# "Microplastics": The Next Threat to Mankind?

**Chapter** · December 2019

DOI: 10.4018/978-1-7998-0369-0.ch006



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# Chapter 6
# "Microplastics": The Next Threat to Mankind?

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## ABSTRACT

*Microplastics are plastics with smaller than 5mm particle size and they originate from sequential degradation of larger plastic molecules or are manufactured, and they have found use in many realms of life. Their gradual degradability and ingestion by aquatic organisms have become an environmental concern. Microplastics are regarded as a "tiny problem" requiring massive attention. Occurrences of microplastics have been detected in almost all environment matrices. Although several committees have taken steps towards handling the menace, most of the regulations' guidelines refer to "all wastes" in general, leaving many loopholes. This chapter views microplastics, occurrences, detection, and existing policies. The roles of industry and individuals in preserving the ecosystems are deliberated. In summary, emphasis on the bottom-up strategy to curb the escalating amount of plastics waste in our environment is sought and adoption of the "avoid the avoidable" attitude for a more holistic approach in tackling the severity of the impending threat.*

DOI: 10.4018/978-1-7998-0369-0.ch006

# INTRODUCTION

## Occurrence of Microplastics

Plastics are undeniably a key component of our contemporary world, confronted every day at home, offices, grocery shops to the hospitals, schools and almost everywhere. However Fendell and Sewell, (2009) observed that unfortunately, over 50% large plastic items culminate in the oceans and over the course of time form macroplastic debris.

Global plastic production in 2017 according to Statistica (2017), was estimated at a whopping 348 million metric tonnes. This trend is still likely to rise as depicted in Figure 1.

## Sources of Microplastics

Microplastics are defined as plastic fragments with the size of less than 5 mm. Browne et al., (2015) had however proposed that the definition should take into account smaller fragments as well (<1 mm). Their gradual degradability, ingestion by aquatic organisms and carriers of persistent organic pollutants from environment to aquatic organisms has become a major source of growing environmental concern.

Figure 2 illustrates the classification of microplastics based on shape, size and polymer type. Generally, microplastics in the marine environment are typically found as pellets, fragments, or fibers and are composed of diverse polymers (Smith et al., 2018, Galgani et al., 2013). Denser particles such as PVC, polyester, polyamide tend to settle at the bottom of the ocean bed while the lighter (polyethylene, polypropylene, and polystyrene) are found floating on the surface of the oceans.

Mega debris fall in the 100 mm range while micro-debris is below 5 mm (Ryan et al., 2009; Thompson et al., 2009). Also, they are categorized based on their production. Primary microplastics are produced for direct consumption which is found in our everyday lives whereas the secondary microplastics occur as a result of the degradation of larger plastic molecules. Table 1 shows a compilation of the worldwide production of plastic polymers in million tonnes, estimated decomposition rate and recyclability. It reveals that production of LPDE (used in production of containers for milk, cleaning agents, shampoo, boxes) is 57 million tonnes yearly, closely followed by PP (55 million tonnes). However, a good reprieve is that they are recyclable and can be used for other things long after their primary uses are over. It is alarming to know that polyamide polymers take an estimated time of 600 years to degrade and is not recyclable.

## Microplastics in Fresh Water Ecosystems

Thompson et al. (2009) observed that there is limited documentation on the accumulation of plastics in freshwater organisms unlike in marine systems. Eleven streams in France were reported to have microplastics in the digestive tracts of gudgeon fish (Sanchez et al., 2014). A study conducted in the Mongolian lakes, revealed that the lakes were heavily polluted with microplastics (Christopher et al., 2014) with fragments and films as the most abundant microplastic type. Moore et al. (2005) discovered that in three Californian rivers, an average of 30-109 items $m^{-3}$ microplastics particles were found. Even though Africa is a continent with largest and deepest freshwater lakes, till 2017 there has been no reports on studies with regards to microplastics (Khan et al., 2017). Racchid et al.'s study (2017) in the Metropolis of Paris, revealed the heavy presence of fibers which include plastic fibers as well as also other

*Figure 1. Global trends of plastic production (metric tonnes).*
*Source: Plastics Europe 2015 (http://grid-arendal.herokuapp.com/resources/6923)*
*Maphoto/Riccardo Pravettoni*

