species [207]. This area is contaminated with many different sources, including factory waste, crop waste, hospital wastewater, and dirty waterways, placing a severe strain on the wetland and eventually leading to microplastic contamination in the water. There are possibilities for the species to have unintentionally consumed substances that are present on plant surfaces, retained in sediment, or confined inside biofilm structures [207]. The fish species analyzed were omnivores, and such species might absorb microplastics through sediment or flora's exterior during consumption of benthic creatures, as the amount of debris is greater in sediments and showed a maximum value of 3690 items per kg of sediment in Anzali swamp [208].

Omnivores tend to retain particles in the stomach for lengthier periods of time, which may p result in a larger volume of micro debris in the digestive tracts of these species [207]. Furthermore, the stomachs of fish from the Karkheh basin, which is close to the Qarasu stream, a significant stream in the country of the Kermanshah metropolis that supplies water to farming areas, were contaminated with microparticles that varied between 1.5 and 15 pieces per fish with a predominance of fibers [209]. This is relatable as the Qarasu estuarine that connects to the waterways of the area is polluted with microplastics. Studies based on ingestion by crustaceans, shellfish, and other aquatic organisms are limited in Iran. Based on the terrestrial ecosystem, a soil specimen analysis conducted recently in Ahvaz town on urban and manufacturing soils showed microplastics that amounted to an overall count of 10,940 pieces [210]. Micro debris in topsoil could have impacted flora interactions with the topsoil by changing the morphology, liquid dynamics, and the biological growth of plants.

According to Nematollahi et al. [210], microparticles may influence the manner in which earthworms build their tunnels, leading to higher amounts of micro debris seeping into ground liquids. Ahvaz's atmospheric air contains microplastics that have been analyzed and shown in a recent study [130]; thus, air precipitation could have contributed considerably to transfer into soils from the town's urban as well as commercial sectors, leading to high amounts in deep soils [210]. In terms of the atmospheric environment, the direct impact of microplastic contamination in such an environment is human exposure, wherein the micro debris is located on the external parts of a human body. The impact of the atmospheric ecosystem was proven with the presence of micro debris found on the human skull, epidermis, hair strands, as well as hands and spittle, in a study conducted at a few locations in Iran [138]. A cumulative of 16,000 microparticles was found in which the male population had a greater count compared to the female population chosen for the research [138].

The prevalence of atmospheric particles, particularly fibers, was abundantly noticed on hair follicles, which was deduced to be a consequence of meteorological conditions that could influence the regional variations of microplastics on skulls and hair follicles [138]. It is assumed that Bushehr's humid climate could have encouraged the adherence of microplastics to the participants selected for the study [138]. Additionally, the utilization of helmets by men and head veils by Iranian women serve as primary settling sites for micro debris onto skull and hair follicles. The presence of microplastics in Iran's land dust, as well as airborne micro debris, is an emerging matter due to deposition onto the human body; thus, more studies have to be conducted in Iran to further explain the situation and its consequences.

3.6. Thailand

In Thailand, the environmental impact primarily relates to the marine environment, where ingestion by sea animals has been observed, yet limited research has been carried out in the country. One of the conducted studies was based on the blood of cockles as well as green mussels acquired from a few carefully chosen markets and rearing spots. In this study, the blood of the cockles retrieved from the rearing spot yielded fewer microplastics, 6 ± 1 pieces, compared to the market-purchased cockles, which yielded 11 ± 5 pieces per cockle, whereas green mussels also yielded similar results of 96 ± 19 for market-purchased and lower values of 11 ± 7 pieces per mussel from the rearing spots [211]. Approximately 193,000 tons of mollusk and an overall 21% brine aquaculture yield are delivered each year by green mollusks [212]. According to Tuan-Ta et al. [211], the increased quantity of microparticles in commercialized bivalves could be caused by pollution during wrapping and shipping from rearing areas to marketplaces [211].

Additionally, bivalves for sale may be polluted by precipitated atmospheric microplastics as the bivalves are presented for sale in an exposed area [213]; hence leading to more particles being observed at the marketplace than the rearing spots. Mussels are farmed using a variety of plastic equipment, including cords made of polypropylene and buckets comprising polyethylene, to assist in suspending the bivalve over the water's surface, whereas cockles are raised by employing a sowing cultivation approach, as cockles are prone to residing about 2 m inside of a mudflat via burying [211]. There was a predominance of fragments in the bivalves exposed to nylon located in the marketplace, which might be due to shipping and wrapping [211]. In addition, sessile invertebrates surfaced as a species that ingested microplastics, amounting to a maximum of 0.6 pieces per gram [214]. According to this study, the key elements that influenced the concentration of the micro debris consumed by sea creatures were the degree of contamination in the intertidal ecosystem and duration away from habitat spots as well as anthropogenically impacted places near beachfronts [214].

One of the spots where invertebrate samples were collected was Angsila, which appeared to have improper management measures enforced to handle plastic contamination, and as a result, economic shellfish and fish cultivation techniques have been negatively impacted in the region, eventually leading to an increased buildup of microplastics [214]. Mussels and clams that have ingested microplastics were collected from Bandon Bay with water flowing from the Tapi-Phumduang stream with a prevalence of fibers and fragments inside the tissue specimens of both the species. This is in line with the predominance of microplastic shapes discovered in the top water and deep sediment acquired from the Bandon environment [150]. This bay is a significant mariculture area for its abundance of commercially valuable shellfish [150], and it has been suggested that stream release combined with ocean practices, such as angling and mariculture, could be a crucial source and channel for microparticles to access Bandon Bay. Furthermore, at Songkhla, prawn and catfish, which are popular foods in the area, were acquired, and the abdomen of these species contained a total of roughly 172 microparticles, extracted with a predominance of fiber-shaped forms [215].

Catfish are known to be a benthic species that dwells inside Songkhla pond and are widely distributed during the monsoon period until the end of the period, whereas yellow shrimp are distributed in the outer part of the pond nearly year-long [215]. Prawns have commercial importance, notably at this pond, where there is a high demand from marketplaces and surrounding nations, such as Malaysia and Singapore, due to their excellent flavor, delicate shells, and suitability for a variety of cuisines [215]. The authors predicted that amid the COVID-19 pandemic, the majority of workers remained at home, which could have led to more frequent laundry, removing extra fibers, which then infiltrate drains, canals, and ponds, polluting ground and ocean animals [215]. The polyester polymer type could have arisen from the cleaning of face covers made of fabric, whereas rayon may be derived via laundry-generated garment lint. Moreover, it is possible that pieces of shattered angling nets would float and gather on the sea surface at the outflow of the pond, eventually flowing into the Gulf of Thailand [215].

Due to high waves, liquid from the ocean in the Gulf of Thailand would access Songkhla Lake via the pond's opening, and vice versa, the situation occurs in the mid of lesser tides [215], leading to microplastic contamination in the Gulf of Thailand. Sating Phra Division, situated close to the lower bay of Thailand, is among the fastest-growing regions in terms of commercial expansion, and microplastic ingestion in demersal as well as pelagic types of fish was demonstrated [216]. The abdomens of demersal species showed a little larger mean count of microplastic, amounting to 5.41 particles per gram compared to pelagic fish, which exhibited a mean count of 4.61 particles per gram, and the author deduced that this occurrence could be the result of abundant polymer waste present on the surface water of the sea [216]. Owing to the firmness and nature of plastic, the majority of polymer waste tends to float on water top, wherein pelagic species could misinterpret plastic as feed for consumption. After reaching the sea, polymers tend to remain at the top layer of the seawater for a specific amount of time before disintegrating into smaller shards and moving to different trophic zones in the sea, including the center zone and, eventually, to deeper zones of water. Hence, the above has become a leading cause for the abundance of microplastics in pelagic fish abdomens.

3.7. Philippines

The impact on the environment in the Philippines mainly relates to marine environments. Based on the marine environment, ingestion by aquatic species is prominent in the Philippines. Market fish species obtained from Cebu islet consumed microparticles that came to an overall count of 635 particles from 81 species, with over a 90% predominance of fiber pieces [217]. According to the authors, the area of study is crowded with a high number of people, approximately 1.68 million people compared to other towns within the country [217], which may have led to micro debris pollution in the area. In another study based on the same island, whale shark excrement contained a count of 393 microparticles, with larger amounts of fragments shape and the PP plastic polymer group [218]. The imperiled whale shark could devote about 7.5 h daily eating at the top level of the water, which permits the species to filter roughly 326, 000 L of water every hour [219]. In addition, whale sharks can effectively consume small particulates, notably fish larvae via cross-flow screening (Motta et al., 2010 [219]) and hence potentially also consume microplastics.

Whale sharks that feed at the top level of waters in Cebu could have potentially consumed roughly 14, 000 microplastics daily [218], presuming seawater filter efficiency is 326, 000 L per hour and an average of 7.5 h daily devoted to eating at the top level of the water [219]. In addition, microparticles were observed in cultivated green mussels that varied between 0.27 and 0.41 pieces per gram at Bacoor Cove. This bay has a thriving mussel market and is regarded as being among the country's leading mussel growers [220]. Fibers were most counted supposedly due to the widespread usage of PP cords used by numerous mussel growers at the bay, whereas the subsequent prevalence of fragments can possibly be related to the utilization of readily compostable polymer bags made from oxo-biodegradable PE [220]. Additionally, based on oyster analysis in the country from three different locations, 11.8 pieces in an oyster were extracted recently [221], which is in line with another study conducted at the Bombong estuarine, where about 40 small particles were extracted from oysters grown in the aquaculture spot.

The microplastic shapes observed in green mussels were also found in the oyster specimens. In addition, many different fish species have been shown to have ingested microparticles from the aquatic environment; the occurrence of microplastics are also found in rabbitfish and mullets, which contained 85 and 33 pieces in their bodies, as obtained from different areas of East Visayas [222]; an abundance of 97 microplastics in the gastroenteric of all rabbitfish species taken from the Tanon Strait [223] and Negros. This observation of similar fish species showed an ingestion of 0.6 pieces per species [162]. Rabbitfish have been analyzed in many studies, as this species is among the main fish that are highly consumed by the people in the country due to the flavor and rich protein content of the species. Mullets consume sand as well as dirt along with tiny algae or natural substances [222], causing the species to have high chances of ingesting microplastics that are under intertidal strata as mullets are known as benthic creatures [224]. Angling is a leading sector, with a mean intake level of roughly 40 kg of fish or derivatives from the species by an individual yearly, leading the Philippines to be the largest worldwide in these terms [225].

As rabbit fish species are deep water consumers, the species have the potential to persistently intake significant amounts of microparticles in situations of over-exploitation of coastal habitats, notably excessive clearing of algae as well as the constant dumping of polymer into waters [223]. Additionally, habitat splitting occurs frequently among rabbit fish that shares the same resources [226]; therefore, they could be susceptible to different microplastics, as rabbit fish have such an ecological approach. In addition, "sardinella lemuru", commonly called sardine, are a significant aquatic food resource in the country, and those primarily caught offshore are filled with microplastics in the abdomen of the species, amounting to 2238 pieces from 600 species collected [227]. This important fishing area yields roughly 50 to 60 percent of the overall yearly output, which is then converted into products, such as canned or bottled sardines [227]. The high presence of microparticles in sardines from different areas in Northern Mindanao was explained by the magnitude of the human population, which could be the reason, as in this study, the overall number of microplastic consumed by the species substantially correlated with the number of people living close to the collection areas [227].

