SPECIAL REPORT

Characteristics of Microplastics in the Lower Musi River in Palembang City, Indonesia

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The Musi River is a main river in South Sumatra Province, Indonesia with a length of 750 km from Bengkulu to the Bangka Strait. Many sectors utilize the Musi River including agriculture, fisheries, transportation, industries, forestry, plantations, and settlements. However, due to its environmentally stressed condition, the Musi River was prioritized as one of the 15 watersheds and 108 critical rivers in the National Medium-Term Development Plan of the government (BAPENAS, 2014; KLHK, 2019). The pressure on the Musi River is continually increasing as the human population of South Sumatra increased from 8.05 million (92 people/km^2) in 2015 to more than 8.65 million (100 people/km^2) in 2022. The increasing population could have exacerbated the condition of the Musi River particularly the discharge of toxic and hazardous waste (B3) and other water pollutants such as microplastics, and caused a decline in the water quality index from 69.36 in 2015 to 64.45 in 2019 (KLHK, 2019).

Concerning microplastics in rivers, it is believed that these pollutants can affect behavior, growth, and nutrient absorption in freshwater fishes (Mattsson *et al.*, 2015). However, information on the accumulation of microplastics in inland waters is limited and no studies specifically address the direct effects of microplastic accumulation in freshwater fishes. As a preliminary study under the project "Regional Collaborative Research and Capacity Building for Monitoring and Reduction of Marine Debris from Fisheries in Southeast Asia" supported by the Japan-ASEAN Integration Fund (JAIF), IFRDMD investigated the characteristics of microplastics in the lower Musi River in Palembang City. Samples of water and sediment were collected in August–December 2022 from the three sampling sites in Pulokerto District, Musi 4 Bridge, and Mariana District which are located from the upper to lower of the downstream areas of the Musi River (**Figure 1**). The three sampling stations are navigational channels and are surrounded by houses, while aquaculture farms are also present except in Musi 4 Bridge. In 2021, the human population density was 1,097 people/km^2 in Pulokerto District, 9,406 people/km^2 in Musi 4 Bridge, and 294 people/km^2 in Mariana District.

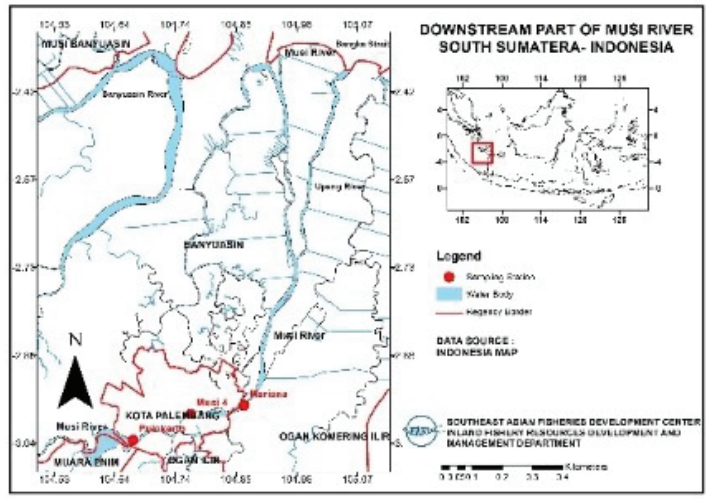

Figure 1. *Sampling stations for assessing the characteristics of microplastics in water and sediment of the lower Musi River in Palembang City, Indonesia in August–December 2022*

Density, form, and size, of microplastics

In the context of inland water bodies, such as rivers and streams, the water flow is unidirectional, moving from the source (upstream) to the mouth (downstream). The downstream areas of the Musi River have a more expansive coastal plain where there is a higher occurrence of sedimentation due to the coagulation process of various materials including sediment, minerals, heavy metals, as well as microplastics that settle and retain at the bottom of the water. Higher salinity in downstream areas also reinforces the rapid deposition and accumulation of microplastics in downstream waters. Considering that the

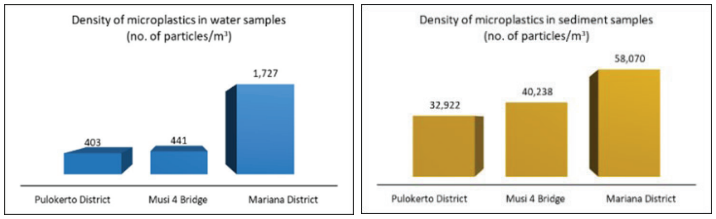

Figure 2. *Density (no. of particles/m^3) of microplastics in the water and sediment samples collected from the lower Musi River in Palembang City, Indonesia in August–December 2022*

sampling station in Mariana District is located in the furthest downstream area of the Musi River, **Figure 2** shows that it had the highest density of microplastics in both water (1,727 particles/m^3) and sediment (58,070 particles/m^3) samples.