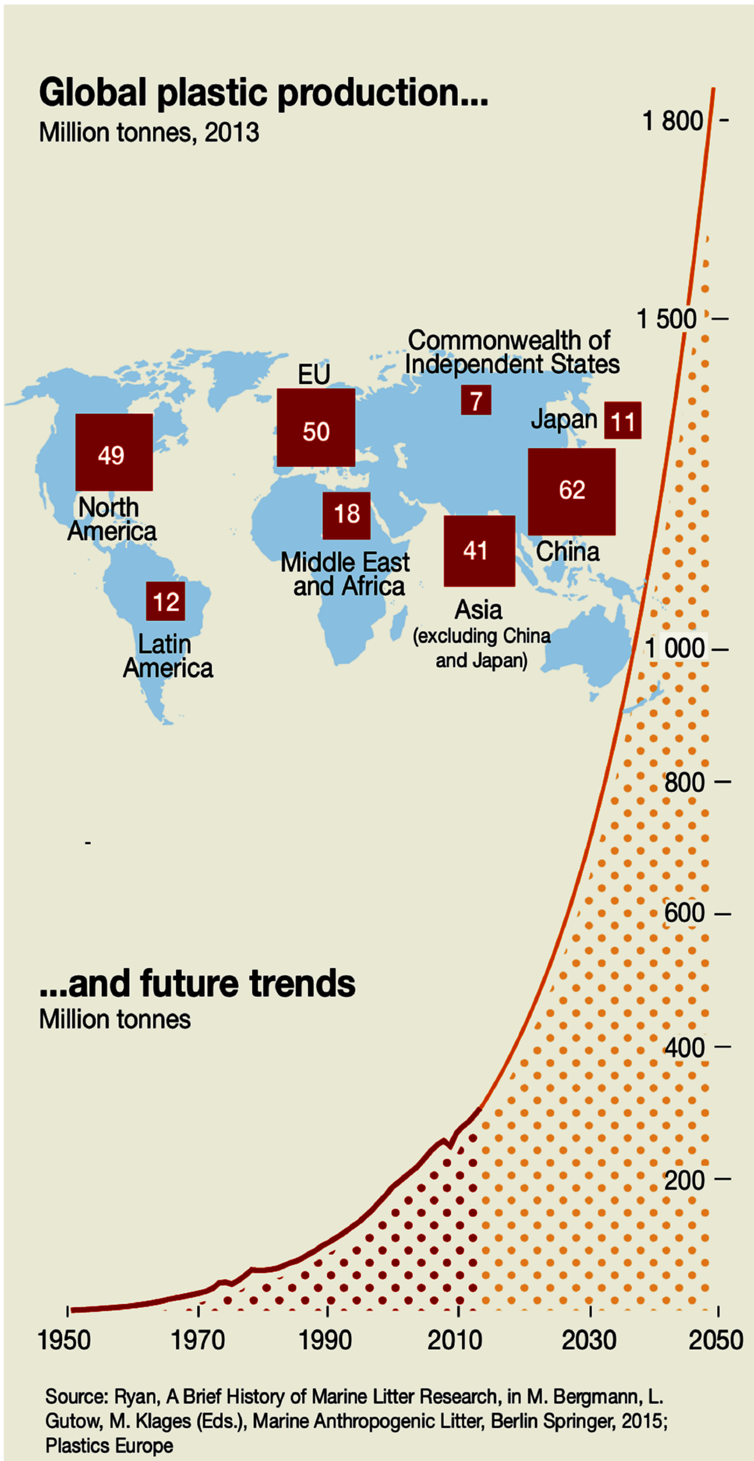


*Figure 2. Classification of microplastics based on shape, size and polymer type.*

