Plastic Litter as Pollutant in the Aquatic Environment: A mini-review

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Abstract

The negative impact that comes from plastic litter in the aquatic environment is a scourge for the entire world including Indonesia. Plastic litter has a huge influence on the most biota who lives in symbiosis with along the aquatic environment as it is able to sustainability. Moreover, there are other factors that cause the death of aquatic biota. Nowadays, the negative impact of plastic litter occurs on an ongoing basis through the food chain process which until now has not been well studied. Therefore, it is necessary to do further studies on the influence of the food chain as a vector of plastic litter distribution, particularly microplastic on aquatic biota from the first trophic level to high trophic levels.

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1. Introduction

Plastic waste is the biggest problem in the world since it is the type that dominant marine debris (CBD-STAP, 2012). It is formed by a synthetic organic polymer that has the characteristics of materials that are suitable in daily life. Plastic litter is also a complex problem for people who live in an area near the mouth of the river. The impact of plastic waste is able to cause damage to the aesthetics of aquatic ecosystems and also to the biota that lives in it, causing various diseases, influencing food webs and reducing the productivity of captured fish (Dewi et al., 2015; Gall and Thompson, 2015).

Plastic waste is going to influence the food chain in waters and ecosystems, the economy and public health (Citasari et al., 2012). Plastic waste is also can be swallowed by marine mammals, seabirds or sea turtles (Coppock et al., 2017). Anthropogenic activities such as domestic activities, agriculture, industry, tourism and other activities have the potential to become sources of plastic waste, especially microplastics. Plastic waste enters the water column until it is finally accumulated in the sediment. The type of plastic litter that has negative and great influence on the food chain and is harmful to aquatic biota is microplastic. Microplastics pose a very serious threat compared to other plastic materials, particularly in the biota that digests them (NOAA, 2016).

If microplastics are accumulated in sediments, it is going to cause disruption of the balance of ecosystems and food chains in biota, especially for the fishes. The result is going to influence high trophic organisms through the process of bioaccumulation (Bergmann et al., 2015). Microplastics in sediments are going to rise to the water column through an upwelling process which is going to be swallowed and digested by the biota that lives in the water column such as fishes (Tankovic et al., 2015).

Furthermore, fish is one of the biotas who is often used see to the spread of microplastic. There are more than 100 species of fish from all over the world who was detected to contain microplastics. Microplastics that enter the fish’s body is able to be harmful to the health of individuals and population development. The results of laboratory studies revealed that the negative effects of microplastic on fish include: intestinal damage and short-term to long-term inflammation (Jabeen et al., 2017; Miranda and de Carvalho-Souza, 2016; Wesch et al., 2016). In this review, we provide information on plastic litter in general for study on plastic litters that pollute the aquatic environment including the aquatic environment in Indonesia.

2. Plastic Litter

Industrialization and anthropogenic activities in various parts of the world is the main cause of pollution (Risjani et al., 2014), including the problem of plastic litters. Based on environmental regulation of Republic of Indonesia UU No. 18 of 2008 a litter is a remnant of human daily activities and or natural processes that produce solid formations and do not contain hazardous litter. Based on that decree, it’s known that the primary focus concerning waste management in the environment explains that litter is the residue away from human activities or natural activities in the configuration of solid or semi-solid in the configuration of organic and inorganic matter which have biodegradable or non-biodegradable properties which are regarded as of anymore useless and disposed of neighborhood. According to Kodoatie (2003) debris is solid, semi-solid debris or debris which is the result of population activities or the life cycle of humans, animals and plants. Debris is a man-made concept in natural processes.

Marine litters is a solid material which is produced and processed directly or indirectly, intentionally or not which flows into the aquatic environment (CSIRO, 2014). Marine litters is defined as residual litters due to anthropogenic activities that enter the coastal environment or the environmental (NOAA, 2015; Heatherington et al., 2005). One type of marine litter that is currently in the hot news is plastic. This is related to the amount of what increase that occurs in the environment (Lee and Sanders, 2015; Suaria et al., 2015).

Plastic litter itself can last up to hundreds of years and become a trigger for pollution in the environment. If the plastic litter is burned, it will produce gas that can pollute the air, as well as endanger the human respiratory system. In addition, plastic litter piled up in the ground will pollute the soil and groundwater. The amount of plastic that has been consumed is around 100 million tons/year worldwide. This is able to be a direct threat to the aquatic biota, aesthetics of the ecosystem, human health and safety of navigation, which in turn will have a major loss. Around 12 billion tons of marine litter are dumped every year at sea (NOAA, 2016).

