3. INDONESIA

Summary of research topics: *Published research articles focus mainly on surveying and monitoring, with good coverage of micro- and macro-plastics (including ALDFG) through a combination of sampling, quantification, identification and characterisation methods. Various marine environs where marine plastics can be found have also been examined. The presence of marine plastics in the aquatic environment, downstream impacts in both ecological-environmental and socio-economic, source differentiation, movement and accumulation probabilities are also examined and well-understood.*

Summary of understanding at national level: *Pollution from marine plastic is a known issue in Indonesia. This awareness has triggered research in various research foci and there is a holistic understanding of the issues raised. Research suggests that mangroves may be a plastic sink and accumulation areas and a greater concentration of microplastics in proximity to human settlements. Packaging was reported as the most common macroplastic across all studies, followed by consumer products, fishing gears and building and construction material. There is experience in source differentiation and pathways at local level as well as coastal communities' perception and willingness to mitigate pollution from plastic debris. Pollution from organic and inorganic contaminants associated with plastic are understood.*

Keywords/research fields: *National approach; solid waste; trade of plastic waste; research foci; marine environs; waste management; guidelines; beach clean-up; national research framework; surveys and monitoring; methodology of monitoring and assessment of marine litter; source differentiation; contribution from fisheries; ALDFG; contribution from rivers; accumulation zones; hotspots; fragmentation and degradation; ecological and environmental impact; socio-economic impact; methodology for marine plastic clean-up; movement of plastics; social perceptions; main players*

3.1 Context

3.1.1 National approach to plastic waste and its management

The management of municipal solid waste (MSW) in Indonesia is the responsibility of the municipality (local government). Publications indicate that most municipalities give low priority to solid waste services due to low allocation in their annual budget, which mainly covers operational costs but is insufficient for maintenance and investment (Damanhuri et al., 2013). Adequate management of MSW is one of the most challenging urban issues for city administrators in Indonesia, particularly in big cities. Although the general method embraced in principle in MSW management all over Indonesia is collect-transport-dispose, it appears that operations vary across the cities (Lestari and Tridiningrum, 2019). Almost half of the country continues to operate open dumping sites, according to 2018 Environment and Forest Ministry data (The Jakarta Post, 2019: available https://www.thejakartapost.com/news/2019/03/03/inadequate-landfills-worsen-indonesias-waste-problems.html).

Reports indicate that the amount of MSW is generally dominated by organic compositions (e.g. food scraps), followed by plastic and paper (e.g. packaging/wrapping materials). Although local methods employed for sorting and separation of MSW in Southeast Asian countries may be considered inappropriate for solid waste management systems as defined by developed countries, existing recycling practices provide an income stream for hundreds of thousands of people involved in this informal sector. They also enable for a far greater amount of MSW to be recycled (Damanhuri et al., 2013) than would otherwise be the case.

Approximately 9 to 10% of plastic waste is recycled while the remaining is burnt or disposed of at landfills. Out of 3.22 million tonnes of mismanaged waste in 2010, an estimated 0.48 to 1.29 million tonnes of plastics leaked into the marine environment annually (Jambeck et al., 2015). Of the top 20 polluted rivers identified based on a global river plastic inputs model, four main rivers (i.e. Brantas, Solo, Serayu, Progo) can be found in Indonesia (Lebreton et al., 2017).

Since the release of Jambeck et al. (2015) study, the Indonesian government has committed to a goal of 70% reduction in marine plastics by 2025 through Indonesia's Plan of Action on Marine Plastic Debris 2017–2025 (Coordinating Ministry for Maritime Affairs, 2018). This plan of action includes a commitment to an intervention based on five strategies for systemic change to improve the way plastics are produced, used, and disposed of. Thus far, Indonesia has imposed strict laws on managing plastic waste imports, limited imports to only recyclable plastics, and banned non-recyclable plastic waste (UNESCO: available http://www.unesco.or.id/publication/SC_Retreat/4_MarineDebrisIndonesia.pdf). Bans and/or taxes have also been imposed on the use of plastic bags.