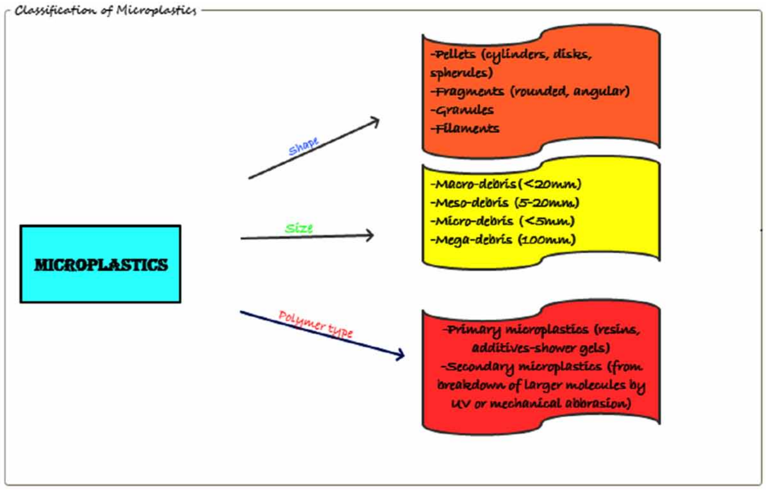



*Table 1. Worldwide production of polymers (million tonnes), estimated decomposition (years) time and recyclability*

| Type of Microplastics Present | Production in Million Tonnes | Commercial Application | Estimated Time for Decomposition (yrs) | Recyclability |
|---|---|---|---|---|
| Polyamide (PA)/Nylon | 42 | Fishing nets and ropes, carpets, sportswear, textile | 600 | No |
| Polyvinyl chloride (PVC) | 15 | Film, Pipe, Insulation, roofing materials, | >450 | No |
| Polypropylene (PP), Polyterephthalate (PET), Polyester(PES) | 55<br>32 | Rope, bottle caps, gear. Strapping, bottles, boats, textiles | 450 | Yes |
| Polystyrene (PS) | 17 | Cool boxes, floats, cups, utensils, take away packs. | 50 | Rarely |
| Polyethylene PE HPDE LPDE | 40<br>57 | Plastic bags, storage, Containers for milk, cleaning agents, shampoo, boxes, straws, | 20 | Yes |
| Cellulose acetate(CA) | 11 | Cigarette butts | 10-12 | No |

Modified from: Enders et al.,2015, Geyer et al., 2017 synthetic fibers such as rayon. Wastewater from washing machines was postulated as a major source of these fibers which could be eliminated with an efficient wastewater treatment system (Racchid et., 2017).

## Microplastics in Marine Water Systems

Microplastics have accumulated in oceans worldwide in recent years, with maximum concentrations reaching over 100,000 particles $m^3$ (Gallo et al., 2018). Although the intake of microplastics by marine organisms is a familiar concept, the experimental demonstration of the consequences of these ingested microplastics on marine organisms has piqued the interest of the scientific community in recent years. Low density microplastic debris accumulate in ocean gyres and pelagic invertebrates dwelling in these regions while the benthic community is a probable sink for high density microplastics (Duis and Coors 2016). Benthic suspension and deposit feeders are therefore likely to ingest sinking and sedimentary microplastics (Wright et al., 2013). Microplastics were discovered in the guts of seabirds in the 60's and have been on the increase since then (Barnes et al., 2009). A study by Amanda et al. (2014), divulged that the microplastics colonized by bacterial biofilms possess distinct taxonomic composition as compared to the bacteria present in the water surrounding them. The circulation of microplastics in the marine ecosystem is correlated to their polymer density (Graca et al., 2017). This would imply that low density plastic debris most likely recirculates between beach sediments and seawater to a greater extent unlike high density debris. In the 1990s, it was recognized that a minor source of microplastics pollution was derived from liquid hand-cleansers which was still new to the markets. However over a decade after, the average household now uses microplastic-containing products on a daily basis, as the majority of facial cleansers and personal care products are found to contain polyethylene (93%) microplastics (Lisa et al., 2009, Gouin et al., 2012). These are not often caught by sewage treatment plants and thus end up in the oceans.

## Microplastics in Beach Sediments

Global occurrence of microplastics in marine and freshwater habitats has been so far documented in mostly in sandy beaches and coastal/transitional sediments (Browne et al., 2010). Zbyszewski and Corcoran. (2011) conducted one the first thorough investigation on the types, distribution, types and degradation processes of plastic particles in Lake Huron, Canada. Results indicated that polypropylene degraded much faster whereas polyethylene was more resistant to degradation under natural conditions. Likewise, Rowshyra et al. (2014) revealed that sediment samples obtained from St Lawrence river, also in Canada contained polyethylene microbeads of 0.40-2.16 mm diameter. An Italian study in 2015 reported that the beach sediments of subalpine lake was littered with plastic particles and the northern beach was more contaminated with microplastics than the southern beach due to wind actions (Imhof et al., 2015). A recent investigation of the river sediments in Shanghai, China indicated approximately 800 particles/kg dry weight of sediment (Guyu et al., 2018).