The enhancement and increase in the number of plastic litter in waters originate from anthropogenic activities where the source of the pollution is materials that are not from nature and are influenced by human intervention (Jambeck et al., 2015). Plastic litter enter-
ing the ecosystem of the water comes from the input of river, estuary and ocean waste itself, as well as the presence of intrusion from land waste. Sources of plastic waste in accordance with NOAA (2016):

Mainland Activities

Waste from settlements or domestic (household) activities is not well managed end up in the waters through river mouths (Syakti et al., 2017). About 80% of plastic waste comes from land activities (NOAA, 2016).

Industry

One of the wastes produced in the industry is plastic, paper, bottles and so on. The most dominant and most found marine trash is plastic (CBD-STAP, 2012).

Fishermen Activities

The activities of fishermen are one of the factors increasing the amount of waste in sea waters. This is because fishermen deliberately dispose off debris in the form of fishing gear which is plastic material such as unused nets into aquatic ecosystems, particularly at sea. The United States government issued a regulation prohibiting disposal of debris at sea because it could disrupt navigation of the shipping lanes, particularly those from fishing activities (NOAA, 2015).

3. Type of Plastic Polymers and Size

Plastics are polymers composed of hydrocarbon chains consisting of long chains of carbon (carbon molecules and hydrogen atoms). The term plastic includes synthetic or semi-synthetic polymerization products, but there are a number of natural polymers classified as plastic. The plastic itself is formed from the evaporation of organic material or the addition of other polymers to increase selling value and durability. Since the 20th century, the use of plastic has expanded widely to reach 220 million tons/year in 2005 (Heteringthon, 2005; Kadir, 2012).

There are two categories of plastic with different functions these are thermoplastic type and thermostetting type (UNEP, 2009). The categories of plastic are presented in Table 1. There are seven types of plastic polymers that are found in the environment based on the specific gravity and function of the plastic itself. The types of plastic polymers are presented in Table 2. To find out the size of the plastic whisis able to have a negative impact on biota, the size of the plastic got categorized into several types of different sizes (Ryan et al., 2009). According to Barnes et al. (2009); GESAMP (2016) is known that types of plastic sizes are able to be broadly grouped into four types such as: mega plastic, macroplastic, meso-plastic and microplastic (Table 3).

The larger size of the plastic fragments creates the risk of being entangled, swallowed to suffocation on biota. This event often occurs in most seabirds, fish and marine mammals that live in areas that are contaminated with microplastics, while mesoplasmic and microplastic types can be swallowed by various marine organisms such as fish, dugongs, turtles and others. This is able to cause concern for this species, particularly for endangered species (Gall and Thompson, 2015).

4. Microplastic

Plastic is a common comodity in modern society. The most plastic consumption is only used once. As a result, a pile of plastic litter will pollute the environment and become marine litter (Wang et al., 2016). The Ministry of Industry in Indonesia has confirm that around 4 million of tons of plastic have been produced since 2016. It is known that 0.52 kg/person of litters is released or discarded every day and more than 83% of the litter is not managed properly or in other words, it is just thrown away into the environment. Among the volume of litters, about 11% is plastic litter that is dumped into the sea (Jambeck et al., 2015). Indonesia has produced more than 5.4 million tons of plastic litter. Around 3.22 million tons are not managed. Around 0.48-1.29 million tons end up being a marine litters (Jambeck et al., 2015). Microplastic is part of plasticless than 5 mm - 0.33 mm in size (GESAMP, 2015; NOAA, 2015). Microplastic is divided into two these are primary microplastic and secondary microplastic (GESAMP, 2015).

Primary microplastic is a plastic that has a microscopic size (UNEP, 2016). Primary microplastics include pre-production (before production) of pellets in companies or the plastics industry. Microbeads or primary microplastics are used as additions to cosmetic ingredients (da Costa et al., 2016; Napper et al., 2015; Murphy, 2017). Meanwhile, secondary microplastics are plastic particles that are formed due to the degradation of plastic material due to environmental factors such as sunlight, wind, rain and water wave activity (Cole et al., 2013). Microplastic can be divided into several types of plastics including film, fibre, fragments, and pellets as below table
Table 1. Categorise of Plastics