3.1.2 Plastics as a proportion of solid waste

In 2016, the MSW for Indonesia was estimated at 65.2 million tonnes, and with a projection of reaching 88.0 million tonnes in 2030 and 119.0 million tonnes in 2050 (Kaza et al., 2018). Major urban centres in Indonesia produce nearly 10 million tonnes of waste annually, and this amount increases by 2-4% annually (Ministry of Environment, 2008). Jakarta uses a major landfill located at Bantar Gebang in the suburban town of Bekasi, which receives approximately 6,000 tonnes daily (Aprilia et al., 2012).

Plastic accounts for the second largest proportion of MSW and was estimated at 11% to 15% of waste generated across cities in Indonesia (Hoornweg and Perinaz, 2012; Shuker and Cadman, 2018; Lestari and Trihadiningrum, 2019). Based on Jambeck et al. (2015) estimates, Indonesia would have produced 3.22 million tonnes of mismanaged plastic waste in 2010 and approximately 0.48-1.29 million tonnes of plastic marine debris. Plastic bags were the most prevalent type of plastic waste, followed by plastic packaging (Shuker and Cadman, 2018).

Based on the abovementioned estimates (i.e. the 2018 World Bank estimate of national waste production; the estimate of 15% of waste being plastic; and the Jambeck et al. 2015 estimate of mismanaged plastic waste), Indonesia would be mismanaging 38% of its municipal plastic waste. However, it is unclear how to include past imports of plastic waste in these figures.

3.1.3 Illegal trade of plastic waste

Based on data from the Indonesian National Statistics Agency (2018), illegal imports of plastic waste into Indonesia were prevalent, with a spike in imports after China implemented its National Sword Policy in January 2018. The quantity of illegal plastic waste imports into Indonesia drastically surged following the 2018 China ban, with an increase of up to 141% from 2017 to 2018, and at a total of 283,000 tonnes in 2018, the highest ever in the past decade (Indonesian National Statistics Agency, 2018). The bulk of plastic waste appears to be coming from the Marshall Islands in Oceania (92,682 tonnes) and the United States of America (56,753 tonnes) (Greenpeace, 2019).

According to the Indonesian Minister of Environment and Forestry Siti Nurbaya Bakar, this was not the first-time illicit plastic had been imported into Indonesia. In 2015 and 2016, the Ministry had re-exported dozens of containers filled with illegal plastic waste or waste that was non-compliant with their regulations. Indonesian government's intent to re-export this illegal plastic waste is clear, although this may not always occur. (VOA News, 2019: available https://www.voanews.com/east-asia/indonesia-vows-send-back-illegal-plastic-waste).

3.2 Research review of pollution from marine plastic

3.2.1 Research overview

Among the 10 ASEAN member states, Indonesia appears to have done the most extensive research on pollution from marine plastics, especially in the years 2018 and 2019 (See complete table in Appendix III). Research efforts span a large geographical extent, involving 15 out of the 34 provinces in Indonesia, including the provinces of Java, Bali, Kalimantan, Sulawesi, Sumatra, Tenggara, Banten, Riau and Jakarta. Purba et al. (2019) provides a comprehensive overview of national marine plastic in 'Marine debris in Indonesia: A review of research and status'. This study found 64 relevant studies for assessing the current state of knowledge of marine plastics in Indonesia. Marine plastic research articles that were found span across 17 research foci (Figure 1.2.3.1).

Research efforts appear to place priority on surveying and monitoring to understand the pollution status (n=46) through sampling of microplastics floating on the sea surface or in the water column, sampling of macroplastics found among macro-debris on the shoreline, and sampling of microplastics in various marine biota. There is also an emphasis on impacts of marine plastics on the marine environment (e.g. plastic ingestion in biota, n=12), and on the socio-economy (n=8), particularly on human health and food safety. There are also attempts at understanding the movement of plastic in water bodies (n=7) through the use of modelling tools that lead to the discoveries of possible accumulation zones and hotspot areas (n=5), and studies on social perceptions (n=8), mostly to understand the level of awareness and perspectives the locals have of marine pollution responsibility.