4. Summary of Study

Microplastic contamination is prevalent in all South Asian countries. In summary, based on the coastal environment, fiber and films were more commonly observed in coastal studies in Bangladesh and the Philippines and, in contrast, fibers and smaller amounts of fragments were observed in India, Indonesia, Iran, and Thailand. The common polymers detected in coastal areas are rayon, nylon, PVC, HDPE, LDPE, polyester, and PP based on the seven countries. For beach areas, fibers, fragments, foams, and pellets were located in Bangladesh, India, Vietnam, Iran, and Thailand, all studies where PP, PE, PS, EPS, and PET polymer forms were discovered. In terms of river environments, Bangladesh, Indonesia, and Iran showed primarily fiber polymers, whereas Thailand and Vietnam have a subsequent abundance of fragments, and the Philippines is the sole country that has additional shapes of microplastics, such as films, pellets, and lines in the streams. The polymer types predominantly located in river streams were PP, PE, polyester, LDPE, and PS in all six South Asian countries. Based on lake and wetland specimen analysis involving water and sediments, the prominent shapes of fibers, films, and pellets were observed with HDPE, PVC, and PP polymer types in Bangladesh, Vietnam, and Iran, whereas Indonesian bay environments were characterized by foam, followed by fragments, which contrasts with the detection of microplastics in Iran, Thailand, and the Philippines that exhibited fragment dominance, followed by fiber and pellet shapes. In all four of these countries, the polymer types in the bay are PE, PET, PP, and PS. Mangrove area specimens in Vietnam showed fiber dominance with larger sizes, contrasting to the findings in Indonesia that yielded foam and fragments smaller than 1000 μm; however, the polymer types were identical in both countries, with PE, PP, and PS. Watershed analysis in Vietnam and the Philippines showed common polymers of PP, PE, and PET in the shapes of fibers and fragments. Based on the estuarine environment, fiber is the most dominant shape and is mostly below 1 mm in size of polyester, PP, LDPE, and PE in India, Indonesia, Iran, and Thailand. In all the studies conducted based on the seven South Asian countries, the microplastics range in size between 100 μm and 5000 μm, with the majority having a size below 1000 μm. Fibers are commonly observed in every country and are mainly related to household launder waste as well as wearing off of garments, leading to the accumulation of fiber-shaped microplastics, and another contributing factor is the higher population in the area, which could create more launder effluents.

In addition, in every country, polyethylene was observed, where PE and PP are known to be in plastic products, such as plastic bags, bottles, wrappers, and more items. The high utilization and improper disposal of plastics made up of PE or PP polymer leads to the accumulation of microplastics, as plastics are not naturally biodegradable products, and these plastics tend to degrade due to high UV or climate-induced reasons. Additionally, aquaculture-related activities, mainly fishing, lead to the generation of microplastics of different forms in most of the South Asian countries reviewed in this study. Moreover, microplastics tend to further disintegrate into smaller sizes, as low as 300 μm, which is a result of aging and wear brought about by environmental factors as well as hydrodynamic fluctuations. One of the reasons for the accumulation of microplastics in huge water environments such as seas, bays or coastal areas is due to the influx of water from rivers, lakes, waterways, or canals, which are already contaminated with microplastics. In terms of the current conditions of microplastics in South Asian countries, the main environments that are highly contaminated are water-based places, such as rivers, estuarine, beaches, and seas, as the transfer of microplastic to water environments is easy due to air movement and rainfall. Moreover, a few food items that are commonly utilized, such as sugar, teabags, shrimp paste, and salts, have been contaminated with microplastics based on recent research conducted in some of the countries.

In brief, the condition of microplastics in each South Asian country relates to the abundance of microplastics found in various environments as well as the presence of microplastics in the food and air. The main environments that are highly contaminated are water-based places, such as rivers, estuarine, beaches, and seas, as the transfer of microplastic to water-based places is easy due to air movement and rainfall. The majority of the countries reviewed were characterized by the presence of microplastics in food items, such as tea bags, sugar, and, notably, salt packets. Microplastics have also been present in the atmosphere in a few countries, such as Indonesia, Iran, and Vietnam. The presence of microplastics in the air leads to the settling of these particles in various areas, such as classrooms and indoor buildings as well as being carried by snow particles and dust. In terms of the impacts on the environment, every South Asian country has been affected in the marine environment, where ingestion by aquatic life has been widely observed, such as in shrimp, oysters, clams, mussels, and fish, wherein this ingestion by seafood species could be a vulnerable pathway for human exposure to microplastics.

5. Future Works

The Sustainable Development Goals (SDGs), global goals that are a set of separate but interrelated objectives precisely crafted to provide everyone on Earth a brighter future, comprising numerous milestones and evaluation markers focused toward 2030. The purpose of Sustainable Development is to promote progress that meets current requirements without affecting the resource supply of subsequent generations [228]. Two Sustainable Development Goals that can be related to this study are SDG 6, clean water and sanitation, and SDG 14, for water-based life. As the microplastics issue is highly concerning in terms of water-based environments, achieving both SDGs is highly important. Accessibility to clean water and sanitation, as well as the sustainable maintenance of freshwater supply, are crucial, and they relate to Sustainable Development Goal 6 in that they boost economic output and act as powerful multipliers for newly made expenditures in healthcare and for educational purposes [229]. In terms of SDG 14, this goal focuses on the protection and appropriate utilization of marine resources. According to GSMA [230], by 2100, a roughly 100 to 150 percent increase in acidity could occur, causing damage to over 50% of aquatic species and, in 2050, it is predicted that plastics could be higher in number than fish species present in oceans.

One of the targets of SDG 14 is to minimize and eliminate marine contamination by inhibiting and drastically decreasing all forms of marine contamination, especially that caused by land-based practices, such as fertilizer pollution and ocean waste disposal by 2025 [230]. Moreover, one of the targets of SDG 6 is to enhance water purity by 2030 by decreasing contamination, stopping dumping, limiting the discharge of dangerous chemicals and substances, lowering the amount of unprocessed wastewater as well as vastly expanding recovery and ethical reusing worldwide [229]. Hence, to achieve the aim of SDG 6 and SDG 14, rapid measures should be taken through the implementation of new and advanced rules related to plastic utilization, and more efficient water processing facilities as microplastic contamination from plastics is becoming more prevalent. Persistent improper disposals may cause more microplastic to be generated, and thus, more efficient disposal systems and facilities must be developed, and greater attention has to be given to developing and developed countries to prevent more accumulation and dispersion of these microplastic to food and other environments. Higher enforcement of plastic usage policies with stricter laws is needed, as the increased usage of plastic will cause many folds of microplastic generation. In order to minimize fiber abundance, the innovation of good microplastic-filtrating systems in laundry machines could possibly be a promising way to reduce fiber microplastics from residential areas, as fibers were prominently noticed in every South Asian country viewed in this study, and the addition of extra processing or filtration systems in purification facilities to remove other forms of microplastics. The characterization of microplastics in South Asian countries and the current condition of microplastic pollution, and the impacts on the environment, were researched in this study. Regarding the current conditions, the presence of microplastics in the food chain was mainly observed in salt, sugar, tea bags, and many more food items in certain South Asian Countries. Wide research has to be conducted regarding the microplastics found in food and beverage items in South Asian Countries to locate the possible routes of the microplastics to food and beverage goods as well as the potential consequences to humans due to the ingestion of food and beverages contaminated with microplastics. Microplastic contamination in the human body must be studied to better understand the level of dispersion of microplastics.

Author Contributions: Conceptualization, L.T.S. and S.-T.B.; writing—original draft preparation, V.B.; writing—review and editing, L.T.S., S.-T.B. and S.-L.B.; supervision, L.T.S.; project administration, S.-T.B. and S.-L.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Universiti Tunku Abdul Rahman Internal Funding 6251-B04.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

µm	micrometer
mm	millimeter
cm	centimeter
kg	kilogram
MMT	Million Metric Tons
AR	Awano River
AsR	Asa River
AyR	Ayaragi River
MR	Majime River
EPS	Expanded Polystyrene
PAN	Polyacrylonitrile
PDAP	Polydiallyl phthalate
PE	Polyethylene
PET	Polyethylene terephthalate
PES	Polyester
PMMA	Polymethyl methacrylate
PS	Polystyrene
PTFE	Polytetrafluoroethylene
PP	Polypropylene
PVA	Polyvinyl alcohol
PVC	Polyvinyl chloride
SIS	Seto Inland Sea
SJ	Sea of Japan
HDPE	High Density Polyethylene
CA	Cellulose Acetate
LMP	Large Microplastics
SMP	Small Microplastics
ABS	Acrylonitrile Butadiene Styrene
PPE	Personal Protective Equipment

References

1. Abbasi, S.; Jaafarzadeh, N.; Zahedi, A.; Ravanbakhsh, M.; Abbaszadeh, S.; Turner, A. Microplastics in the atmosphere of Ahvaz City, Iran. *J. Environ. Sci.* **2023**, *126*, 95–102. [CrossRef] [PubMed]
2. Weldon, N.A. Chapter 8-The Environmental Impacts of Plastic Pollution. 2020. Available online: https://www.sciencedirect.com/science/article/pii/B9780128178805000086 (accessed on 31 January 2022).
3. Wang, Y.; Zou, X.; Peng, C.; Qiao, S.; Wang, T.; Yu, W.; Khokiattiwong, S.; Kornkanitnan, N. Occurrence and distribution of microplastics in surface sediments from the Gulf of Thailand. *Mar. Pollut. Bull.* **2020**, *152*, 110916. [CrossRef] [PubMed]
4. Rogers, K. "Microplastics". Encyclopedia Britannica. 2020. Available online: https://www.britannica.com/technology/microplastic (accessed on 31 January 2022).
5. Chatziparaskeva, G.; Papamichael, I.; Zorpas, A.A. Microplastics in the coastal environment of Mediterranean and the impact on sustainability level. *Sustain. Chem. Pharm.* **2022**, *29*, 100768. [CrossRef]
6. Gkatzioura, A.; Zafirakou, A.; Zorpas, A.A. Wastewater treatment plants' contribution in microplastics' contamination of surface water. Effluent concentration and detection techniques review. *Desalination Water Treat.* **2021**, *227*, 26–33. [CrossRef]
7. Loizia, P.; Voukkali, I.; Chatziparaskeva, G.; Navarro-Pedreño, J.; Zorpas, A. Measuring the Level of Environmental Performance on Coastal Environment before and during the COVID-19 Pandemic: A Case Study from Cyprus. *Sustainability* **2021**, *13*, 2485. [CrossRef]
8. Patterson, J.; Jeyasanta, K.I.; Sathish, N.; Booth, A.M.; Edward, J.P. Profiling microplastics in the Indian edible oyster, *Magallana bilineata* collected from the Tuticorin coast, Gulf of Mannar, Southeastern India. *Sci. Total. Environ.* **2019**, *691*, 727–735. [CrossRef]
9. Kim, H.; Lee, J.-Y. Emerging Concerns about Microplastic Pollution on Groundwater in South Korea. Microplastics-Macro Challenge for Environmental Sustainability. 2020. Available online: https://www.mdpi.com/2071-1050/ (accessed on 1 February 2022).
10. Sebille, E.V.; Wilcox, C.; Lebreton, L.; Maximenko, N.; Hardesty, B.D.; Franeker JA, V.; Eriksen, M.; Siegel, D.; Galgani, F.; Law, K.L. A global inventory of small floating plastic debris. *Environ. Res. Lett.* **2015**, *10*, 124006. Available online: https://www.researchgate.net/publication/286243165_A_global_inventory_of_small_floating_plastic_debris (accessed on 31 January 2022). [CrossRef]
11. Dowarah, K.; Devipriya, S.P. Microplastic prevalence in the beaches of Puducherry, India and its correlation with fishing and tourism/recreational activities. *Mar. Pollut. Bull.* **2019**, *148*, 123–133. [CrossRef]