| No. | Categorize of Plastic | Character | Example | Reference |
|-----|-----------------------|-----------|---------|-----------|
| 1.  | Thermoplastic         | Small molecular weight, easy to melt when heated and easy to harden when cooled, flexible, low melting point, linear molecular structure | Polyethylene (PE), Polyvinyl Chloride (PVC), Polypropylene (PP), Polystyrene, LDPE, PP, ACETATE, packing material | Elzubair et al. (2006) |
| 2.  | Thermosetting         | Inflexible, cannot melt (rigid), difficult to be reshaped, resistant to acid-base, has crosslinking | Bakelite (ashtrays, electric light fittings, electric plugs, photographic equipment, radios, plywood adhesives) | UNEP, 2009; Sofiana, 2010 |

Table 2. Types of Plastic Polymers

| No. | Name                          | Abbreviation | Specific Gravity | Character | Function | References |
|-----|-------------------------------|--------------|-----------------|-----------|----------|------------|
| 1.  | Polyethylene Terephthalate    | PETE/PET     | 1.37-1.39       | Clear, strong, resistant solvent, can be used for food (oven and microwave) | Lightweight bottles, fast food jars, rigid sheets and fibres | Andrady, (2011); Li et al. (2016) |
| 2.  | High Density Polyethylene     | HDPE         | 0.94-0.96       | A type of plastic that is difficult to semi-flexible, opaque surfaces | Freezer, milk bottle, bleach bottle, bucket and others | Adhikary et al. 2008; Andrady, (2011); Li et al. (2016) |
| 3.  | Polyvinyl Chloride            | PVC          | 1.37-1.39       | Flexible, elastic properties, can be dissolved | Shoe soles, cables and others | UNEP, 2009; Andrady, (2011); Li et al. (2016) |
| 4.  | Low Density Polyethylene      | LDPE         | 0.91-0.93       | A soft, flexible and waxy surface that is translucent, resistant to solution | NA | UNEP, 2009; Andrady, (2011); Li et al. (2016) |
| 5.  | Polypropylene                 | PP           | 0.83-0.85       | Hard, flexible, translucent and resistant to chemicals | NA | Andrady, (2011); Li et al. (2016) |
| 6.  | Polystyrene                   | PS           | 1.04            | Properties Clear, glassy, rigid, brittle, opaque, melting at 95°C | Refrigerator and clothes hanger | UNEP, 2009; Andrady, (2011); Li et al. (2016) |
| 7.  | The other ones                |              |                 | Resin and multi-material | Acrylonitrile butadiene styrene (ABS), acrylic, nylon, polyurethane (PU), polycarbonates (PC) and phenolics | Andrady, (2011); Li et al. (2016) |

Table 3. Categorise Size of Plastic Litter

| Types        | Diameter | Source                                  | Example                                                                 |
|--------------|----------|-----------------------------------------|------------------------------------------------------------------------|
| Megaplastic  | >100 mm  | Abandoned gear, the result of natural disasters | Nets, fish traps, broken fishing lines, ropes, ship hulls, plastic litter from the agricultural industry |
| Macroplastic | >20 mm   | Disposal resulting from a maritime activity or from rivers | Plastic bags, packaging of food and others, floats of fishing and another buoy, balloons |
| Mesoplastic  | 5–20 mm  | Large plastic fragmentation             | Bottle caps, plastic litter                                           |
| Microplastic | ≤5 mm    | Primary and secondary microplastics      | Industrial and domestic products (primary), as well as textiles, fibre, tire dust (secondary) |

Source: Barnes et al., 2009; GESAMP, 2016
(UNEP, 2016). The film is a plastic polymer particle which comes from fragmentation of plastic bags or plastic packaging and has a very low density or volume (GESAMP, 2015). Kingfisher (2011) states that fibre is an elongated plastic particle or fiber derived from monofilament fragmentation in fishing nets, plastic ropes and synthetic fabrics. Fragments are microplastic particles produced by products of plastic with plastic polymers that dominate likebottles of drink, gallons of plastic and so on. Pellets are primary microplastics that originate directly from industry or factories as raw materials for making plastic products (Kingfisher, 2011; Tanada and Takada, 2016).

4.1 Primary Microplastic

Primary microplastic is parts of plastic with microscopic size. Mostly, primary microplastics are the industrial result and domestic litter (Betts, 2008; Moore, 2008) which is generally used as media of blasting (Gregory, 1996) to women’s needs, such as cosmetics (Zitko and Hanlon, 1991), as well as on the medical field widely used as a vector in drug manufacturing. One example of this microplastic is melamine or polyester with a size of 0.25-1.7 mm which is often used to rust off coat and paint cleaner (Browne et al., 2007).