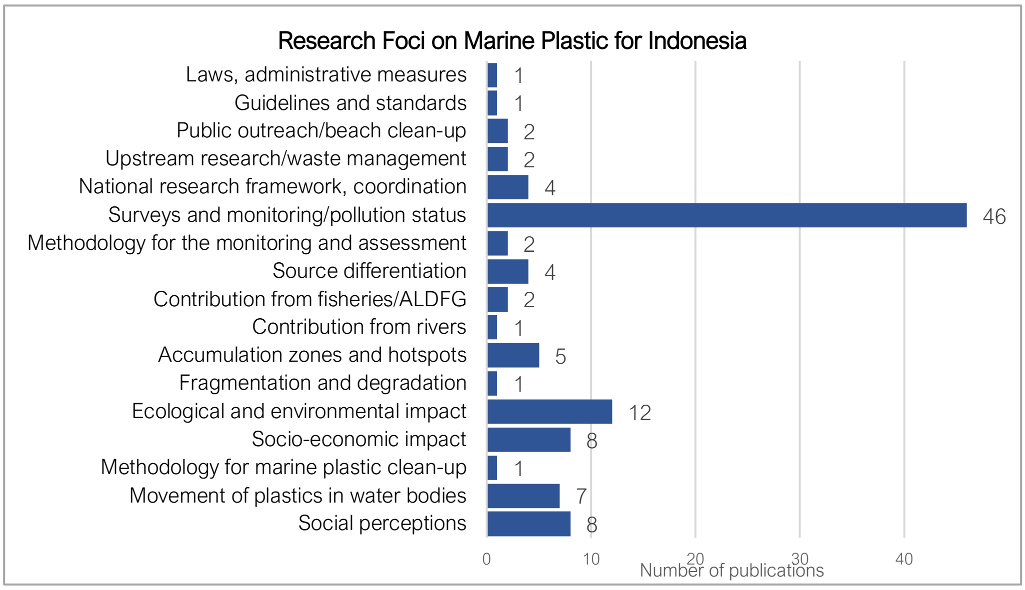

Figure 1.2.3.1. Research foci of marine plastic research conducted in Indonesia.

3.2.2 Types of research conducted

Types of plastics research foci

Of the marine plastic research conducted, microplastics appears to be of utmost concern (n=30). This is followed by research of macroplastics-only (n=19) and of both microplastics and macroplastics (n=11) (Figure 1.2.3.2). The microplastic studies mostly examined the presence/absence of microplastic in marine biota and/or in the various abiotic environments (i.e. sea surface or water column, seafloor, shoreline). The macroplastic studies on the other hand were focused on macroplastics on the shoreline, such as in coastline debris surveys.

Of all the research, only a small proportion (<15%) further identified plastics into their polymer types. No published peer-reviewed study on plastic-associated (organic or inorganic) contaminants was found.

Coverage of marine environs

Most of the field research has been conducted on the sea surface or water column, from estuaries (mainly the Jakarta Bay), to coastal waters and out to the open ocean. The shorelines of Indonesia have also been well-examined, with studies looking into the different characteristics of sandy coastal beaches, mangrove ecosystems, remote beaches or shorelines with high anthropogenic pressure from nearby human settlement or aquaculture activities. There has been less studies conducted in marine biota and on the seafloor, i.e. surface and subsurface sediments (Figure1.2.3.3). Of note, Indonesia is the first ASEAN state to have studied microplastics present in deep-sea sediments of the southwestern Sumatera waters (Cordova and Wahyudi, 2016).

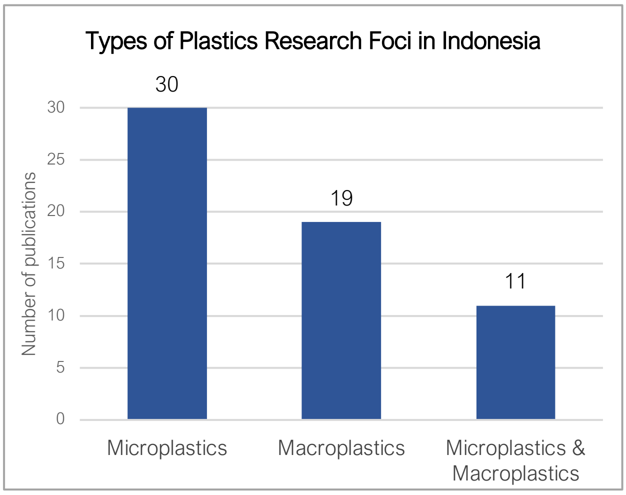

Figure 1.2.3.2. Distribution of marine micro-/macro-plastics researched in Indonesia.