12. Irfan, M.; Qadir, A.; Mumtaz, M.; Ahmad, S.R. An unintended challenge of microplastic pollution in the urban surface water system of Lahore, Pakistan. *Env. Sci. Pollut. Res.* **2020**, *27*, 16718–16730. Available online: https://www.researchgate.net/publication/339704099_An_unintended_challenge_of_microplastic_pollution_in_the_urban_surface_water_system_of_Lahore_Pakistan (accessed on 25 March 2022). [CrossRef] [PubMed]
13. Ahmed, Q.; Ali, Q.M.; Bat, L.; Oztekin, A.; Memon, S.; Baloch, A. Preliminary Study on Abundance of Microplastic in Sediments and Water Samples along the Coast of Pakistan (Sindh and Balochistan)-Northern Arabian Sea. *Turk. J. Fish. Aquat. Sci.* **2021**, *22*, TRJFAS19998. Available online: https://www.trjfas.org/uploads/pdf_14866.pdf (accessed on 26 March 2022). [CrossRef]
14. Business Recorder. World Economy and Business, Aug 2016, pg 11. Available online: epaper.brecorder.com/2016/08/18/11---page/784169-news.html (accessed on 25 March 2022).
15. Isobe, A. Percentage of mcirobeads in pelagic microplastics within Japanese coastal waters. *Mar. Pollut. Bull.* **2016**, *110*, 432–437. [CrossRef] [PubMed]
16. Pan, Z.; Guo, H.; Chen, H.; Wang, S.; Sun, X.; Zou, Q.; Zhang, Y.; Lin, H.; Cai, S.; Huang, J. Microplastics in the Northwestern Pacific: Abundance, distribution, and characteristics. *Sci. Total. Environ.* **2019**, *650*, 1913–1922. [CrossRef]
17. Oteef, M.D.Y.; Elhassan, M.S. Plastic toys and child care articles as a source of children exposure to phthalates and other plasticisers in Saudi Arabia. *Int. J. Environ. Anal. Chem.* **2020**, *102*, 4316–4330. Available online: https://www.tandfonline.com/doi/abs/10.1080/03067319.2020.1784407 (accessed on 25 March 2022). [CrossRef]
18. Alharbi, N.S.; Qattan, M.Y.; Alhaji, J.H. Towards Sustainable Food Services in Hospitals Exapnding the Concept of 'Plate Waste' to 'Tray Waste'. *Sustainability* **2020**, *12*, 6872. Available online: https://www.mdpi.com/2071-1050/12/17/6872 (accessed on 15 February 2022). [CrossRef]
19. Ouda, O.K.M.; Raza, S.A.; Nizami, A.S.; Rehan, M.; Al-Waked, R.; Korres, N.E. Waste to energy potential: A case study of Saudi Arabia. *Renew. Sustain. Energy Rev.* **2016**, *61*, 328–340. [CrossRef]
20. Alam, F.C.; Sembiring, E.; Muntalif, B.S.; Suendo, V. Microplastic distribution in surface water and sediment river around slum and industrial area (case study: Ciwalengke River, Majalaya district, Indonesia). *Chemosphere* **2019**, *224*, 637–645. [CrossRef]
21. Anjum, M.; Miandad, R.; Waqas, M.; Ahmad, I.; Alafif, Z.O.A.; Aburizaiza, A.; Barakat, M.; Akhtar, T. Solid waste management in Saudi Arabia: A review. *J. Sci. Food Agric.* 2016. Available online: https://www.researchgate.net/publication/303348044_Solid_waste_management_in_Saudi_Arabia_A_review (accessed on 20 March 2022).
22. Pico, Y.; Soursou, V.; Alfarhan, A.H.; El-Sheikh, M.A.; Barcelo, D. First evidence of microplatics occurance in mixed surface and treated wastewater from two major Saudi Arabian cities and assessment of their acological risk. *J. Haz-Ardous Mater.* **2021**, *416*, 125747. [CrossRef] [PubMed]
23. Al-Lihaibi, S.; Al-Mehmadi, A.; Alarif, W.M.; Bawakid, N.; Kallenborn, R.; Ali, A.M. Microplastics in Sediments and Fish from the Red Sea Coast at Jeddah (Saudi Arabia). Environemental Chemistry. 2019. Available online: https://www.researchgate.net/publication/336576075_Microplastics_in_sediments_and_fish_from_the_Red_Sea_coast_at_Jeddah_Saudi_Arabia (accessed on 29 March 2022).
24. Woodward, R.T.; Wui, Y.S. The economic value of wetland services: A meta-analysis. *Ecol. Econ.* **2001**, *37*, 257–270. [CrossRef]
25. Eriksen, M.; Mason, S.; Wilson, S.; Box, C.; Zellers, A.; Edwards, W.; Farley, H.; Amato, S. Microplastic pollution in the surface waters of the Laurentian Great Lakes. *Mar. Pollut. Bull.* **2013**, *77*, 177–182. [CrossRef]
26. Driedger, A.G.; Dürr, H.H.; Mitchell, K.; Van Cappellen, P. Plastic debris in the Laurentian Great Lakes: A review. *J. Great Lakes Res.* **2015**, *41*, 9–19. [CrossRef]
27. Floehr, T.; Xiao, H.; Starke, S.B.; Wu, L.; Hou, J.; Yin, D.; Zhang, X.; Ji, R.; Yuan, X.; Ottermanns, R. Solution by dilution?—A review on the pollution status of the Yangtze River. *Environ. Sci. Pollut. Res.* **2013**, *20*, 6934–6971. Available online: https://pubmed.ncbi.nlm.nih.gov/23608976/ (accessed on 16 June 2022).
28. Ismail, N.S.; Müller, C.E.; Morgan, R.R.; Luthy, R.G. Uptake of Contaminants of Emerging Concern by the Bivalves *Anodonta californiensis* and *Corbicula fluminea*. *Environ. Sci. Technol.* **2014**, *48*, 9211–9219. Available online: https://pubmed.ncbi.nlm.nih.gov/25017714/ (accessed on 16 June 2022). [CrossRef]
29. Wong, T.; Geiger, W. Adaptation of wastewater surface flow wetland formulae for application in constructed stormwater wetlands. *Ecol. Eng.* **1997**, *9*, 187–202. [CrossRef]
30. Hossain, J.; AftabUddin, S.; Akhter, F.; Nusrat, N.; Rahaman, A.; Sikder, M.N.A.; Monwar, M.; Chowdhury, M.S.N.; Jiang, S.; Shi, H.; et al. Surface water, sediment, and biota: The first multi-compartment analysis of microplastics in the Karnafully river, Bangladesh. *Mar. Pollut. Bull.* **2022**, *180*, 113820. [CrossRef] [PubMed]
31. Mercy, F.T.; Alam, A.K.M.R.; Akbor, M.A. Abundance and Characteristics of Microplastics in Major Urban Wetlands of Dhaka, Bangladesh. 2022. Available online: https://assets.researchsquare.com/files/rs-1455552/v1/eff (accessed on 16 June 2022).
32. Hossain, M.B.; Banik, P.; Nur, A.-A.U.; Rahman, T. Abundance and characteristics of microplastics in sediments from the world's longest natural beach, Cox's Bazar, Bangladesh. *Mar. Pollut. Bull.* **2020**, *163*, 111956. [CrossRef]
33. Banik, P.; Hossain, M.B.; Sun, J.; Choudhury, T.R.; Liba, S.I.; Yu, J.; Noman, A.; Nur, A.U. Microplastics in Sediment of Kuakata Beach, Bangladesh: Occurrence, Spatial Distribution, and Risk Assessment. Marine Science. 2022. Available online: https://www.researchgate.net/publication/359929908_Microplastics_in_Sediment_of_Kuakata_Beach_Bangladesh_Occurrence_Spatial_Distribution_and_Risk_Assessment (accessed on 16 June 2022).
34. Tajwar, M.; Shreya, S.S.; Gazi, Y.; Hasan, M.; Saha, S.K. Microplastic contamination in the sediments of the Saint Martin's Island, Bangladesh. *Reg. Stud. Mar. Sci.* **2022**, *53*, 102401. [CrossRef]