On polythene and particle of polypropylene (<5 mm) and particle of polystyrene (<2 mm) are found as a mixture in cosmetic products (Fendall and Sewell, 2009). There was microplastic contamination along the coastline at 18 stations representing six continents (poles to the equator). One of the most significant microplastic sources in the ocean is pollutants in the form of fibre. About 78% of the polyester fibre and 22% of acrylic are found in coastal areas and come from washing machine disposal. This is due to the large proportion of fibres of polyester found at wastewater and ocean deep sediments (Browne et al., 2011; Oerlikon, 2009).

4.2 Secondary Microplastic

Secondary microplastic is part of the result of the fragmentation of large plastics into plastic litter (Ryan et al., 2009). This microplastic takes thousands of years to be degraded (Barnes et al., 2009). This plastic fragmentation process is an impact produced by sundry physical, biological and chemical processes to degrade the plastic presence (Browne et al., 2007). Corrosion process is one of the triggers for fragmentation of plastic (Arthur et al., 2009). The beach is an area that strongly supports plastic fragmentation due to chemical weathering activities (Corcoran et al., 2009).

Another equally important process which is no less important is photodegradation due to sunlight. Ultraviolet radiation from the sun contributes to oxidation processes in the polymer matrix, causing damage to the plastic chemical structure (Barnes et al., 2009). The process of plastic degradation in coastal areas is faster than in cooler waters. This is caused by the high availability of oxygen and the intensity of sunlight more frequently, resulting in damaged molecular groups from plastic (Browne et al., 2007). Mechanical processes such as abrasion, waves and turbulence also affect plastic fragmentation (Barnes et al., 2009).

5. The Risk of Plastic Litter in the Aquatic Environment

Ingestion of plastic litter through the digestive tract is a big threat and very dangerous for aquatic biota. The effects of plastic consumption on the health of wildlife can be divided into two major groups which are physical effects and physiological effects that are interrelated. It also provides a retention effect on any biota that accidentally swallows plastic litter. All physical effects will ultimately lead to physiological effects on biota (Barboza et al., 2019; NOAA Marine Debris Programme, 2014). In addition, plastic litter is often associated with chemical poisons that contribute to sublethal effects on biota, particularly aquatic biota (Thompson et al., 2009). The effects of ingestion of plastic litter on aquatic biota are presented in table 4.

A species of aquatic biota can be affected by the consumption of plastic litter due to the transfer and accumulation of plastics as pollutants. The amount of plastic litter swallowed by aquatic biota has been documented. Seabirds and sea turtles are one of examples of aquatic biota that consume the most plastic litter (Barboza et al., 2019). About >90% of seabirds store plastic litter on the intestines (Wilcox et al., 2015) which is thought to be a natural feed as well as fish eggs and crustaceans (Azarelle and Vleet, 1987). Most of the world’s sea turtles have consumed plastic and plastic litter produced by humans (Schuyler et al., 2016). Furthermore, sea turtles also ingest plastic litter which is thought to be a jellyfish which is a natural food for turtles while in the waters (Laist, 1987; Schuyler et al., 2014).

Use of plastic litter, mostly microplastic trapped on the beach is higher because the coastal area is a spawning ground, feeding ground and nursery ground. The symptoms of hunger of seabirds and sea turtles is higher and truly worrisome. This aquatic biota will stop eating because of a false sense of fullness due to the volume of plastic that cannot be digested in the stomach.
Table 4. Effects caused by plastic Litter on aquatic biota

| No. | Condition | Organ | Effect | Biota | References |
|-----|-----------|-------|--------|-------|------------|
| 1.  | Physical  | Digestive system, skin and muscle tissue | Lacerations, lesions, ulcerations, inflammation and blockages in the stomach | Aquatic Biota | NOAA Marine Debris Programme, 2014 |
| 2.  | Physiological | Digestive System, Immune System | Inhibition of absorption of nutrients, disruption of the body’s immunological development, the presence of toxicology | Aquatic Biota | Barboza et al., 2019 |
| 3.  | Sublethal | Reproductive System, Digestive System | Inflammatory bowel, Reproductive cycle problems | Seabirds, turtles | Thompson et al., 2009; Wilcox et al., 2015; Azzarello dan Vleet, 1987; Schuyler et al., 2016; Laist, 1987; Schuyler et al., 2014 |
| 4.  | Retention | Digestive system | Inflammation until blockage in the stomach | Aquatic Biota | Barboza et al., 2019 |