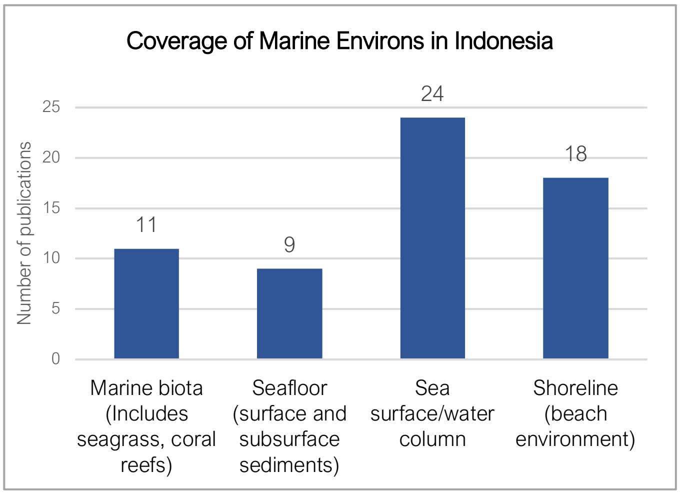

Figure 1.2.3.3. Distribution of marine environs researched in Indonesia.

3.2.3 Survey and monitoring

A great majority of the studies conducted in Indonesia focused on surveying and monitoring to understand the current status and extent of marine plastic pollution in the country.

Microplastics

Microplastics have been found and examined in an array of abiotic environments. Their prevalence is especially highlighted in environments with high human impact: in the coastal waters near human settlement (Afdal et al., 2019; Cordova et al., 2019; Falahudin et al., 2019; Hiwari et al., 2019; Rachmat et al., 2019; Ismail et al., 2018; Syakti et al., 2017, 2018) and in coastal sediments (Asadi et al., 2019; Yona et al., 2019; Wahyuningsih et al., 2018; Manalu et al., 2017; Balasubramaniam and Phillott, 2016; Dewi et al., 2015). They are also present in mangrove ecosystems (Rahmawati and Patria, 2019; Hastuti et al., 2014), seagrass ecosystems (Tahir et al., 2019), coral reef ecosystems (Cordova et al., 2018), pristine areas (Cordova and Hernawan, 2019), the open ocean (Pangetsu et al., 2016), deep-sea sediments (Cordova and Wahyudi, 2016) and across a mixture of physical environment (Ayuningtyas et al., 2019; Bangun et al., 2018).

Microplastics have also been monitored in various marine biota and their surroundings, from wild fish (Lubis et al., 2019; Germanov et al., 2019) to commercial fish and bivalves (Hastuti et al., 2019; Ismail et al., 2018, 2019; Rahmawati and Patria, 2019; Khoironi et al., 2018; Lestari et al., 2018; Rochman et al., 2015).

In these studies, ‘microplastics’ was commonly defined as being <5 mm, with the exception of 2 studies. Hiwari et al. (2019) defined microplastics as being <2 mm, while Rochman et al. (2018) did not make a clear distinction of the term ‘microplastics’ and simply considered debris found as ‘small’ as it averaged at 6.3 mm (±6.7 SD). Of the microplastic studies, one-third of the studies further identified microplastics to their polymer types. Commonly-found microplastics polymer types included PS, PE, PP, PET. Almost all studies characterised the morphology of plastics sampled into finer structure of films and fibres, with commonly reported forms of fibres, films or fragments.

In one particular study by Syakti et al. (2017), the status of microplastic degradation was examined using the measurement of carbonyl index. It determined that the floating microplastic sampled from the Cilacap Bay of Indonesia was slightly degraded.

In comparing the microplastic contamination across different studies, comparison seemed feasible where the measurement of abundance was reported in the same unit. This was the case for microplastics in sediments which were mostly reported using particles per kg of dry sediment, and for microplastics in marine biota which were mostly reported using particles per individual (only two studies used particles per 1g of animal tissue or per 0.25g animal tissue). Microplastics in sea water or the water column however, were reported in a range of units, e.g. particles per m^3, km^2, kg, litre or 100 particles per m^3. These studies also used a large diversity of methodologies and units with no clear preference for any. Nevertheless, many of these units can be converted, including, with some caveats, from areas to volumes.