These and many more documented studies have identified benthic sediments as the major sink for microplastics and the interactions between this plastic debris and marine organisms play a key role in the circulation of plastics across the oceans (Clark et al., 2016). Nonetheless, the effects of microplastics on soil aggregation are still uncertain with regards to clogging of macropores and movement (Devriese et al., 2015).

## Microplastics in Biota

Monitoring the intake of microplastics in the wild is methodologically a herculean task; nonetheless there have been an increasing number of researches reporting microplastics ingestion across the trophic levels (Browne et al., 2008). The existence of microplastics has been reported in a large number of fish species captured in the oceans, seas and freshwater (Alomar et al., 2017; Bessa et al., 2018; Jabeen et al., 2017; Morgana et al., 2018). Research also suggests that the effects of the ingestion of microplastics on smaller animals are quite similar to that of microplastics in larger animals as plastic fragments block the feeding appendages resulting in reduced food intake (Barnes et al.,2009; Fendall and Sewell, 2009). Nonetheless, a number of marine organisms (polycheate worms) possess the ability to excrete unwanted materials such as microplastics, sediments and particulates from their body without it being detrimental to them (Thomson et al., 2004). Translocation of polystyrene microspheres was first reported in rodents, humans and also mussels (Browne et al., 2008). The biological effects of some of these plasticizers in invertebrates, fish and amphibians was investigated by Oehlmann et al. (2009) revealing the impairment of development in the species. They also observed that mollusks, crustaceans and amphibians appear to be especially sensitive to these compounds. In the African Great Lakes, polyethylene, polypropylene and silicone rubber were recovered from the gastrointestinal tracts of Nile perch (*Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*) fished from Lake Victoria (Farhan, 2017). The likely sources of these plastics were postulated to be from human activities such as fishing, tourism and urban waste.

Several duck species in South Africa were reported to have been exposed to microplastics detected in their faeces and feather brushings (Reynolds and Ryan, 2016). On a sadder note, Lima et al. (2015) disclosed that at certain time intervals in the north of Brazil, microplastics were of higher density than the ichthyoplankton in the Goiana Estuary. In another context, the presence of earthworms in contaminated soils increased the presence of micro plastic particles (PE) at 3.5 cm depth (Rillig et al., 2017). This is because of the feeding mechanism of earthworms which aid in breaking down of the microparticles.

During the production of plastics, certain additives referred to as "*plasticizers*" are used to alter their physical properties. These plasticizers are harmful to the living organisms and the environment. The presence of phthalate group (high percentage) and others such as epoxies, aliphatic polybrominated diphenyl ethers (PBDEs), bisphenol A etc. can result in the imbalance of hormones in aquatic life as well as the effects on mortality, abnormal reproductive and neurological development depending on the dosage of intake (Barnes et al., 2009; Lithner et al., 2009, Tullo 2015). These additives have become an environmental concern since they both extend the degradation times of plastic and in addition, leach out, introducing potentially hazardous chemicals to biota and eventually humans who are the major consumers of fish and other marine organisms.

## Wastewater Treatment Plants (WWTP) as Hotspots of Microplastics

Another major source of microplastics is wastewater treatment plants (WWTP) giving rise to environmental and health concerns. Studies have reported that plastics harbor distinct microbial communities and the risk of introduction of unknown and potentially pathogenic taxa from wastewaters to freshwaters and eventually marine habitats is very high (Harrison, 2014, Mirka et al., 2018). In this context, microplastics may act as vectors for harmful additives and contaminants (Teuten et al., 2009) and they have the capability of being transferred within the food web (Setala et al., 2014). This has a direct impact on the fate of numerous toxic substances in the ecosystem. In the last decade, global surveys with regards to the occurrence and fate of microplastics (MPs) in aquatic environments have amplified. This is as a result of the increase in plastic production (Plastics Europe, 2016) and subsequently the threat of microplastics contamination in the environment. As discussed in previous sections, the sources of microplastics are numerous and most wastewater treatment plants do not have any specific system in place to check the contamination or removal of microplastics. Microplastics have been detected in both the primary and secondary treatment stages of the plants even though study showed that most microplastics are actually removed during the primary treatment stage during the skimming and sludge settling stages (Car et al., 2016). Proper functioning of the treatment plants would result in lesser contamination of water ways with microplastics. Nonetheless, in several countries, the sludge from the WWTPs is used as soil fertilizer which exposes microplastics present to different environmental conditions such as extreme heat and cold or other biological factors resulting in fragmentation of these polymers. Subsequently, the resulting microplastics most frequently wind up in drains and ultimately into water bodies. As time goes by the fate of these microplastics are becoming known to man. In addition to that an important reason for the urgent need to promote research studies on microplastics is their potential to cause eco-toxicological issues in the environment (Hidalgo-Ruz et al., 2012). Marcus et al., (2017) concluded that of all analyzed polymers in a WWTP, Polyethylene terephthalate (PET) was revealed to be most abundant, constituting 79% of the entire microplastics load and being present in all studied stages of the wastewater treatment plants.