Table 5. Effects of microplastics on aquatic biota

| No. | Type of Plastic | Concentration | Biota | Effect | References |
|-----|----------------|---------------|-------|--------|------------|
| 1.  | Polystyrene   | 0.22-103 mg nano polystyrene/L | Daphnia magna | Shrinking body size and reproduction | Besseling et al. (2014) |
| 2.  | Polystyrene   | >30 mg nano polystyrene/L | D. magna | Increased neonatal malformation problems | Besseling et al. (2014) |
| 3.  | Polystyrene   | 5-100 μg/mL | Artemia franciscana larvae | Sublethal effect (adsorption on antennules who increase the amount of moult) | Bergami et al. (2016) |
| 4.  | Nano Polystyrene Particles | 3,85 μg/mL | Sea urchin embryo (Paracentrotus lividus) | Disposition and toxicity, and gene upregulation of cellular stress response | Della Torre et al. (2014) |
| 5.  | Nano Polystyrene Particles (–NH₂) | 2,61 μg/mL | Sea urchin embryo (P. lividus) | Disablement | Della Torre et al. (2014) |
| 6.  | Nano Polystyrene Particles (–COOH) | >50 μg/Ml | Embryonic digestive tract P. lividus | Cessation of growth | Della Torre et al. (2014) |
| 7.  | Polystyrene (0,05; 0,5 dan 6 μm) | NA | Monogonont rotifer (Brachionus koreanus) | Disorders of the digestive process | Jeong et al. (2016) |
| 8.  | Polyethylene | 12,5-400 mg/L | Monogonont rotifer (B. koreanus) | Decreased growth rate, decreased the fertility of a biota, shortened life span, longer periods to reproduce and increased levels of enzymatic biomarkers from stress | Jeong et al. (2016) |
| 9.  | Polyethylene | 57,43 mg/L | D. magna | Effects of immobilization | Rehse et al. (2016) |
| 10. | Polystyrene | NA | Fish (Crassiuscrassius) | Changes in fish behaviour, decreased appetite for fish, changes in fish metabolism, Change of morphology on the brain and cellular disorders | Mattsson et al. (2015) |
| 11. | Microplastic (general) | NA | Copepoda | Inhibiting the ability to swim if it is attached to the carapace | Cole et al. (2013) |
so that this constant sense of fullness causes the aquatic biota to starve to death (Gregory, 2009). Plastics in the aquatic environment itself be plausible to cause physical or nutritional disorders directly when consumed by the biota that lives in these waters. This can be made worse by the attendance of plasticizers at the plastic granules themselves of other toxic pollutants attached to the plastic surface. Some indications suggest that microplastics are able to plague main producers at the bottom of food webs in the aquatic environment (Harmon, 2018).

Microplastics are small in size and move freely in the water column making it similar to plankton which enable their consumption by aquatic biota at different trophic levels. This is consistent with what was conveyed by do Sul and Costa (2014); Anderson et al. (2016); Ivleva et al. (2017) which is known that the highest level of microplastic consumption is found in fish, seabirds, marine mammals, and a number of invertebrates on marine and estuarine.

Meanwhile, microplastic exposure on freshwater is well known. This is from research conducted by Biginagwa et al. (2016); Faure et al. (2015); Mc Goran et al. (2017); Peters and Bratton (2016); Phillips and Bonner (2015); Silva-Cavalcanti et al. (2017); Eerkes-Medrano et al. (2015) that the results showed that fish originating from freshwater were exposed to microplastic by consuming the microplastic. It thereby shows microplastics are not accidentally or selectively digested by aquatic biota (Harmon, 2018).