The form of microplastics found in the water and sediment samples were classified as fibers, flakes, and fragments (**Figure 3**). Fibers are very small thread-like particles of plastic with an approximate size of 28 µm × 100 µm and < 1 g/cm^3 weight. Flakes are thin sheets of broken plastic with < 5 mm length and < 1 g/cm^3 weight that easily float and drift away with the water current. Fragments are chunks of plastic broken down by ultraviolet light and mechanical forces of the wind and waves that vary in size (< 5 mm long), are heavy (> 1 g/cm^3), and can easily bind to various types of river substrates. In the sampling stations going downstream, it was found that the proportion of flakes was increasing while the proportion of fragments was decreasing in the water samples (**Figure 4**). On the other hand, fragments had the highest proportion in the sediment samples in all sampling stations. It is also important to note that fibers were 20–25 % of the microplastics found in the water and sediment samples in the furthest downstream sampling station.

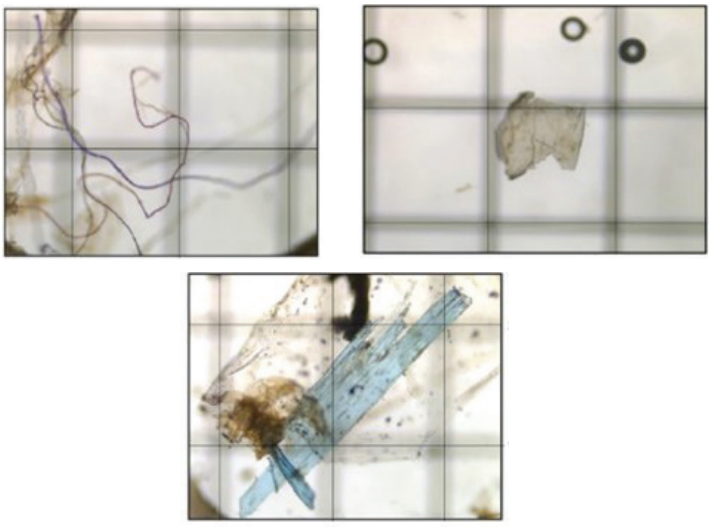

Figure 3. *Forms of microplastics (upper left-right: fibers, flakes) (lower: fragments) found in the water and sediment samples collected from the lower Musi River in Palembang City, Indonesia in August–December 2022 (Scale: 1 grid = 1 mm²)*

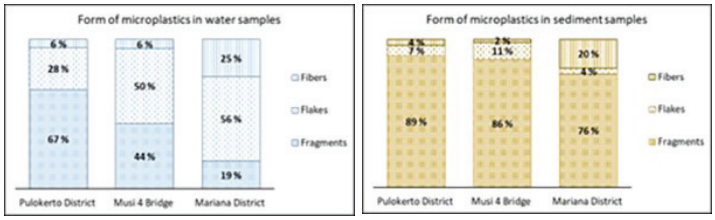

Figure 4. *Ratio (%) of microplastics in different forms in the water and sediment samples collected from the lower Musi River in Palembang City, Indonesia in August–December 2022*

In terms of size, the results revealed that in the water samples, the proportion of microplastics with a size of 1–5 mm had the highest proportion which increased further downstream (**Figure 5**). In the sediment samples, the microplastics with a size of < 1 mm had the highest proportion which also increased further downstream. This implies that microplastics with larger sizes are carried by the water current, while the microplastics with smaller sizes settle and bind with the substrate of the river.

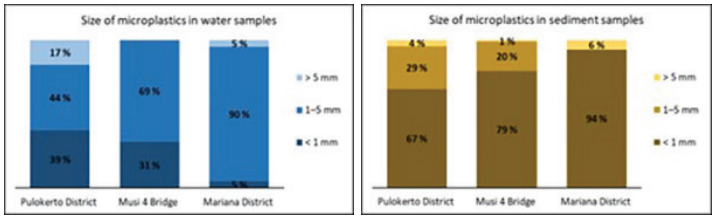

Figure 5. *Ratio (%) of microplastics in different sizes in the water and sediment samples collected from the lower Musi River in Palembang City, Indonesia in August–December 2022*

Way Forward

The results revealed that there is a significant microplastic pollution problem in the lower Musi River with concentrations increasing further downstream. This information will contribute to a better understanding of the characteristics of microplastics which is critical to developing effective mitigation measures to maintain the health of aquatic ecosystems. The Project will continue the conduct of the study by investigating the microplastic particles in the intestinal tissues of freshwater fish.

References

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