35. Rahman, S.M.A.; Robin, G.S.; Momotaj, M.; Uddin, J.; Siddique, M.A.M. Occurrence and spatial distribution of microplastics in beach sediments of Cox's Bazar, Bangladesh. *Mar. Pollut. Bull.* **2020**, *160*, 111587. [CrossRef] [PubMed]
36. Bhuyan, M.S.; Sharif, A.S.M.; Islam, M.S. Beach Pollution and Sustainable Tourism in the St. Martin's Island. *Glob. J. Environ. Res.* **2019**, *3*, 1–6. Available online: https://www.researchgate.net/publication/333998732_Beach_Pollution_and_Sustainable_Tourism_in_the_St_Martin\T1\textquoterights_Island (accessed on 16 June 2022).
37. Nor, N.H.M.; Obbard, J.P. Microplastics in Singapore's coastal mangrove ecosystems. *Mar. Pollut. Bull.* **2014**, *79*, 278–283. [CrossRef] [PubMed]
38. Yang, L.; Luo, W.; Zhao, P.; Zhang, Y.; Kang, S.; Giesy, J.P.; Zhang, F. Microplastics in the Koshi River, a remote alpine river crossing the Himalayas from China to Nepal. *Environ. Pollut.* **2021**, *290*, 118121. [CrossRef]
39. Hosseini, R.; Sayadi, M.H.; Aazami, J.; Savabieasfehani, M. Accumulation and distribution of microplastics in the sediment and coastal water samples of Chabahar Bay in the Oman Sea, Iran. *Mar. Pollut. Bull.* **2020**, *160*, 111682. [CrossRef]
40. Wu, F.; Wang, J.; Jiang, S.; Zeng, H.; Wu, Q.; Chen, Q.; Chen, J. Effect of cascade damming on microplastics transport in rivers: A large-scale investigation in Wujiang River, Southwest China. *Chemosphere* **2022**, *299*, 134455. [CrossRef] [PubMed]
41. Lebreton, L.-M.; Greer, S.; Borrero, J. Numerical modelling of floating debris in the world's oceans. *Mar. Pollut. Bull.* **2012**, *64*, 653–661. [CrossRef]
42. Environment and Social Development Association (ESDO). Microbeads! Unfold Health Risk and Environmental Pollutant. 2016. Available online: https://esdo.org/wp-content/uploads/Microbeads-final-report-10.11.16-1.pdf (accessed on 17 June 2022).
43. Browne, M.A.; Galloway, T.S.; Thompson, R.C. Spatial Patterns of Plastic Debris along Estuarine Shorelines. *Environ. Sci. Technol.* **2010**, *44*, 3404–3409. [CrossRef]
44. Thompson, R.C. Microplastics in the Marine Environment: Sources, Consequences and Solutions. In *Marine Anthropogenic Litter*; Springer: Berlin/Heidelberg, Germany, 2006; pp. 185–200.
45. Gazi, M.Y.; Mawsumi, T.J.; Ahmed, M.K. Detection of Coral Reefs Degradation using Geospatial Techniques around Saint Martin's Island, Bay of Bengal. *Ocean. Sci. J.* **2020**, *55*, 419–431. [CrossRef]
46. Meyers, R.A. Encyclopedia of Sustainability Science and Technology. 2020. Available online: https://link.springer.com/book/9781493927746 (accessed on 18 June 2022).
47. Afrin, S.; Rahman, M.; Hossain, N.; Uddin, K.; Malafaia, G. Are there plastic particles in my sugar? A pioneering study on the characterization of microplastics in commercial sugars and risk assessment. *Sci. Total. Environ.* **2022**, *837*, 155849. [CrossRef]
48. Afrin, S.; Rahman, M.; Akbor, A.; Siddique, A.B.; Uddin, K.; Malafaia, G. Is there tea complemented with the appealing flavor of microplastics? A pioneering study on plastic pollution in commercially available tea bags in Bangladesh. *Sci. Total. Environ.* **2022**, *837*, 155833. [CrossRef] [PubMed]
49. Rahman, M.S.; Khatun, S. Sugarcane and Sugar Industry in Bangladesh: An Overview. *Sugar Tech* **2016**, *18*, 627–635. Available online: https://link.springer.com/article/10.1007/s12355-016-0489-z (accessed on 19 June 2022). [CrossRef]
50. Saha, J.; Adnan, K.M.; Sarker, S.A.; Bunerjee, S. Analysis of growth trends in area, production and yield of tea in Bangladesh. *J. Agric. Food Res.* **2021**, *4*, 100136. [CrossRef]
51. Atlas Big, World Tea Production by Country. 2021. Available online: https://www.atlasbig.com/en-ie/countries-by-tea-production (accessed on 19 June 2022).
52. Helgi-Library. Sugar Consumption per Capita in Bangladesh. 2022. Available online: https://www.helgilibrary.com/indicators/sugar-consumption-per-capita/bangladesh/ (accessed on 19 June 2022).
53. Parvin, F.; Nath, J.; Hannan, T.; Tareq, S.M. Proliferation of microplastics in commercial sea salts from the world longest sea beach of Bangladesh. *Environ. Adv.* **2022**, *7*, 100173. [CrossRef]
54. Rakib, R.J.; Al Nahian, S.; Alfonso, M.B.; Khandaker, M.U.; Enyoh, C.E.; Hamid, F.S.; Alsubaie, A.; Almalki, A.S.A.; Bradley, D.A.; Mohafez, H.; et al. Microplastics pollution in salt pans from the Maheshkhali Channel, Bangladesh. *Sci. Rep.* **2021**, *11*, 23187. [CrossRef]
55. Uddin, R.; Hossain, M.; Akter, S.; Ali, M.E.; Ahsan, A. Assessment of some physicochemical parameters and determining the corrosive characteristics of the Karnaphuli estuarine water, Chittagong, Bangladesh. *Water Sci.* **2020**, *34*, 164–180. [CrossRef]
56. Hossain, M.S.; Islam, M.S.; Chowdhury, M.A.T. Shore Based Pollution Sources of the Karnafully River and the Effects of Oil-Grease on the Riverine Environment. *J. Geo-Environ.* **2005**, *5*, 55–66. Available online: https://www.researchgate.net/publication/235004579_Shore_Based_Pollution_Sources_of_the_Karnafully_River_and_the_Effects_of_Oil-Grease_on_the_Riverine_Environment (accessed on 19 June 2022).
57. Masum, M.M.H.; Riyad, S.I.; Riaz, R.R. Solid Waste Management in Chattogram City Corporation Area. *Solid Waste Manag.* 2018. Available online: https://www.researchgate.net/publication/329980487_SOLID_WASTE_MANAGEMENT_IN_CHATTOGRAM_CITY_CORPORATION_AREA (accessed on 19 June 2022).
58. Zaman, M.M.; Choudhury, S.R.; Ahmed, J.; Khandaker, R.K.; Rouf, M.A.; Malik, A. Salt Intake in an Adult Population of Bangladesh. *Glob. Heart* **2017**, *12*, 265–266. Available online: https://fp.brecorder.com/2016/10/2016101994395/ (accessed on 14 March 2022). [CrossRef]
59. Radhakrishnan, K.; Sivapriya, V.; Rajkumar, A.; Akramkhan, N.; Prakasheswar, P.; Krishnakumar, S.; Hussain, S. Characterization and distribution of microplastics in estuarine surface sediments, Kayamkulam estuary, southwest coast of India. *Mar. Pollut. Bull.* **2021**, *168*, 112389. [CrossRef]

60. Nithin, A.; Sundaramanickam, A.; Sathish, M. Seasonal distribution of microplastics in the surface water and sediments of the Vellar estuary, Parangipettai, southeast coast of India. *Mar. Pollut. Bull.* **2021**, *174*, 113248. [CrossRef] [PubMed]
61. Venkatramanan, S.; Chung, S.; Selvam, S.; Sivakumar, K.; Soundhariya, G.; Elzain, H.E.; Bhuyan, S. Characteristics of microplastics in the beach sediments of Marina tourist beach, Chennai, India. *Mar. Pollut. Bull.* **2022**, *176*, 113409. [CrossRef]
62. Yaranal, N.A.; Subbiah, S.; Mohanty, K. Distribution and characterization of microplastics in beach sediments from Karnataka (India) coastal environments. *Mar. Pollut. Bull.* **2021**, *169*, 112550. [CrossRef]
63. Patchaiyappan, A.; Ahmed, S.Z.; Dowarah, K.; Jayakumar, S.; Devipriya, S.P. Occurrence, distribution and composition of microplastics in the sediments of South Andaman beaches. *Mar. Pollut. Bull.* **2020**, *156*, 111227. [CrossRef]
64. Patchaiyappan, A.; ZakiAhmed, S.; Dowarah, K.; Khadanga, S.S.; Singh, T.; Jayakumar, S.; Thirunavukkarasu, C.; Devipriya, S.P. Prevalence of microplastics in the sediments of Odisha beaches, southeastern coast of India. *Mar. Pollut. Bull.* **2021**, *167*, 112265. [CrossRef]
65. Patchaiyappan, A.; Dowarah, K.; Ahmed, S.Z.; Prabakaran, M.; Jayakumar, S.; Thirunavukkarasu, C.; Devipriya, S.P. Prevalence and characteristics of microplastics present in the street dust collected from Chennai metropolitan city, India. *Chemosphere* **2020**, *269*, 128757. [CrossRef]
66. Thomas, E.M. *HVAC Principles and Applications Manual: Technology & Engineering*; McGraw-Hill Education: Berkshire, UK, 1998; p. 288.
67. Geyer, R.; Jambeck, J.R.; Law, K.L. Production, use, and fate of all plastics ever made. *Sci. Adv.* **2017**, *3*, e1700782. [CrossRef] [PubMed]
68. Ranjani, M.; Veerasingam, S.; Venkatachalapathy, R.; Mugilarasan, M.; Bagaev, A.; Mukhanov, V.; Vethamony, P. Assessment of potential ecological risk of microplastics in the coastal sediments of India: A meta-analysis. *Mar. Pollut. Bull.* **2021**, *163*, 111969. [CrossRef] [PubMed]
69. Joshi, R.; Ahmed, S. Status and challenges of municipal solid waste management in India: A review. *Cogent Environ. Sci.* **2016**, *2*, 1139434. [CrossRef]
70. Khan, H.S.; Setu, S. Microplastic Ingestion by Fishes from Jamuna River, Bangladesh. *Environ. Nat. Resour. J.* **2022**, *20*, 1–11. [CrossRef]
71. Jambeck, J.R.; Geyer, R.; Wilcox, C.; Siegler, T.R.; Perryman, M.; Andrady, A.; Narayan, R.; Law, K.L. Plastic waste inputs from land into the ocean. *Science* **2015**, *347*, 768–771. [CrossRef]
72. Kumar, V.E.; Ravikumar, G.; Jeyasanta, K.I. Occurrence of microplastics in fishes from two landing sites in Tuticorin, South east coast of India. *Mar. Pollut. Bull.* **2018**, *135*, 889–894. [CrossRef]
73. Yadav, H.; Sethulekshmi, S.; Shriwastav, A. Estimation of microplastic exposure via the composite sampling of drinking water, respirable air, and cooked food from Mumbai, India. *Environ. Res.* **2022**, *214*, 113735. [CrossRef]
74. Sathish, M.N.; Jeyasanta, I.; Patterson, J. Microplastics in Salt of Tuticorin, Southeast Coast of India. *Arch. Environ. Contam. Toxicol.* **2020**, *79*, 111–121. [CrossRef]
75. Sathish, M.N.; Jeyasanta, I.; Patterson, J. Occurrence of microplastics in epipelagic and mesopelagic fishes from Tuticorin, Southeast coast of India. *Sci. Total. Environ.* **2020**, *720*, 137614. [CrossRef]
76. Seth, C.K.; Shriwastav, A. Contamination of Indian sea salts with microplastics and a potential prevention strategy. *Environ. Sci. Pollut. Res.* **2018**, *25*, 30122–30131. [CrossRef]
77. Vidyasakar, A.; Krishnakumar, S.; Kumar, K.S.; Neelavannan, K.; Anbalagan, S.; Kasilingam, K.; Srinivasalu, S.; Saravanan, P.; Kamaraj, S.; Magesh, N. Microplastic contamination in edible sea salt from the largest salt-producing states of India. *Mar. Pollut. Bull.* **2021**, *171*, 112728. [CrossRef] [PubMed]
78. Sivagami, M.; Selvambigai, M.; Devan, U.; Velangani, A.A.J.; Karmegam, N.; Biruntha, M.; Arun, A.; Kim, W.; Govarthanan, M.; Kumar, P. Extraction of microplastics from commonly used sea salts in India and their toxicological evaluation. *Chemosphere* **2020**, *263*, 128181. [CrossRef] [PubMed]
79. Bharath, M.; Natesan, U.; Ayyamperumal, R.; Kalam, N.; Muir, D.; Manikandabharath, K.R.; Srinivasalu, S. Microplastics as an emerging threat to the freshwater ecosystems of *Veeranam lake* in south India: A multidimensional approach. *Chemosphere* **2021**, *264*, 128502. [CrossRef] [PubMed]
80. The Indian Exspress. 'Microplastics in Tap Water': Goa Says Drinking Water Safe. 13 August 2021. Available online: https://indianexpress.com/article/india/microplastics-in-tap-water-goa-says-drinking-water-safe-7451311/ (accessed on 23 June 2022).
81. The Times of India. Microplastics Found in Goa's Tap Water, Reveals Study. 11 August 2021. Available online: https://timesofindia.indiatimes.com/city/goa/microplastics-found-in-goas-tap-water-reveals-study/articleshow/85249794.cms (accessed on 23 June 2022).
82. The Hindustan Times. Tap Water in Goa Contains Potentially Hazardous Microplastics: Study. 12 August 2021. Available online: https://www.hindustantimes.com/india-news/tap-water-in-goa-contains-potentially-hazardous-microplastics-study-101628743834050.html (accessed on 23 June 2022).
83. Joy, J.; Kanga, S.; Singh, S.K. Kerala Flood 2018: Flood Mapping by Participatory GIS Approach. *Meloor Panchayat* **2019**, *10*, 197–205. Available online: https://www.researchgate.net/publication/334508520_Kerala_Flood_2018_Flood_Mapping_by_Participatory_GIS_approach_Meloor_Panchayat (accessed on 23 June 2022).
84. Daniel, D.B.; Ashraf, P.M.; Thomas, S.N. Impact of 2018 Kerala flood on the abundance and distribution of microplastics in marine environment off Cochin, Southeastern Arabian Sea, India. *Reg. Stud. Mar. Sci.* **2022**, *53*, 102367. [CrossRef]