In general, microplastics studies appear to have benefited from appropriate equipment and set-up for in-depth analysis. They however might not be performed across all institutions, or might have discrepancies in terms of methodologies and interpretation of results.

Macroplastics

Macroplastics were also found to be the most common among other debris types, especially on sandy beaches of varied types: recreational, private/remote, fishery-related (Isyrini et al., 2018, 2019; Maharani et al., 2018; Purba et al., 2017, 2018a, 2018b; Tahir et al., 2018; Husrin et al., 2017; Syakti et al., 2017; Attamimi et al., 2015). Beaches of mangrove ecosystems also showed similar trends (Maharani et al., 2018; Purba et al., 2017; Hastuti et al., 2014). Most studies reported that mangrove systems may possibly serve as a plastic sink and accumulation zone.

Most studies categorised macroplastics according to their uses. Packaging was reported as the most common macroplastic across all studies, followed by consumer products, fishing gears, and building and construction materials. Fishing gears, i.e. ALDFG, were examined in two studies on how ALDFG provides substrata for coral life, and also on the possible sources of ALDFG (see Part 1, Section 2.3.2.7). Only three macroplastics studies identified the polymer types, and revealed the common polymer type as PET.

3.2.4 Source differentiation and pathways

Source differentiation studies were focused on macroplastics, and mostly focused on determining the country of origin from existing labels on the macroplastics sampled (Maharani et al., 2018; Purba et al., 2017, 2018a, 2018b). These studies were able to point to the possible sources of marine litter i.e. nearby residential sources, fishery activities, shipping activities or from other origins as brought in by currents.

There appears to be no research in Indonesia on marine plastic acting as a pathway or vector for pollution by other organic substances, polymers and inorganic contaminants. Such research would focus on how these plastic additives or other contaminants may become adsorbed and transported by plastic debris, then released into the marine environment. Examples of studies in other countries relate to arsenic, lead and copper. Petrlik et al. (2019) also suggest that contamination by other persistent organic pollutants (POPs) (e.g. dioxins, PCBs, PBDEs, SCCPS and PFOS) could be possible as they are found in the terrestrial environment in proximity to dumping sites.

3.2.5 Movement of plastics, accumulation and hotspots

The use of models, hydrodynamic and particle tracking, are useful in revealing the movement of plastic in water bodies, and subsequently identifying potential accumulation zones and hotspots. Van Emmerik et al. (2019) found that annual plastic emission into the ocean through Jakarta's rivers and canals equals 3% of the city's total annual unsoundly disposed plastic waste. Jasmin et al. (2019) found that reclamation at Jakarta Bay has changed the existing trajectory of microplastic in the bay and may lead to accumulation in the eastern part of the bay, especially in wet seasons. Handyman et al. (2019) hypothesised that the Java Sea could be the biggest microplastics patch in Indonesia due to trapping caused by the reversing tidal current. Purba et al. (2019b) investigated the trajectory of microplastics at Savu Sea Marine National Park. Ramos et al. (2018) rebut the hypothesis of the Pacific Garbage Patch being a source of microplastics for Indonesian waters. Husrin et al. (2017) revealed that marine surface debris found in Kuta might be transported from the Bali Straits and other sources in the South of Bali to Kuta during the West Monsoon season. Purba and Faizal (2019) examined the efficiency and feasibility of using novel surface drifters (Float Artificial Debris) in measuring the spread and movement of marine debris.

These articles show Indonesia's research capacity on movements of plastic debris. With a similar approach to that of the World Bank (see Part 1, Section 5.1), Nordén and Karlsson (2018) took a risk assessment approach through the identification of plastic accumulation areas. Their paper sought to optimise the placement of clean-up systems for marine plastic debris at the mouth of the estuarine network in Jakarta Bay. It should be noted that this paper was written by undergraduate students, and that there is no other academic paper on this topic.

Research on movement of plastic debris seems to focus primarily on the Java Seas although research projects on pollution from marine plastics have also been carried out in many other parts of Indonesia. However, Kalimantan, Sulawesi and Papua seem to have generally been less studied.