## Methods of Detection of Microplastics

Small particles of plastic were first reported in the marine environment in the early 1970s (Hidalgo-Ruz et al., 2012). The abundance of microplastics may vary with sampling sites, which is not necessarily reflective of the magnitudes of microplastics pollution, but may also be related to the pore sizes of sampling tools. Identification of micro plastics is based on the physical and chemical characterization of isolated particles in mixtures of inorganic and organic remnant particles after the extraction and clean-up steps. It is difficult to identify micro plastics of various sizes, shapes, and polymer types fully and reliably from complex environmental matrices using a single analytical method (Shim et al. 2017). Therefore, the combination of more than two analytical techniques has been widely recommended.

### Visual Sorting

After separation and purification, target MPs need to be sorted from the remaining surrounding substance. Large plastics can be sorted out directly, while smaller-sized ones need further observation under a microscope (usually a stereomicroscope) after the samples are dried under cover in an oven, generally at 60 °C (Mai et al 2018). Potential target MPs are thus magnified, sorted, and counted. This method is suitable for the sorting of large MPs, but it is not always applicable and is necessary to use other instrumental techniques (e.g. Fourier Transform-Infrared Spectroscopy (FT-IR) and Raman spectroscopy) for further identification. Many researchers reported that only 68% of visually sorted particles were MPs after identification by Raman spectroscopy, and the success rates of different particles or fibers were dependent on the particle color. Fibers are easier to be identified than particles.

## Thermal Analysis

The thermo-analytical technique, which measures changes in the physical and chemical properties of polymers depending on their thermal stability, has been recently tested for micro plastic identification. Differential scanning calorimetry (DSC) is a useful method for studying the thermal properties of polymeric materials (Shim et al., 2017)

### *Pyrolysis-Gas Chromatography/Mass Spectrophotometry (P-GC/MS) and Thermal Desorption SamplingGas Chromatography/Mass Spectrophotometry (TDS-GC/MS)*

PGC/MS can simultaneously analyze both the polymer type and organic additives of MPs. Upon being extracted from environmental matrices, plastic particles are thermally deconstructed before the polymer composition of each particle is determined with GC/MS (Mai et al 2018). This technique allows only one particle at a time to go through the pyrolysis tube, which is both time consuming and limited by the aperture size of the tube.

## FT-IR Spectroscopy

FTIR spectroscopy provides information on the specific chemical bonds of particles. Carbon-based polymers are easily identified with this method, and different bond compositions produce unique spectra that discriminate plastics from other organic and inorganic particles (Shim et al 2017). FT-IR and its optimized technologies, such as micro FT-IR, attenuated total reflectance (ATR) FTIR, and focal plane array detector-based micro FT-IR imaging, are also used in MP studies.

## Raman Spectroscopy

Raman spectroscopy is another promising analytical technique frequently used for MP detection. The main benefits of Raman spectroscopy are that small particles down to 1 μm can be examined and that it has better responses to non-polar plastic functional groups than other analytical methods. To minimize false signals with Raman micro-spectrometry, rigorous sample purification is strongly recommended (Mai et al 2018).

Due to the non-uniformity of protocols in the detection of microplastics currently in practice, the reliability of the data is often a cause for debate (Hidalgo-Ruz et al. 2012). Therefore in order to rectify this, the standardization of methodologies for identification, quantification and ensuring the formulation of SOPs of microplastics in the marine environment must be put in place. The whole cycle of the assessment of microplastics from sampling procedures to purification and identification of microplastic particles must be considered (Loder and Gerdts 2015). This would guarantee for a reliable appraisal and the quantification of potential impacts and risks of microplastics in the oceans globally.