85. Cordova, M.R.; Ulumuddin, Y.I.; Purbonegoro, T.; Puspitasari, R.; Afianti, N.F.; Rositasari, R.; Yogaswara, D.; Hafizt, M.; Iswari, M.Y.; Fitriya, N.; et al. Seasonal heterogeneity and a link to precipitation in the release of microplastic during COVID-19 outbreak from the Greater Jakarta area to Jakarta Bay, Indonesia. *Mar. Pollut. Bull.* **2022**, *181*, 113926. [CrossRef]
86. Falahudin, D.; Cordova, M.R.; Sun, X.; Yogaswara, D.; Wulandari, I.; Hindarti, D.; Arifin, Z. The first occurrence, spatial distribution and characteristics of microplastic particles in sediments from Banten Bay, Indonesia. *Sci. Total. Environ.* **2019**, *705*, 135304. [CrossRef]
87. Cordova, M.R.; Purwiyanto, A.I.S.; Suteja, Y. Abundance and characteristics of microplastics in the northern coastal waters of Surabaya, Indonesia. *Mar. Pollut. Bull.* **2019**, *142*, 183–188. [CrossRef]
88. Lestari, P.; Trihadiningrum, Y.; Wijaya, B.A.; Yunus, K.A.; Firdaus, M. Distribution of microplastics in Surabaya River, Indonesia. *Sci. Total. Environ.* **2020**, *726*, 138560. [CrossRef]
89. Natsir, M.F.; Selomo, M.; Ibrahim, E.; Arsin, A.A.; Alni, N.C. Analysis on microplastics in dug wells around Tamangapa Landfills, Makassar City, Indonesia. *Gac. Sanit.* **2021**, *35*, S87–S89. [CrossRef]
90. Cordova, M.R.; Ulumuddin, Y.I.; Purbonegoro, T.; Shiomoto, A. Characterization of microplastics in mangrove sediment of Muara Angke Wildlife Reserve, Indonesia. *Mar. Pollut. Bull.* **2021**, *163*, 112012. [CrossRef] [PubMed]
91. Firdaus, M.; Trihadiningrum, Y.; Lestari, P. Microplastic pollution in the sediment of Jagir Estuary, Surabaya City, Indonesia. *Mar. Pollut. Bull.* **2020**, *150*, 110790. [CrossRef] [PubMed]
92. Azizi, A.; Setyowati, W.N.; Fairus, S.; A Puspito, D.; Irawan, D.S. Microplastic pollution in the sediment of Jakarta Bay, Indonesia. *IOP Conf. Series Earth Environ. Sci.* **2021**, *930*, 012010. [CrossRef]
93. Suteja, Y.; Atmadipoera, A.S.; Riani, E.; Nurjaya, I.W.; Nugroho, D.; Cordova, M.R. Spatial and temporal distribution of microplastic in surface water of tropical estuary: Case study in Benoa Bay, Bali, Indonesia. *Mar. Pollut. Bull.* **2021**, *163*, 111979. [CrossRef]
94. Cordova, M.R.; Nurhati, I.S. Major sources and monthly variations in the release of land-derived marine debris from the Greater Jakarta area, Indonesia. *Sci. Rep.* **2019**, *9*, 18730. [CrossRef]
95. Syakti, A.D.; Bouhroum, R.; Hidayati, N.V.; Koenawan, C.J.; Boulkamh, A.; Sulistyo, I.; Lebarillier, S.; Akhlus, S.; Doumenq, P.; Wong-Wah-Chung, P. Beach macro-litter monitoring and floating microplastic in a coastal area of Indonesia. *Mar. Pollut. Bull.* **2017**, *122*, 217–225. [CrossRef]
96. Statista Research Department. *Global Waste Generation: Statistics and Fact*; Statista Research Department: New York, NY, USA, 2021; Volume 2013–2019.
97. Mani, T.; Hauk, A.; Walter, U.; Burkhardt-Holm, P. Microplastics profile along the Rhine River. *Sci. Rep.* **2016**, *5*, 17988. Available online: https://www.nature.com/articles/srep17988 (accessed on 22 June 2022). [CrossRef]
98. Trihadiningrum, Y.; Laksono, I.J.; Dhokhikah, Y.; Moesriati, A.; Radita, D.R.; Sunaryo, S. Community activities in residential solid waste reduction in Tenggilis Mejoyo District, Surabaya City, Indonesia. *J. Mater. Cycles Waste Manag.* **2015**, *19*, 526–535. [CrossRef]
99. World Bank. *The World Bank Annual Repoart 2018 (English)*; World Bank Group: Washington, DC, USA, 2018; Available online: http://document.worldbank.org/curated/en/630671538158537244/The-World-Bank-Annual-Report-2018 (accessed on 22 June 2022).
100. Radityaningrum, A.D.; Trihadiningrum, Y.; Mar'Atusholihah; Soedjono, E.S.; Herumurti, W. Microplastic contamination in water supply and the removal efficiencies of the treatment plants: A case of Surabaya City, Indonesia. *J. Water Process. Eng.* **2021**, *43*, 102195. [CrossRef]
101. Wibowo, A.T.; Nugrahapraja, H.; Wahyuono, R.A.; Islami, I.; Haekal, M.H.; Fardiansyah, Y.; Sugiyo, P.W.W.; Putro, Y.K.; Fauzia, F.N.; Santoso, H.; et al. Microplastic Contamination in the Human Gastrointestinal Tract and Daily Consumables Associated with an Indonesian Farming Community. *Sustainability* **2021**, *13*, 12840. [CrossRef]
102. Nguyen, Q.A.T.; Nguyen, H.N.Y.; Strady, E.; Nguyen, Q.T.; Trinh-Dang, M.; Vo, V.M. Characteristics of microplastics in shoreline sediments from a tropical and urbanized beach (Da Nang, Vietnam). *Mar. Pollut. Bull.* **2020**, *161*, 111768. [CrossRef] [PubMed]
103. Hien, T.T.; Nhon, N.T.T.; Thu, V.T.M.; Quyen, D.T.T.; Nguyen, N.T. The Distribution of Microplastics in Beach Sand in Tien Giang Province and Vung Tau City, Vietnam. *J. Eng. Technol. Sci.* **2020**, *52*, 208–221. [CrossRef]
104. Nhon, N.T.T.; Nguyen, N.T.; Hai, H.T.N.; Hien, T.T. Physical and Chemical Characteristics of Microplastic in Beach Sand in Can Gio, Ho Chi Minh City, Vietnam. *Res. Square* **2021**, *in press*. [CrossRef]
105. Dung, L.V.; Duc, T.H.; Linh, L.T.K.; Ly, T.T.D.; Duong, H.A.; Hao, N.T.M. Depth Profiles of Microplastics in Sediment Cores from Two Mangrove Forests in Northern Vietnam. *J. Mar. Sci. Eng.* **2021**, *9*, 1381. [CrossRef]
106. Lahens, L.; Strady, E.; Kieu-Le, T.-C.; Dris, R.; Boukerma, K.; Rinnert, E.; Gasperi, J.; Tassin, B. Macroplastic and microplastic contamination assessment of a tropical river (Saigon River, Vietnam) transversed by a developing megacity. *Environ. Pollut.* **2018**, *236*, 661–671. [CrossRef] [PubMed]
107. Le, D.N.; Hoang, T.T.H.; Duong, T.T.; Lu, X.; Pham, T.M.H.; Phung, T.X.B.; Le, T.M.H.; Nguyen, T.D. First observation of microplastics in surface sediment of some aquaculture ponds in Hanoi city, Vietnam. *J. Hazard. Mater. Adv.* **2022**, *6*, 100061. [CrossRef]
108. Yukioka, S.; Tanaka, S.; Nabetani, Y.; Suzuki, Y.; Ushijima, T.; Fujii, S.; Takada, H.; Van Tran, Q.; Singh, S. Occurrence and characteristics of microplastics in surface road dust in Kusatsu (Japan), Da Nang (Vietnam), and Kathmandu (Nepal). *Environ. Pollut.* **2019**, *256*, 113447. [CrossRef]
109. Nguyen, Q.A.T.; Vu, T.B.H.; Nguyen, Q.T.; Nguyen, H.N.Y.; Le, T.M.; Vo, V.M.; Trinh-Dang, M. Urban drainage channels as microplastics pollution hotspots in developing areas: A case study in Da Nang, Vietnam. *Mar. Pollut. Bull.* **2022**, *175*, 113323. [CrossRef]