3.2.6 Ecological and environmental impacts

Studies on ecological impacts mostly quantified plastic ingestion in wild animals through dissection and analysis, such as in grey-eel catfish (Lubis et al., 2019), benthic species (Tahir et al., 2019; Bangun et al., 2018), commercial fish and bivalves species (Hastuti et al., 2019; Ismail et al., 2018, 2019; Rahmawati and Patria, 2019; Khoironi et al., 2018; Lestari et al., 2018; Rochman et al., 2015).

These studies showed similar evidence of microplastic ingestion in animals, particularly in their digestive tract, as opposed respiratory organs. In fish, the varied ingestion rate was hypothesised to be due to the different feeding behaviours of different fish types. Germanov et al. (2019) validated microplastic ingestion in manta rays and whale sharks in Nusa Penida, Bali through a different approach of quantifying microplastic in their feeding grounds, and in their regurgitated or egested material.

The direct impact of plastic on the marine biota health has been studied in Syakti et al. (2019d), a study on *Acropora formosa* corals. Of note, this research was the only polymer-specific experiment realised in a laboratory setting. The choice of LDPE polymer differed from the polymers previously identified in the natural environment. The authors justified their choice on the fact that it is commonly found in the marine environment according to a GESAMP report (2015). In this study, coral fragments from the wild were exposed to different treatments of LDPE microplastics and had visible negative impacts of bleaching and necrosis when the LDPE exposed were of the right size and concentration. This impact on coral health was hypothesised to be due to the reduction of light penetration to allow for sufficient zooxanthellae photosynthesis or possibly, by the release of toxic chemicals acting on the corals.

Despite much general news coverage of the physical impact on and ingestion by wild animals of macroplastic such as whales and sea turtles, no peer-reviewed articles were found on this topic.

3.2.7 ALDFG

Two studies on ALDFG were found. Hoeksema and Hermanto (2018) found plastic fishing nets on the seafloor and as an unstable and unnatural substrate for reef corals in the Lembeh Strait. Richardson et al. (2018) explored existing challenges in Indonesian fisheries management (i.e. over-allocation of fishing licenses and illegal, unreported and unregulated (IUU) fishing pressures) which are factors that may contribute to the issue of ALDFG.

Indonesia has shown a particular interest managing ALDFG through tracking efforts, as part of the Global Ghost Gear Initiative (GGGI) (see Part 1, Section 6.1.4).

3.2.8 Social perceptions and socio-economic impacts

Several studies have conducted interviews with locals to find out more about people's perspectives on or awareness of marine plastic pollution issues and their responsibility in waste management. The diversity of explorations summarised below appears to provide a basis to inform steps that may be helpful to improve education and outreach on the topic.

Kusumawati et al. (2020a) examined the perception of millennial youths in West Aceh towards marine litter, as well as the potential influence of environmental education. In Kusumawati et al. (2020b), the team also examined the perception of the locals of Aceh Jaya Regency towards marine litter responsibility. Husrin et al. (2017) and Attamimi et al. (2015) examined the awareness and perception of beach littering and cleanliness responsibility in locals of Bali. Giesler (2018) examined the status of understanding on existing environmental laws, with respect to plastic disposal and recycling, and the level of education received by the locals in Bali. Sur et al. (2018) explored the feasibility and the willingness of locals, specifically the younger generation, in participating in beach clean-up events. Shuker and Cadman (2018) and Oktaviana et al. (2014) assessed community perceptions to waste management and found varied community-level attitudes and practices in different community profiles.

Studies on the socio-economic impact of marine plastic are primarily framed around considerations of human health, especially in studies which quantify plastics in seafood that are commonly sold for human consumption. 27 common commercial species of fish were studied and tested positive for microplastics ingestion (Hastuti et al., 2019; Ismail et al., 2018, 2019; Rahmawati and Patria, 2019; Rochman et al., 2015). Two commercial bivalves, specifically *Perna viridis* and *Meretrix meretrix* examined also showed microplastic ingestion and contamination (Khoironi et al., 2018; Lestari et al., 2018).