## **Degradation of Microplastics by Bacteria**

Biodegradation of synthetic polymers has come into the limelight in recent years as a result of the ever increasing pressure on scientists to come up with solutions to this plastic ‘*menace*’. Several bacteria species have been reported to degrade plastic polymers on the assumption that bacteria are very opportunistic and have the potential to invade/adapt in harsh conditions. (Sangeetha Devi, 2019). Singh et al., (2016) reported the degradation of polyethylene by 3 strains of bacteria; *Staphylococcus sp., Pseudomonas sp*., and *Bacillus sp.*, isolated from soil while Sivan (2011) testified that *Brevibacillus spp.* and *Bacillus spp.* were capable of degrading polyethylene as well. In other studies; Mor and Sivan (2008) and Caruso, (2015) noted that polystyrene and polyvinyl chloride (PVC) were broken down by *Rhodococcus ruber* and *Pseudomonas putida* respectively. *Arthrobacter sp. and Pseudomonas sp*. were identified as having the potential to degrade HDPE by Balasubramanian et al. (2010). In 2016, *Ideonella sakaiensis*201-F6 was discovered to have used PET as a carbon source for feeding Yoshida et al. (2016). Most recently, Alka Kumari et al., (2019) observed the destabilization of LDPE, HPDE and PVC) by AIIW2 strain.

It is therefore evident that the process of biodegradation does show potential in the reduction of plastic waste or harmful effects of the waste. This however should be given more consideration and support in order to seek for a long-lasting solution to our impending threat.

## Revisiting the Existing Policies on Microplastics

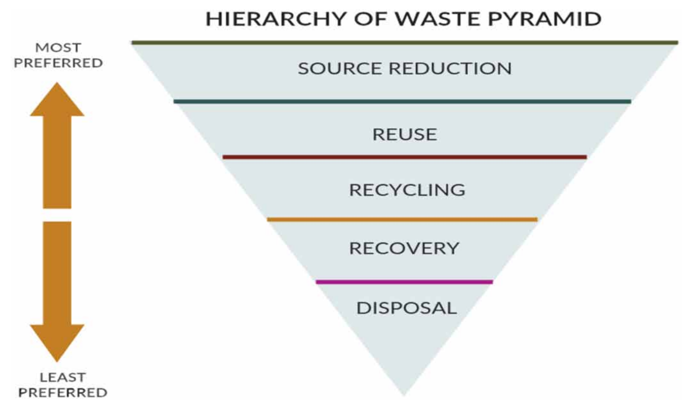
Potential consequences of the increasing release of microplastics into the environment are not covered by current environmental risk assessment acts which were typically developed for chemical substances. Steensgaard et al., 2017 advocated in their analysis of macro to micro plastics that polymers should not be exempted from the Registration, Evaluation Authorisation & Restriction of Chemicals (REACH) (EC regulation, 1907/2006). If considered in the same category as hazardous waste there is bound to be stricter regulations as to their processing and lifecycle. However, the fate and effects in water and soil, and size distributions in all environmental compartments need to be analysed and quantified before adopting of the risk procedure statutes.

Thorough assessments of the potential environmental risks caused by microplastics remain to be vetted despite many damning reports and visualisation from news and social media. The UNEP came forward with several actions towards ridding our oceans of the humungous amounts of plastic debris found in the marine ecosystem. This further led to the creation of awareness and promotion of recycling plastic, proper disposal measures. In the same vein there have been several attempts by various governmental and non-governmental organizations (the United Nations Environment Program/ Mediterranean Action Plan (UNEP–MAP), the Oslo/Paris convention (for the protection of the marine environment of the North-East Atlantic (OSPAR), and the Baltic Marine Environment Protection Commission-Helsinki Commission (HELCOM) in setting guidelines for the assessment of marine litter taking account of microplastics (Lassen et al., 2015).