110. Hoang, A.T.; Pham, X.D. An investigation of remediation and recovery of oil spill and toxic heavy metal from maritime pollution by new absorbent material. *J. Mar. Eng. Technol.* **2018**, *20*, 159–169. [CrossRef]
111. Hai, D.M. Current situation and solutions for the environmental pollution in vietnam. *J. Mech. Eng. Res. Dev.* **2019**, *42*, 06–10. [CrossRef]
112. Ministry of Natural Resources and Environement (MONRE). Plastic Waste Management in Vietnam. 2019. Available online: https://www.env.go.jp/en/recycle/asian_net/Annual_Workshops/2019_PDF/Session1/S1_12_Vietnam_ANWS2019.pdf (accessed on 11 November 2022).
113. Ministry of Natural Resources and Environement (MONRE). National Environment Report 2019 pdf. 2019. Available online: https://www.vd-office.org/en/national-state-of-environment-report-2019-on-solid-waste-released/ (accessed on 11 November 2022).
114. Ministry of Natural Resources and Environement (MONRE). Ocean Plastic Waste Records pdf. 2020. Available online: https://www.oecd.org/ocean/topics/ocean-pollution/marine-plastics-pollution-Malaysia.pdf (accessed on 11 November 2022).
115. Khuyen, V.T.K.; Le, D.V.; Anh, L.H.; Fischer, A.R.; Dornack, C. Investigation of Microplastic Contamination in Vietnamese Sea Salts Based on Raman and Fourier-Transform Infrared Spectroscopies. *Environ. Asia* **2021**, *14*, 1. [CrossRef]
116. Jensen, P.N.; Bao, T.Q.; Huong, T.T.T.; Heckbert, S.R.; Fitzpatrick, A.L.; LoGerfo, J.P.; Le Van Ngoc, T.; Mokdad, A.H. The association of estimated salt intake with blood pressure in a Viet Nam national survey. *PLoS ONE* **2018**, *13*, e0191437. [CrossRef] [PubMed]
117. Ha, D.T. Microplastic contamination in commercial sea salt of Vietnam. *Vietnam. J. Sci. Technol.* **2021**, *59*, 333–344. [CrossRef]
118. World Health Organization. 2022. Available online: https://www.who.int/ (accessed on 15 August 2021).
119. Thinh, T.Q.; Sang, T.T.N.; Viet, T.Q.; Tam, L.T.M.; Dan, N.P.; Strady, E.; Chung, K.L.T.; Alpes, C.U.G. Preliminary assessment on the microplastic contamination in the atmospheric fallout in the Phuoc Hiep landfill, Cu Chi, Ho Chi Minh city. *Vietnam. J. Sci. Technol. Eng.* **2020**, *62*, 83–89. [CrossRef]
120. Gallagher, A.; Rees, A.; Rowe, R.; Stevens, J.; Wright, P. Microplastics in the Solent estuarine complex, UK: An initial assessment. *Mar. Pollut. Bull.* **2015**, *102*, 243–249. [CrossRef]
121. Mehdinia, A.; Dehbandi, R.; Hamzehpour, A.; Rahnama, R. Identification of microplastics in the sediments of southern coasts of the Caspian Sea, north of Iran. *Environ. Pollut.* **2020**, *258*, 113738. [CrossRef]
122. Vayghan, A.H.; Rasta, M.; Zakeri, M.; Kelly, F.J. Spatial distribution of microplastics pollution in sediments and surface waters of the Aras River and reservoir: An international river in Northwestern Iran. *Sci. Total. Environ.* **2022**, *843*, 156894. [CrossRef] [PubMed]
123. Gholizadeh, M.; Cera, A. Microplastic contamination in the sediments of Qarasu estuary in Gorgan Bay, south-east of Caspian Sea, Iran. *Sci. Total. Environ.* **2022**, *838*, 155913. [CrossRef]
124. Abbasi, S. Prevalence and physicochemical characteristics of microplastics in the sediment and water of Hashilan Wetland, a national heritage in NW Iran. *Environ. Technol. Innov.* **2021**, *23*, 101782. [CrossRef]
125. Nabizadeh, R.; Sajadi, M.; Rastkari, N.; Yaghmaeian, K. Microplastic pollution on the Persian Gulf shoreline: A case study of Bandar Abbas city, Hormozgan Province, Iran. *Mar. Pollut. Bull.* **2019**, *145*, 536–546. [CrossRef]
126. Abbasi, S.; Turner, A.; Sharifi, R.; Nematollahi, M.; Keshavarzifard, M.; Moghtaderi, T. Microplastics in the school classrooms of Shiraz, Iran. *Build. Environ.* **2021**, *207*, 108562. [CrossRef]
127. United Nations Environment Program (UNEP). Marine Litter: A Global Challenge. 2009. Available online: https://www.unep.org/resources/report/marine-litter-global-challenge-0 (accessed on 25 July 2022).
128. Li, M.; Zhang, X.; Yi, K.; He, L.; Han, P.; Tong, M. Transport and deposition of microplastic particles in saturated porous media: Co-effects of clay particles and natural organic matter. *Environ. Pollut.* **2021**, *287*, 117585. [CrossRef]
129. Maghsodian, Z.; Sanati, A.M.; Ramavandi, B.; Ghasemi, A.; Sorial, G.A. Microplastics accumulation in sediments and Periophthalmus waltoni fish, mangrove forests in southern Iran. *Chemosphere* **2020**, *264*, 128543. [CrossRef] [PubMed]
130. Abbasi, S.; Rezaei, M.; Ahmadi, F.; Turner, A. Atmospheric transport of microplastics during a dust storm. *Chemosphere* **2022**, *292*, 133456. [CrossRef] [PubMed]
131. Abbasi, S.; Keshavarzi, B.; Moore, F.; Turner, A.; Kelly, F.J.; Dominguez, A.O.; Jaafarzadeh, N. Distribution and potential health impacts of microplastics and microrubbers in air and street dusts from Asaluyeh County, Iran. *Environ. Pollut.* **2018**, *244*, 153–164. [CrossRef]
132. Naji, A.; Azadkhah, S.; Farahani, H.; Uddin, S.; Khan, F.R. Microplastics in wastewater outlets of Bandar Abbas city (Iran): A potential point source of microplastics into the Persian Gulf. *Chemosphere* **2020**, *262*, 128039. [CrossRef]
133. Demirbas, A.; Edris, G.; Alalayah, W.M. Sludge production from municipal wastewater treatment in sewage treatment plant. *Energy Sources Part A Recovery Util. Environ. Eff.* **2017**, *39*, 999–1006. [CrossRef]
134. Petroody, S.S.A.; Hashemi, S.H.; van Gestel, C.A. Transport and accumulation of microplastics through wastewater treatment sludge processes. *Chemosphere* **2021**, *278*, 130471. [CrossRef]
135. Amiri, H.; Hoseini, M.; Abbasi, S.; Malakootian, M.; Hashemi, M.; Jaafarzadeh, N.; Turner, A. Geophagy and microplastic ingestion. *J. Food Compos. Anal.* **2021**, *106*, 104290. [CrossRef]
136. Goudie, A.S. Dust storms: Recent developments. *J. Environ. Manag.* **2009**, *90*, 89–94. [CrossRef] [PubMed]
137. Abbasi, S.; Alirezazadeh, M.; Razeghi, N.; Rezaei, M.; Pourmahmood, H.; Dehbandi, R.; Mehr, M.R.; Ashayeri, S.Y.; Oleszczuk, P.; Turner, A. Microplastics captured by snowfall: A study in Northern Iran. *Sci. Total. Environ.* **2022**, *822*, 153451. [CrossRef] [PubMed]

138. Abbasi, S.; Turner, A. Human exposure to microplastics: A study in Iran. *J. Hazard. Mater.* **2020**, *403*, 123799. [CrossRef]
139. Chen, L.; Zhi, X.; Shen, Z.; Dai, Y.; Aini, G. Comparison between snowmelt-runoff and rainfall-runoff nonpoint source pollution in a typical urban catchment in Beijing, China. *Environ. Sci. Pollut. Res.* **2017**, *25*, 2377–2388. [CrossRef]
140. Butte, W.; Heinzow, B. Pollutants in house dust as indicators of indoor contamination. *Rev. Environ. Contam. Toxicol.* **2002**, *175*, 1–46. Available online: https://pubmed.ncbi.nlm.nih.gov/12206053/ (accessed on 11 November 2022). [PubMed]
141. Turner, A.; Simmonds, L. Elemental concentrations and metal bioaccessibility in UK household dust. *Sci. Total. Environ.* **2006**, *371*, 74–81. [CrossRef]
142. Abbasi, S.; Turner, A. Dry and wet deposition of microplastics in a semi-arid region (Shiraz, Iran). *Sci. Total. Environ.* **2021**, *786*, 147358. [CrossRef]
143. Kashfi, F.S.; Ramavandi, B.; Arfaeinia, H.; Mohammadi, A.; Saeedi, R.; De-La-Torre, G.E.; Dobaradaran, S. Occurrence and exposure assessment of microplastics in indoor dusts of buildings with different applications in Bushehr and Shiraz cities, Iran. *Sci. Total. Environ.* **2022**, *829*, 154651. [CrossRef] [PubMed]
144. Prarat, P.; Hongsawat, P. Microplastic pollution in surface seawater and beach sand from the shore of Rayong province, Thailand: Distribution, characterization, and ecological risk assessment. *Mar. Pollut. Bull.* **2021**, *174*, 113200. [CrossRef]
145. Akkajit, P.; Tipmanee, D.; Cherdsukjai, P.; Suteerasak, T.; Thongnonghin, S. Occurrence and distribution of microplastics in beach sediments along Phuket coastline. *Mar. Pollut. Bull.* **2021**, *169*, 112496. [CrossRef] [PubMed]
146. Ta, A.T.; Babel, S. Microplastics pollution with heavy metals in the aquaculture zone of the Chao Phraya River Estuary, Thailand. *Mar. Pollut. Bull.* **2020**, *161*, 111747. [CrossRef]
147. Vibhatabandhu, P.; Srithongouthai, S. Influence of seasonal variations on the distribution characteristics of microplastics in the surface water of the Inner Gulf of Thailand. *Mar. Pollut. Bull.* **2022**, *180*, 113747. [CrossRef] [PubMed]
148. Wichaiutcha, N.; Chavalparit, O. 3Rs Policy and Plastic Waste Management in Thailand. *J. Mater. Cycles Waste Manag.* **2019**, *21*, 10–22. Available online: https://www.researchgate.net/publication/327229173_3Rs_Policy_and_plastic_waste_management_in_Thailand (accessed on 25 July 2022). [CrossRef]
149. Ruangpanupan, N.; Ussawarujikulchai, A.; Prapagdee, B.; Chavanich, S. Microplastics in the surface seawater of Bandon Bay, Gulf of Thailand. *Mar. Pollut. Bull.* **2022**, *179*, 113664. [CrossRef]
150. Chinfak, N.; Sompongchaiyakul, P.; Charoenpong, C.; Shi, H.; Yeemin, T.; Zhang, J. Abundance, composition, and fate of microplastics in water, sediment, and shellfish in the Tapi-Phumduang River system and Bandon Bay, Thailand. *Sci. Total. Environ.* **2021**, *781*, 146700. [CrossRef]
151. Ratchatapattanakul, N.; Kazuya, W.; Yuki, O.; Yasuyuki, K. Living under the State and Storms: The History of Blood Cockle Aquaculture in Bandon Bay, Thailand. *South Asian Stud.* **2017**, *6*, 3–30. [CrossRef]
152. Jiwarungrueangkul, T.; Phaksopa, J.; Sompongchaiyakul, P.; Tipmanee, D. Seasonal microplastic variations in estuarine sediments from urban canal on the west coast of Thailand: A case study in Phuket province. *Mar. Pollut. Bull.* **2021**, *168*, 112452. [CrossRef]
153. Khanunthong, A. Industry Outlook 2021–2023: Plastics. 2021. Available online: https://www.krungsri.com/en/research/industry/industry-outlook/Petrochemicals/Plastics/IO/io-plastics-21 (accessed on 28 July 2022).
154. Marks, D.; Miller, M.A.; Vassanadumrongdee, S. The geopolitical economy of Thailand's marine plastic pollution crisis. *Asia Pac. Viewp.* **2020**, *61*, 266–282. [CrossRef]
155. Yan, M.; Nie, H.; Xu, K.; He, Y.; Hu, Y.; Huang, Y.; Wang, J. Microplastic abundance, distribution and composition in the Pearl River along Guangzhou city and Pearl River estuary, China. *Chemosphere* **2018**, *217*, 879–886. [CrossRef]
156. Department of Marine and Coastal Resources, Thailand (DMCR). The Information of Marine and Coastal Resources of Suratthanal Province, Ministry of Natural Resources and Environment Bangkok. 2018. Available online: https://www.iyor2018.org/organization/department-marine-coastal-resources-thailand/ (accessed on 30 July 2022).
157. Regional Environment Office 15 (REO 15). Report of the Results of the Monitoring and Evaluation of the Environmental Quality Management Plan Region 15 during 2007–2011. 2012. Available online: https://enviro2.doe.gov.my/ekmc/wp-content/uploads/2017/02/FA-EIA-GUIDELINE-IN-MALAYSIA-1.pdf (accessed on 11 November 2022).
158. Liebmann, B.; Koppel, S.; Konigshofer, P.; Bucsics, T.; Reiberger, T.; Schwabl, P. Assessment of Microplastic Concentrations in Human Stool-Final Results of a Prospective Study. 2018. Available online: https://www.researchgate.net/publication/328702413_ASSESSMENT_OF_MICROPLASTIC_CONCENTRATIONS_IN_HUMAN_STOOL_-_FINAL_RESULTS_OF_A_PROSPECTIVE_STUDY (accessed on 30 July 2022).
159. Sukrita, P.P.; Prasongsom, P.P. Microplastics: Origin, Environmental impact, Food and Beverage contamination and Management methods. *Sci. Technol.* **2020**, *28*, 72–80. [CrossRef]
160. Sutthacheep, M.; Phoaduang, S.; Chamchoy, C.; Klinthong, W.; Salakphet, C.; Silpparasarn, A.; Sangiamdee, D.; Yeemin, T. The particles of microplastics in shrimp paste from the Gulf of Thailand and the Andaman Sea. *Sci. Technol.* **2021**, *4*, 27–34.
161. Tadsuwan, K.; Babel, S. Microplastic abundance and removal via an ultrafiltration system coupled to a conventional municipal wastewater treatment plant in Thailand. *J. Environ. Chem. Eng.* **2022**, *10*, 107142. [CrossRef]
162. Bucol, L.A.; Romano, E.F.; Cabcaban, S.M.; Siplon, L.M.D.; Madrid, G.C.; Bucol, A.A.; Polidoro, B. Microplastics in marine sediments and rabbitfish (*Siganus fuscescens*) from selected coastal areas of Negros Oriental, Philippines. *Mar. Pollut. Bull.* **2019**, *150*, 110685. [CrossRef] [PubMed]