Whilst not included in this research inventory, of note is a multi-NGO-led report titled “Plastic Waste Flooding Indonesia Leads to Toxic Chemical Contamination of the Food Chain” (Petrlik et al., 2019). It reported that eggs sampled from free-range chickens that had roamed and eaten food off the ground near Indonesian plastic waste dumping sites contained various hazardous POPs with potential toxicity to human health. Such impacts are likely to manifest in the marine environment of Indonesia, where an array of marine biota has been reported to ingest plastics – some of which are commercially important food items. This suggests that, within a risk approach to responses to marine plastic pollution, a meaningful step is to map coastal dumping sites in Indonesia.

3.3 Main players in marine plastic research

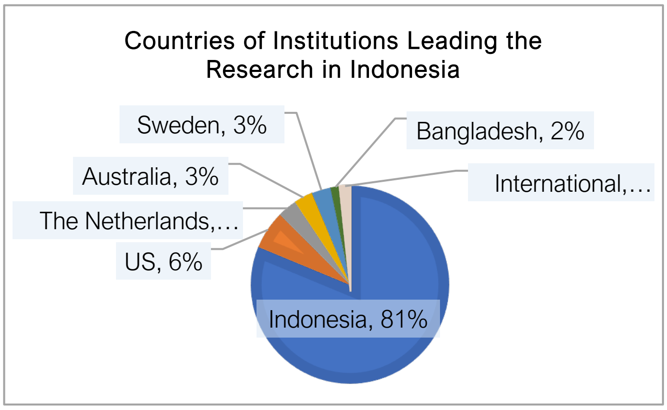

Figure 1.2.3.4. Composition of research efforts seen in Indonesia.

The majority of research studies were headed by local efforts with some research contributions from the US, the Netherlands, Australia, Sweden, Bangladesh and from one international organisation.

Well-known players in marine plastic research in Indonesia include the governmental authority for research and science known as the Indonesian Institute of Sciences, or as Lembaga Ilmu Pengetahuan Indonesia (LIPI). Renowned researchers of LIPI include Cordova M.R. Research teams like that of Purba N.P., Handyman D.I.W and Ismail M.R. from Padjadjaran University and Syakti A.D. from Jenderal Soedirman University also appear to be equally involved in marine plastic research in Indonesia.

Other research teams with experience in oceanographic modelling applied to substances, such as movement of oil particles following a spill, are expected to also have the necessary expertise for further studies of the movement of floating plastic debris. These include oceanographers Susanna Nurdjaman and Ivonne Radjawane from the Faculty of Earth Sciences and Technology of Bandung Institute of Technology.

3.4 Summary of understanding

There has been an impressive effort by Indonesia with respect to producing and publishing information in response to pollution from marine plastics within the country, especially based on the number of articles found in 2018–2019. An important characteristic of this research effort is also its breadth as it covers most aspects of pollution from plastic. Nevertheless, some of this research is still at a very early stage. All environs are also being investigated.

More than half of the articles published seek to quantify the presence and abundance of marine plastic debris. However, the methodologies used are varied and often not immediately comparable. Syakti's discussion of monitoring guidelines (Syakti, 2017) may be leveraged to improve coordination as full harmonisation may not be feasible nor desirable.

Whilst studies on microplastics were able to categorise samples into various forms including those of films and fibres, there is still a limited number of polymer-specific research to understand differences in degradation of different polymer-types in the marine environment, as well as their specific environmental and ecological impact. No research has been found so far either on marine plastics as a pathway for pollution by other organic substances, polymers or inorganic contaminants (e.g. POPs and heavy metals).

Research on ecological and environmental impacts is the second most common category of research focus. There is primarily interest in the ingestion of microplastics by marine life, especially organisms of socio-economic importance. No investigation on plastic transfer through the food chain has been found so far. Interestingly, there is no peer-reviewed article on the physical impact on wild animals (such as endangered migratory species like whales, sea turtles and seabirds) from the ingestion of macroplastic. Only one notable news report in 2018 was found on the impact of plastics in a sperm whale that had washed ashore in eastern Indonesia (off Kapota Island, Wakatobi National Park). The sperm whale was found dead with 6 kg of plastic in its stomach (National Geographic, 2018: available https://www.nationalgeographic.com/environment/2018/11/dead-sperm-whale-filled-with-plastic-trash-indonesia/).

Geographically, the articles reviewed covered most parts of Indonesia. The Java Seas get the most attention, while Kalimantan, Sulawesi and Papua appear to get the least attention.