5.1 Microplastics in Sediments and Water

In the aquatic ecosystems, microplastics have been found in sediments which float on the surface or float across the columns of water, which eventually leads down to the potential of both biota and populations problems in these waters (Harmon, 2018). Research on microplastics in sediments and water is aimed at looking at the abundance of microplastic as pollutants in freshwater (Anderson et al., 2016; Eerkes-Medrano...
et al., 2015; Ivleva et al., 2017; Mason et al., 2016), estuary until ocean waters (Enders et al., 2015; Ivleva et al., 2017; van Sebille et al., 2015). As for the results of the microplastics analysis on the sediments and water obtained it vary greatly in certain amounts. This shows that microplastic has become a very serious problem because of its enormous quantity and has been identified from plastic materials derived from oceans, lakes and rivers. This problem is exacerbate by the fact that microplastics are one of the pollutants that pollute the atmosphere (Dris et al., 2016), Arctic ocean and sea ice (Obbard et al., 2014; Lusher et al., 2015; Amelineau et al., 2016; Tekman et al., 2017), waters of remote lake (Free et al., 2014; Zhang et al., 2016), as well as aquatic biota obtained from seabed sediments (Taylor et al., 2016).

5.2 Plastic Litter in Mangrove Ecosystems

Mangrove ecosystems are found in intertidal areas and they adapt to developing root systems that surface. This occurs as a process of physiological adaptation of mangroves where pneumatophores and buffer roots will function as effective filters by holding back the wave energy and turbulence produced by the sea (Horstman et al., 2014; Norris et al., 2017). Such a mechanism also allows mangroves to trap objects carried by currents entering the coastal area, for example, plastic litter. The role of pneumatophores mangrove as a plastic litter trap has a higher contribution in trapping waste (Barasarathi et al., 2011; Lima et al., 2014; Mohamed Nor and Obbard, 2014; Lourenço et al., 2017; Naji et al., 2017). Plastic litter caught in the mangrove ecosystem shows different retention depending on the hydrodynamics of the object. This process shows a differential interaction between mangrove stands and plastic litter, giving an indication that plastic debris is considered as plastic litter disposed off in the ecosystem (Ivar do Sul et al., 2014).

Plastic litter found at mangrove ecosystems is garbage originating from land or river basins. Trapped plastic in pneumatophore or buffer roots is a physical obstacle to mangroves and can have a negative effect on the mangroves themselves and the biota in symbiosis with mangroves. One of the negative impacts caused is the inhibition of the process of respiration which will cause death slowly (Cordeiro and Costa, 2010). Potential chemical effects are more likely to increase with decreasing plastic particle size, whereas physical effects will increase with increasing plastic litter size. Macro debris has physical effects such as covering the surface of sediments and preventing the growth of mangrove seeds (Smith, 2012).

5.3 Microplastic Effects on Aquatic Biota

Microplastics with a size of 1 μm or less is able to cause problems for aquatic biota and came to particular attention because they have the capability to get through membrane of cells (Mattsson et al., 2015b; da Costa et al., 2016). One type of microplastic is polystyrene (Besseling et al., 2014) and polyethylene (Rehse et al., 2016). Effects which occur at the trophic level due to trophic transfer from the food chain have been suggested by Mattsson et al. (2015). This effect is likely due to morphological changes in the brain and cellular disorders. This suggests that microplastic exposure at lower trophic levels are able to produce effects on higher predatory consumers. Microplastic effects on these aquatic biotas are presented in Table 5.

6. Plastic Litter Problems in Indonesia

In the mid-20th century, the amount of plastic litter increased from 1% (EPA, 2011) to 10% in 61 countries in 2005 from a total of 105 countries (Hornweg et al., 2013). The total amount of plastic litter discharged into the sea ranges from 1.7-4.6% (Jambeck et al., 2015) and can even reach 10% (Avio et al., 2015). The amount of plastic litter is directly proportional to the population in a country with the fastest economic growth rate (Jambeck et al., 2015). In Indonesia, plastic litter is dominant and concentrated in largely populated cities, especially on Java (Table 6).

7. Conclusion

Over the past ten years, research on plastic litter has been a particular concern, mostly for the aquatic environment. Various studies explicate that plastic litter are water contaminants, particularly marine waters, which are spread throughout the water column. The level of plastic litter pollution in the aquatic environment including the biota which lives in a symbiosis get a lot of negative effects from marine waste, both from mega plastic to microplastic sizes. The process of transferring toxic substances contained in the plastic litter, particularly microplastics, attracts a lot of attention for researchers to examine this issue further. Therefore, research on the transfer of pollutants, mostly microplastics, have to be examined more closely related to the food chain that exists in the aquatic environment who can end in humans too.

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Authors’ Contribution

Author R. R A colleted data, drafted and wrote the manuscript while authors Y. N, and UUN devised the main conceptual ideas and critical revision of the article.

Conflict of Interest

All the authors of this review declare that they have no conflict of interest.

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