163. Esquinas, G.G.M.S.; Mantala, A.P.; Atilano, M.G.; Apugan, R.P.; Galarpe, V.R.K.R. Physical characterization of litter and microplastic along the urban coast of Cagayan de Oro in Macajalar Bay, Philippines. *Mar. Pollut. Bull.* **2020**, *154*, 111083. [CrossRef]
164. Osorio, E.D.; Tanchuling, M.A.N.; Diola, M.B.L.D. Microplastics Occurrence in Surface Waters and Sediments in Five River Mouths of Manila Bay. *Front. Environ. Sci.* **2021**, *9*, 719274. [CrossRef]
165. Tanchuling, M.A.N.; Osorio, E.D. The Microplastics in Metro Manila Rivers: Characteristics, Sources, and Abatement. In *Plastics in the Aquatic Environment-Part I: Current Status and Challenges*; Springer International Publishing: Cham, Switzerland, 2020; Volume 111, pp. 405–426. [CrossRef]
166. Limbago, J.S.; Bacabac, M.M.A.; Fajardo, D.R.M.; Mueda, C.R.T.; Bitara, A.U.; Ceguerra, K.L.P.; Lopez, M.R.C.; Posa, G.A.V.; Nacorda, H.M.E. Occurrence and Polymer Types of Microplastics from Surface Sediments of Molawin Watershed of the Makiling Forest Reserve, Los Baños, Laguna, Philippines. *Environ. Nat. Resour. J.* **2020**, *19*, 57–67. [CrossRef]
167. Castro, A.L.J.; Monsada, A.M.; Cruz, K.D. Occurrence of microplastics in the sediments of Baseco Port area at Manila Bay, Philippines. *IOP Conf. Series Earth Environ. Sci.* **2021**, *958*, 012009. [CrossRef]
168. Mercado, R.M. People's Risk Perceptions and Responses to Climate Change and Natural Disasters in BASECO Compound, Manila, Philippines. *Procedia Environ. Sci.* **2016**, *34*, 490–505. [CrossRef]
169. Cutini, V.; Di Pinto, V.; Rinaldi, A.M.; Rossini, F. Proximal Cities: Does Walkability Drive Informal Settlements? *Sustainability* **2020**, *12*, 756. [CrossRef]
170. Department of Environment and Natural Resources, (DENR) Baseco Cleanup Yileds 550 Sacks of Garbage. 2019. Available online: https://denr.gov.ph/index.php/news-events/press-releases/857-basecocleanup-yields (accessed on 30 July 2022).
171. Parvin, F.; Jannat, S.; Tareq, S.M. Abundance, characteristics and variation of microplastics in different freshwater fish species from Bangladesh. *Sci. Total. Environ.* **2021**, *784*, 147137. [CrossRef]
172. Ghosh, G.C.; Akter, S.M.; Islam, R.M.; Habib, A.; Chakraborty, T.K.; Zaman, S.; Kabir, A.E.; Shipin, O.V.; Wahid, M.A. Microplastics contamination in commercial marine fish from the Bay of Bengal. *Reg. Stud. Mar. Sci.* **2021**, *44*, 101728. [CrossRef]
173. Siddique, M.A.M.; Uddin, A.; Rahman, S.M.A.; Rahman, M.; Islam, S.; Kibria, G. Microplastics in an anadromous national fish, Hilsa shad Tenualosa ilisha from the Bay of Bengal, Bangladesh. *Mar. Pollut. Bull.* **2021**, *174*, 113236. [CrossRef]
174. Pauly, D. Tropical fishes: Patterns and propensities. *J. Fish Biol.* **1998**, *53*, 1–17.
175. Hasan, J.; Islam, S.M.; Alam, S.; Johnson, D.; Belton, B.; Hossain, M.A.R. Shahjahan Presence of microplastics in two common dried marine fish species from Bangladesh. *Mar. Pollut. Bull.* **2022**, *176*, 113430. [CrossRef] [PubMed]
176. Jung, M.; Reichstein, M.; Ciais, P.; Seneviratne, S.I.; Sheffield, J.; Goulden, M.L.; Bonan, G.; Cescatti, A.; Chen, J.Q.; de Jeu, R.; et al. Recent decline in the global land evapotranspiration trend due to limited moisture supply. *Nature* **2010**, *467*, 951–954. [CrossRef]
177. Schroter, D.; Cramer, W.; Leemans, R.; Prentice, I.C.; Araujo, M.B.; Arnell, N.W.; Bondeau, A.; Bugmann, H.; Carter, T.R.; Gracia, C.A.; et al. Ecosystem service supply and vulnerability to global change in Europe. *Science* **2005**, *310*, 1333–1337. [CrossRef]
178. Afrin, S.; Uddin, K.; Rahman, M. Microplastics contamination in the soil from Urban Landfill site, Dhaka, Bangladesh. *Heliyon* **2020**, *6*, e05572. [CrossRef] [PubMed]
179. Lwanga, E.H.; Vega, J.M.; Quej, V.K.; Chi, J.D.L.A.; del Cid, L.S.; Chi, C.; Segura, G.E.; Gertsen, H.; Salánki, T.; van der Ploeg, M.; et al. Field evidence for transfer of plastic debris along a terrestrial food chain. *Sci. Rep.* **2017**, *7*, 1–7. [CrossRef]
180. Jeyasanta, K.I.; Sathish, N.; Patterson, J.; Edward, J.P. Macro-, meso- and microplastic debris in the beaches of Tuticorin district, Southeast coast of India. *Mar. Pollut. Bull.* **2020**, *154*, 111055. [CrossRef]
181. Daniel, D.B.; Ashraf, P.M.; Thomas, S.N.; Thomson, K. Microplastics in the edible tissues of shellfishes sold for human consumption. *Chemosphere* **2020**, *264*, 128554. [CrossRef]
182. Naidu, B.C.; Xavier, K.; Shukla, S.P.; Jaiswar, A.K.; Nayak, B.B. Comparative study on the microplastics abundance, characteristics, and possible sources in yellow clams of different demographic regions of the northwest coast of India. *J. Hazard. Mater. Lett.* **2022**, *3*, 100051. [CrossRef]
183. Sarkar, A.; Deb, S.; Ghosh, S.; Mandal, S.; Quazi, S.A.; Kushwaha, A.; Hoque, A.; Choudhury, A. Impact of anthropogenic pollution on soil properties in and around a town in Eastern India. *Geoderma Reg.* **2021**, *28*, e00462. [CrossRef]
184. Rautenberg, G.E.; Ame, M.V.; Monferran, M.V.; Bonansea, R.I.; Hued, A.C. A Multi-Level Approach Using Gambusia Affinis as a Bioindicator of Environmental Pollution in the Middle-Lower Basin of SuquÃ—A River. *Ecol. Indic.* **2015**, *48*, 706–720. [CrossRef]
185. Buwono, N.R.; Risjani, Y.; Soegianto, A. Contamination of microplastics in Brantas River, East Java, Indonesia and its distribution in gills and digestive tracts of fish Gambusia affinis. *Emerg. Contam.* **2021**, *7*, 172–178. [CrossRef]
186. Buwono, N.R.; Risjani, Y.; Soegianto, A. Distribution of microplastic in relation to water quality parameters in the Brantas River, East Java, Indonesia. *Environ. Technol. Innov.* **2021**, *24*, 101915. [CrossRef]
187. Lehtiniemi, M.; Hartikainen, S.; Näkki, P.; Engström-Öst, J.; Koistinen, A.; Setälä, O. Size matters more than shape: Ingestion of primary and secondary microplastics by small predators. *Food Webs* **2018**, *17*, e00097. [CrossRef]
188. McCauley, R.W. Determining the Health of Fish Communities—Parallels with Human Medicine. *J. Great Lakes Res.* **1990**, *16*, 635–636. [CrossRef]
189. Adam, M.A.; Kilawati, Y.; Risjani, Y.; Maftuch, M. Clinical Symptoms of Gambusia Fish (Gambusia Affinis) after Exsposure to Cadmium Absorbed in the Gills. Pollution Research. 2019. Available online: https://www.researchgate.net/publication/352800241_CLINICAL_SYMPTOMS_OF_GAMBUSIA_FISH_GAMBUSIA_AFFINIS_AFTER_EXPOSURE_TO_CADMIUM_ABSORBED_IN_THE_GILLS (accessed on 20 July 2022).