Reports and research articles indicate that the management of MSW is a general issue throughout the country with a diversity of leakage pathways into rivers and into the marine environments. While there are no published articles that seek to quantify different leakage sources and pathways, a few articles provide insights on social perception that may inform the development of an effective waste management policy.

In this context, the research capacity of Indonesia on modelling the movement of marine plastics may be useful to guide a country-wide risk assessment approach or identification of hotspots approach. A multi-prong approach can take into account a number of parameters with different weights depending on local priorities (such as local communities, health, endangered marine life, tourism, etc) and different marine spatial plans. Of note, one example is the articles on marine plastic accumulation in mangroves (Maharani et al., 2018; Hastuti et al., 2014), a habitat that provides numerous ecosystem and social services, making it a priority area for conservation and management.

Finally, ALDFG, whille a recognised issue in Indonesia, appears to still be under-studied.

4. LAO PDR

Summary of research topics: *With Lao PDR being inland, there is no research on marine plastic pollution in the country. However, as the Mekong River flows into the South China Sea and through other ASEAN states, their waste management approach is relevant.*

Summary of understanding at national level: *Plastic pollution appears to have been missed as a priority in the scientific scene.*

Keywords/research fields: *N.A.*

4.1 Context

4.1.1 National approach to plastic waste and its management

Marine plastic pollution is not an important topic for Lao PDR, the only landlocked ASEAN state. In Lao PDR, plastic waste is typically discussed in the context of solid waste management which is a priority area identified as part of the Global Green Growth Institute (GGGI)'s green cities programme in Vientiane (GGGI, 2018). Plastics are considered recyclable materials that are collected by informal workers, but no major recycling industries are reported to exist in Lao PDR (GGGI, 2018).

Plastic waste management is also crucial as land-based leakage into the waterways of the Mekong River are important pathways through which plastic materials can enter the South China Sea. In order to reduce plastic waste, Lao PDR encourages the usage of recyclable bags which are sold in downtown cafes and markets (Greenpeace, 2019). In July 2019, the Minister of Industry and Commerce signed a ministerial order in a bid to protect the environment and improve the operations of plastic waste recycling plants, The order authorised the freezing of licences to new manufacturing plants that would utilise plastic waste as a raw material (Asian News Network, 2019: available http://annx.asianews.network/content/industry-ministry-orders-suspension-plastic-waste-recycling-plants-102439).

Socially, the consumer lifestyle of Laotians has been noted to shift towards reliance on imported and manufactured products, including those of plastic materials. However, there is no proper and established waste disposal management system, which often results in local solutions of either simply burning or dumping plastic into the rivers, as the Laotians appear to be lacking awareness of the harmful impacts that such solutions may bring about (Asia Foundation, 2017: available https://asiafoundation.org/2017/04/19/love-laos-keep-clean/).

4.1.2 Plastics as a proportion of solid waste

In 2016, the municipal solid waste (MSW) for Lao PDR was estimated at 364,000 tonnes, and with a projection of reaching 522,000 tonnes in 2030 and 748,000 tonnes in 2050 (Kaza et al., 2018). Based on these estimations, Lao PDR appears to be one of the smallest generators of MSW among the ASEAN+3 member states (UNEP, 2017).

Of the 500 tonnes of solid waste generated daily in Vientiane, the capital and largest city of Lao PDR, plastics made up 6.1% (Climate and Clean Air Coalition, 2015).

4.1.3 Illegal trade of plastic waste

Following the 2018 China ban on import of plastic waste, plastic waste import into Lao PDR quadrupled from 1,120 tonnes in early 2016 to 4,800 tonnes in end 2018. The top exporters of this plastic waste were from Thailand and Japan (Greenpeace, 2019).

4.2 Main players in marine plastic research

No players are identified. Some information on Lao PDR's plastic waste situation was obtained from a policy brief produced by Greenpeace Southeast Asia (Greenpeace, 2019). No government agency or department could be identified.

4.3 Summary of understanding

Leakages of plastic into the waterways of the Mekong are important to the issue of marine plastics in Southeast and East Asia. A better understanding of sources, leakages and hotspots of plastic would be useful in the context of both local and transboundary pollution.