Cosmetics including toothpaste as well as the UK ban on microbeads in cosmetics by 2017 (UK Department for Environment, Food & Rural Affairs 2016) was another initiative towards the goal. The UNEP's report on "marine plastic debris and microplastics," included the issue in the European Marine Strategy Framework Directive, as "marine litter" (Brennholt et al., 2018)

In 2015, the California Microbead Ban bill was approved followed by the House Representatives Legislation for prohibiting the manufacture, sale, or distribution of microbeads. In France, a decree was created aimed at stopping the use of microplastic particles in cosmetics effective from 1st January 2018 and from January 2020, the use of plastic ear buds will be included to the decree. In addition, Ministry of Environment and Food of Denmark in conjunction with a chemicals Agency (KEMI) proposed a microbeads ban as well. The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) encourages all nations to adopt the *Reduce– Reuse–Recycle* policy as cost effec-

*Figure 3. Hierarchy of waste pyramid*
*Modified from US EPA (2016) and Quaik et al., (2017)*




tive way of lessening the quantity of plastic objects and microplastics particles find way into the ocean (GESAMP, 2015)

In spite of all the efforts made by different countries, microplastic litter in freshwater systems has not yet been explicitly addressed in the respective regulations. Brennholt et al., (2018) observed that most of the decrees, regulations, agreements, strategies, programs, and guidelines refer to "all wastes" in general which still points to the deficit in the policy.

## THE WAY FORWARD

The invasion of plastics and its derivatives in our lives has reached unprecedented levels. It has reached a point that almost everything around us is made of plastic. News and social media have also played active roles in enlightening people across the globe. From whales found with kilograms of plastic in their guts (Thailand), to the deplorable condition of Midway Atoll, North Pacific Ocean a.k.a 'Plastic island' where birds where found choked to death by plastics, "developed" countries sending off their plastic wastes in tonnes to poorer countries and so many more. Experts have located bits of degraded plastic along with synthetic fibres and microbeads lurking around our waterways, soil and even in the air. Despite all this, the question that lingers is what has been done? Has it reduced? What can be done either as an individual or collectively? These questions lead us back to two basic questions? What is being produced? How is it disposed?

There is no single or definite solution. Policy makers all over the world have instigated that the key to plastic waste problems i.e. microplastics inclusive is to go back to fundamental rethinking (3R strategy). This is supported by UNEP's 4- tiered waste management hierarchy as a guide for decision makers in waste management as illustrated in Figure 3. The efforts to combat this menace begin from the source and are the most cost effective and preferred method.

As immediate measures, the curtailing of avoidable single-use plastic items such as shopping bags, straws, food packaging, plates, spoons and water bottles would be a start in the right direction. Cutting down of single-use plastics should cut across various industries other than the food packaging industry (highest user of plastic polymers) such as construction, electronics and fabrics. Reusable items can be retrieved by fortifying the waste disposal systems and more emphasis be placed on the segregation of plastic wastes. As mentioned in the earlier section, recyclable plastics if separated at the source would help reduce the problem by great margins. In addition to this, some of these measures if practiced at home would also go a long way in reducing what is eventually being dumped. There are so many ways we can repurpose our used plastic items at home such as for gardening, storage, etc. The bottom of the pyramid lays disposal which should be considered when all other alternatives have been exhausted. It is least preferred because we have no control on their final resting place.

Although studies have mentioned the ability of certain bacteria and enzymes that are capable of breaking down certain types of plastic (as discussed in earlier section), how much of this can work for the humungous amounts of waste already existing in our oceans and if there are any side effects such as production of greenhouse gases.

In recent years, with all the hype and attention given to microplastics, multinationals have also made some efforts in this regard. IKEA has incorporated EPR (Extended Producer Responsibility) policies into their business model by endorsing material reuse and recycling throughout its production process and consumer experience. Adidas likewise partnered with Parley for the Oceans (a committee that addresses major threats towards our oceans) in 2015, to manufacture sneakers and clothing from plastic pollution in the Maldives.