190. Jabeen, K.; Li, B.; Chen, Q.; Su, L.; Wu, C.; Hollert, H.; Shi, H. Effects of virgin microplastics on goldfish (Carassius auratus). *Chemosphere* **2018**, *213*, 323–332. [CrossRef]
191. Movahedinia, A.; Abtahi, B.; Bahmani, M. Gill histopathological lesions of the sturgeons. *Asian J. Anim. Vet. Adv.* **2012**, *7*, 710–717. [CrossRef]
192. Buwono, N.R.; Risjani, Y.; Soegianto, A. Oxidative stress responses of microplastic-contaminated *Gambusia affinis* obtained from the Brantas River in East Java, Indonesia. *Chemosphere* **2022**, *293*, 133543. [CrossRef]
193. Sawalman, R.; Werorilangi, S.; Ukkas, M.; Mashoreng, S.; Yasir, I.; Tahir, A. Microplastic abundance in sea urchins (*Diadema setosum*) from seagrass beds of Barranglompo Island, Makassar, Indonesia. *IOP Conf. Series Earth Environ. Sci.* **2021**, *763*, 012057. [CrossRef]
194. Archana, A.; Babu, K.R. Nutrient composition and antioxidant activity of gonads of sea urchin *Stomopneustes variolaris*. *Food Chem.* **2016**, *197*, 597–602. [CrossRef] [PubMed]
195. Andreas; Hadibarata, T.; Sathishkumar, P.; Prasetia, H.; Hikmat; Pusfitasari, E.D.; Tasfiyati, A.N.; Muzdalifah, D.; Waluyo, J.; Randy, A.; et al. Microplastic contamination in the Skipjack Tuna (*Euthynnus affinis*) collected from Southern Coast of Java, Indonesia. *Chemosphere* **2021**, *276*, 130185. [CrossRef] [PubMed]
196. Bulleri, F.; Ravaglioli, C.; Anselmi, S.; Ranzi, M. The sea cucumber Holothuria tubulosa does not reduce the size of microplastics but enhances their resuspension in the water column. *Sci. Total Environ.* **2021**, *781*, 146650. [CrossRef]
197. Riani, E.; Cordova, M.R. Microplastic ingestion by the sandfish Holothuria scabra in Lampung and Sumbawa, Indonesia. *Mar. Pollut. Bull.* **2021**, *175*, 113134. [CrossRef] [PubMed]
198. Cordova, M.R.; Riani, E.; Shiomoto, A. Microplastics ingestion by blue panchax fish (*Aplocheilus* sp.) from Ciliwung Estuary, Jakarta, Indonesia. *Mar. Pollut. Bull.* **2020**, *161*, 111763. [CrossRef] [PubMed]
199. Risjani, Y.; Yunianta; Couteau, J.; Minier, C. Cellular immune responses and phagocytic activity of fishes exposed to pollution of volcano mud. *Mar. Environ. Res.* **2014**, *96*, 73–80. [CrossRef] [PubMed]
200. Delzer, G.C.; Mckenzie, S.W. Five Day Biochemical Oxygen Demand. 2003. Available online: https://pubs.usgs.gov/twri/twri9a7/twri9a7_nfmchap7_2_bod.pdf (accessed on 6 August 2022).
201. Supenah, P.; Widiastuti, E.; Priyono, R.E. Study of the quality of condong river water affected by the trusmi cirebon batik industry wastewater. *Biosfera* **2015**, *32*, 110. [CrossRef]
202. Widodo, T.; Budiastuti, M.T.S.; Komariah, K. Water Quality and Pollution Index in Grenjeng River, Boyolali Regency, Indonesia. *Caraka Tani J. Sustain. Agric.* **2019**, *34*, 150. [CrossRef]
203. Hue, H.; Dong, L.; Hien, T.; Nguyen, T.; Pradit, S. Assessment of microplastics contamination in commericial clams in the coastal zone of vietnam. *Appl. Ecol. Environ. Res.* **2021**, *19*, 4977–4991. [CrossRef]
204. Do, V.M.; Dang, T.T.; Le, X.T.T.; Nguyen, D.T.; Phung, T.V.; Vu, D.N.; Pham, H.V. Abundance of microplastics in cultured oysters (*Crassostrea gigas*) from Danang Bay of Vietnam. *Mar. Pollut. Bull.* **2022**, *180*, 113800. [CrossRef]
205. Li, Y.; Chen, G.; Xu, K.; Huang, K.; Wang, J. Microplastics Environmental Effect and Risk Assessment on the Aquaculture Systems from South China. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1869. [CrossRef] [PubMed]
206. Nam, P.N.; Tuan, P.Q.; Thuy, D.T.; Quynh, L.T.P.; Amiard, F. Contamination of microplastic in bivalve: First evaluation in Vietnam. *J. Sci. Earth* **2019**, *41*, 252–258. [CrossRef]
207. Rasta, M.; Sattari, M.; Taleshi, M.S.; Namin, J.I. Microplastics in different tissues of some commercially important fish species from Anzali Wetland in the Southwest Caspian Sea, Northern Iran. *Mar. Pollut. Bull.* **2021**, *169*, 112479. [CrossRef] [PubMed]
208. Rasta, M.; Sattari, M.; Taleshi, M.S.; Namin, J.I. Identification and distribution of microplastics in the sediments and surface waters of Anzali Wetland in the Southwest Caspian Sea, Northern Iran. *Mar. Pollut. Bull.* **2020**, *160*, 111541. [CrossRef] [PubMed]
209. Makhdoumi, P.; Hossini, H.; Nasmara, Z.; Mansouri, K.; Pirsaheb, M. Occurrence and exposure analysis of micro-plastic in the gut and muscle tissue of riverine fish in Kermanshah province of Iran. *Mar. Pollut. Bull.* **2021**, *173*, 112915. [CrossRef] [PubMed]
210. Nematollahi, M.J.; Keshavarzi, B.; Mohit, F.; Moore, F.; Busquets, R. Microplastic occurrence in urban and industrial soils of Ahvaz metropolis: A city with a sustained record of air pollution. *Sci. Total. Environ.* **2022**, *819*, 152051. [CrossRef]
211. Ta, A.T.; Pupuang, P.; Babel, S.; Wang, L.P. Investigation of microplastic contamination in blood cockles and green mussels from selected aquaculture farms and markets in Thailand. *Chemosphere* **2022**, *303*, 134918. [CrossRef]
212. Koedprang, W. Culture of Green Mussel, Perna Viridis in Thailand. 2013. Available online: https://fishconsult.org/?p=9397 (accessed on 7 August 2022).
213. Danopoulos, E.; Jenner, L.C.; Twiddy, M.; Rotchell, J.M. Microplastic Contamination of Seafood Intended for Human Consumption: A Systematic Review and Meta-Analysis. *Environ. Health Perspect.* **2020**, *128*, 126002. [CrossRef]
214. Thushari, G.G.N.; Senevirathna, J.D.M.; Yakupitiyage, A.; Chavanich, S. Effects of microplastics on sessile invertebrates in the eastern coast of Thailand: An approach to coastal zone conservation. *Mar. Pollut. Bull.* **2017**, *124*, 349–355. [CrossRef]
215. Pradit, S.; Noppradit, P.; Goh, B.; Sornplang, K.; Ong, M.; Towatana, P. Occurrence of microplastics and trace metals in fish and shrimp from songkhla lake, thailand during the covid-19 pandemic. *Appl. Ecol. Environ. Res.* **2021**, *19*, 1085–1106. [CrossRef]
216. Azad, S.M.O.; Towatana, P.; Pradit, S.; Patricia, B.G.; Hue, H.T. Ingestion of microplastics by some commercial fishes in the lower Gulf of Thailand: A preliminary approach to ocean conservation. *Agric. Technol.* **2018**, *14*, 1017–1032.
217. Abinon, B.S.; Camporedondo, B.S.; Mercadal, E.M.B.; Olegario, K.M.R.; Palapar, E.M.H.; Ypil, C.W.R.; Tambuli, A.E.; Lomboy, C.A.L.M.; Garces, J.J.C. Abundance and characteristics of microplastics in commercially sold fishes from Cebu Island, Philippines. *Aquat. Biol.* **2020**, *8*, 424. [CrossRef]

218. Yong, M.M.H.; Leistenschneider, C.; Miranda, J.A.; Paler, M.K.; Legaspi, C.; Germanov, E.; Araujo, G.; Burkhardt-Holm, P.; Erni-Cassola, G. Microplastics in fecal samples of whale sharks (Rhincodon typus) and from surface water in the Philippines. *Microplast. Nanoplast.* **2021**, *1*, 17. [CrossRef] [PubMed]
219. Motta, P.J.; Maslanka, M.; Hueter, R.E.; Davis, R.L.; de la Parra, R.; Mulvany, S.L.; Habegger, M.L.; Strother, J.A.; Mara, K.R.; Gardiner, J.M.; et al. Feeding anatomy, filter-feeding rate, and diet of whale sharks Rhincodon typus during surface ram filter feeding off the Yucatan Peninsula, Mexico. *Zoology* **2010**, *113*, 199–212. [CrossRef]
220. Bilugan, Q.M.; Limbago, J.S.; Gutierrez, R.L. Detection and quantification of microplastics from cultured green mussel Perna viridis in Bacoor Bay, Cavite, Philippines. *Sustinere J. Environ. Sustain.* **2021**, *5*, 90–102. [CrossRef]
221. Jambre, K.G.E. Density of Microplastics in Philippine Cupped Oyster (*Crassostrea iredalei*). *Int. J. Adv. Multidiscip. Stud.* **2022**, *1*. Available online: https://www.researchgate.net/publication/358234028_Density_of_Microplastics_in_Philippine_Cupped_Oyster_Crassostrea_iredalei?enrichId=rgreq-d84c6b3e779661a6231927d7293915f3 (accessed on 12 August 2022).
222. Cabansag, J.B.P.; Olimberio, R.B.; Villanobos, Z.M.T. Microplastics in some fish species and their environs in Eastern Visayas, Philippines. *Mar. Pollut. Bull.* **2021**, *167*, 112312. [CrossRef]
223. Paler, M.K.O.; Leistenschneider, C.; Migo, V.; Burkhardt-Holm, P. Low microplastic abundance in *Siganus* spp. from the Tañon Strait, Central Philippines. *Environ. Pollut.* **2021**, *284*, 117166. [CrossRef]
224. Naidoo, T.; Smit, A.J.; Glassom, D. Plastic ingestion by estuarine mullet *Mugil cephalus* (Mugilidae) in an urban harbour. KwaZulu-Natal, South Africa. *Afr. J. Mar. Sci.* **2016**, *38*, 145–149. [CrossRef]
225. Lamarca, N. Fisheries Country Profile: Philippines. 2017. Available online: http://www.seafdec.org/fisheries-country-profile-philippines (accessed on 12 August 2022).
226. Ebrahim, A.; Martin, T.S.H.; Mumby, P.J.; Olds, A.D.; Tibbettss, I.R. Differences in diet and foraging behaviour of commercially important rabbitfish species on coral reefs in the Indian Ocean. *Coral Reefs* **2020**, *39*, 977–988. [CrossRef]
227. Palermo, J.; Labrador, K.; Follante, J.; Agmata, A.; Pante, M.; Rollon, R.; David, L. Susceptibility of Sardinella lemuru to emerging marine microplastic pollution. *Glob. J. Environ. Sci. Manag.* **2020**, *6*, 373–384. [CrossRef]
228. Wings. Essay on Sustainable Dvelopment: Format & Examples. 2020. Available online: https://leverageedu.com/blog/essay-on-sustainable-development/ (accessed on 24 August 2022).
229. UNEP. Sustainable Development Goal 6. 2022. Available online: https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-6 (accessed on 24 August 2022).
230. UNEP. Sustainable Development Goal 14. 2022. Available online: https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-14 (accessed on 24 August 2022).