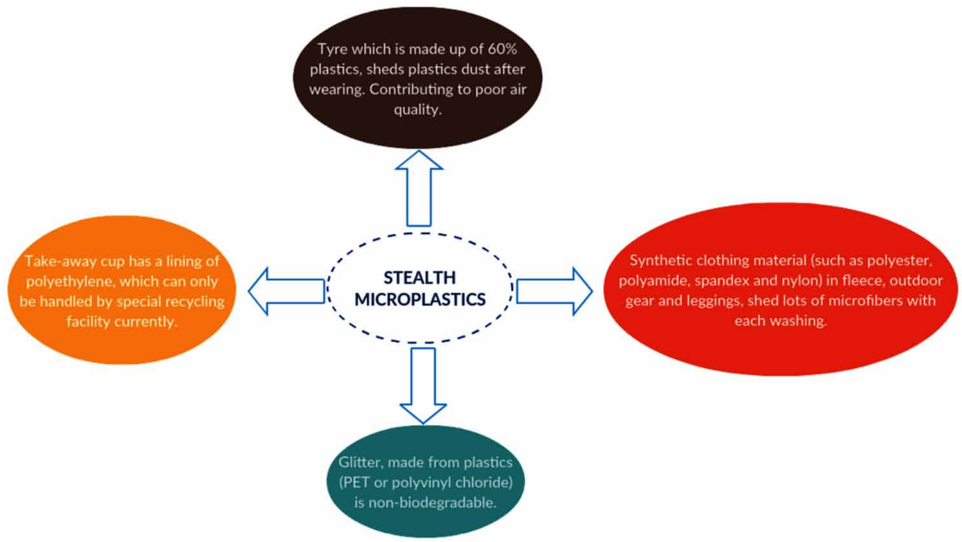
Another approach to mitigation is beach cleanup programs. The International Coastal Cleanup (ICC) coordinated by the Ocean Conservancy, a US NGO, started in 1986 educates and empowers citizens all over the world to take action on behalf of the ocean. In 2018, under the umbrella of Ocean Conservancy a Beach Cleanup at Port Dickson, Malaysia resulted in 1,939.50 kilograms of trash. Reef Check Malaysia (RCM), as part of the International year of the Reef 2018 organised a cleanup campaign that recorded 14,000 plastic bottles, 6,200 plastic bags and 1,700 straws. In India, the Dadar Beach Clean Up Campaign in 2018 spearheaded by Aarna Foundation took it upon themselves to clean up the beaches of Mumbai after the Ganesh Pooja and cyclone Okhi. 100 tonnes of garbage was collected after 19 weeks of the exercise.

As much as these efforts are definitely going to reduce the overall burden of microplastics on our ocean, the solution still lies in our hands. The most effective ways will be avoidance at all costs.

## Stealth Microplastics… 'Discovering the Unknown'

Many are oblivious of so called "stealth microplastics" which are hidden in plain sight but are ever present in our daily life. Right from tea bags, wet wipes, glitter, laundry detergents, to our disposable paper cups are lined with microplastics. The misconception that "disposable coffee cups" are considered recyclable is common. We automatically dispose them in the paper section of recycling bins without realizing that it is not made of 100% paper. Currently, only special recycling facility is able to process such waste which renders it unproductive for the copious amounts discarded all over the world. As expected, they end up in the landfills, which take hundreds of years to degrade. Figure 4 provides an illustration of the sources of these hidden microplastics which are still very much present in our lives despite the efforts to ban the visible ones.

*Figure 4. Stealth microplastics.*




## CONCLUSION

With the advancement of technology and population rise, increase in waste is eminent. The vast application of plastics in our lives has led to accumulation of huge amounts of waste which most often ends up in our oceans. The degradation of these plastics over the years has led to micro plastic pollution which has become an impending threat to mankind. A menace of huge proportions which if left to unattended would lead to severe problems all over the world. It is often referred to as tiny problems requiring massive solution.

Microplastics have invaded every nooks and crannies across the world as a result of human activities such as tourism, marine activities and normal everyday life. From densely populated regions such as China and India, to the sparsely populated areas such as the Polar Regions the presence of microplastics has been known. The distribution of microplastics is determined by environmental factors such as winds and current directions, and natural calamities. The penetration into food chains and ecosystem has resulted in the disruption in the biological systems of fauna leading to poor growth, reproductive and developmental calamities. However, knowledge on the toxicity of microplastics to humans has not been documented and there is little or no evidence to ascertain the direct effects on man other than the implied ones.

Members of the scientific community and other stakeholders have suggested the inclusion of microplastics to the current waste management handling rules and implored people to treat plastics or microplastics with great concern.

Above all, despite all the cautions and rules, the most important measure would be to follow the "avoid the avoidable" principle. Bring our own bottles, use steel cups/glass, biodegradable utensils, and alternate food packing methods. In addition, there is need for a more holistic approach in understanding the severity of the impending threat and plan for the future.

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