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PARLIAMENTARY INSTITUTE OF CAMBODIA
STRENGTHENING PARLIAMENTARY CAPACITY

Briefing Note

ASEAN Inter-Parliamentary Assembly

Overview of plastic issues in ASEAN, focusing on marine debris and microplastics in the region

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February, 2019

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Acronyms

ASEAN	Association of Southeast Asian Nations
CBD	Convention on Biological Diversity
FAO	Food and Agriculture Organization
MARPOL	Marine pollution
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme

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1. Introduction

In order to prepare parliamentarians who will participate in the forthcoming meeting between the ASEAN Inter-parliamentary Assembly (AIPA) and the European Union Parliament from 26 to 30 March 2019 in Brussels on the issue of plastics in ASEAN, in particular marine debris and microplastics, the AIPA Secretariat requested PIC to provide a preliminary study on this issue.

This meeting is the follow up of the first ASEAN conference on reducing marine debris in the ASEAN region held in Phuket, Thailand on 22 and 23 November 2017 [1], and the subsequent East Asia Summit Leaders' Statement on Combating Marine Plastic Debris on 15 November 2018 [2].

The purpose of the study is to provide parliamentarians attending the meeting in March 2019 with the current situation regarding plastic issues in the ASEAN from introducing the lifecycle of plastic to analyzing the situation of marine plastic debris and understanding the issues of micro plastics in the region. The study will also provide up to date insights on the policy dynamics relating to plastic issues relevant to the ASEAN context.

2. The current plastic cycles and its projected ecological and health risks

2.1. Definitions

2.1.1. Plastics and plastic waste

Plastic encompasses a broad range of materials. Plastic is generally light weight and durable. Most plastics are pliable (easy to shape) and production costs are low. These properties make plastics useful for the transportation of products, packaging, as well as disposable medical equipment [36, 37, 41, 44].

A technical definition of plastics would be synthetic polymers that are made from petroleum. Polymers are large molecules with mostly hydrocarbon chains, which make them very stable and durable [28, 32, 34, 35, 41, 44]. Biologic polymers exist, but these can often be broken down by other organisms and are usually not dissolved in water. By contrast, plastics are synthetic (not created by nature) and bacteria have not yet evolved to be able to use plastics as a food source [27, 28, 37]. Polymers can be divided into two groups; thermoplastics which become soft when heated so they can be molded and remolded, and thermosets which cannot be remolded as they stay hard when heated. When it comes to marine debris, both thermosets and thermoplastics are usually considered plastic waste [28] (see Appendix II).

There are many different categories of plastic (see Appendix II for an overview of plastic types), but PE, PP, PVC, PS, PUR, PET make up the majority of plastics produced [28].

2.1.2. Microplastics

It appears that most researchers and inter-governmental bodies (including the UN Environment Programme) consider any plastic particle **smaller than 5 millimeters** to be a "microplastic" [28, 32, 36, 37, 41].

2.1.3. Primary or secondary microplastics

Primary microplastics are plastics that are deliberately produced at a small size. This can be for one of two reasons: ***microbeads*** are made small and are often added to scrubs, soap, and toothpaste to give it abrasive properties, while the other primary microplastics are ***pellets*** small balls (or cylinders) of newly produced plastic that is kept small so it can easily be shipped to a factory where it is remolded into a bigger end product. The first category of primary microplastics can easily end up in

the ocean after just a single consumer use, whereas the second category would only end up in the ocean if it was (unintentionally) spilled [28].

Secondary microplastics, by contrast, come from bigger plastic pieces. When big plastics (e.g. plastic bags) end up in nature they may break or are slowly grinded down into small pieces and end up in the environment as microplastics. **Secondary microplastics make up the majority of microplastics** [28].

2.1.4. Biodegradable or compostable plastics

There are many different varieties of plastic and they are not always strictly regulated. For a plastic to be "biodegradable" it merely needs to be possible to broken down into components under certain conditions, which can include high temperatures or pressure (that do not exist in nature). Therefore, often "biodegradable plastic" still ends up in the ocean as plastic waste. Similarly, compostable plastics are not necessarily fit for home composting, but might need industrial processes to compost. Finally, there are terms invented to market certain plastics (e.g. oxo-degradable, which just means the plastic fragments into smaller pieces easily) that have no proven advantages for the environment [27].

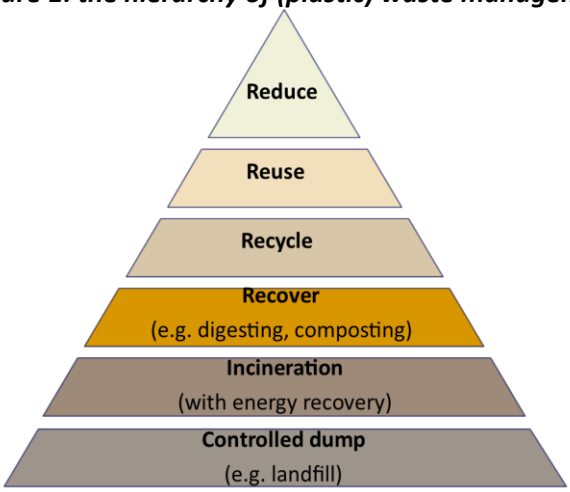
2.1.5. Other microplastic categorizations

Some studies will refer to floating marine debris (FMB), seafloor marine debris (SMD), and beached marine debris (BMD); all these terms refer to the same thing and differ only on where the (plastic) debris was found by the researchers [48]. While these terms refer to all marine debris, three quarters of all marine debris is made of plastic [46, 48].

2.1.6. Hierarchy of waste

There are different ways to deal with used plastic and not all of these are equal. The hierarchy is shown in the pyramid below (see Figure 1), with the top being more desirable than the bottom. Recovery involves composting, which can be aerobic (with oxygen) or anaerobic (without oxygen). The former is cheaper, but the latter creates methane gas that can be used for fuel. Incineration can recover some energy, but if done in the open or with low combustion temperatures, it could cause severe air pollution [34].

Figure 1: the hierarchy of (plastic) waste management



Source: Made by authors with data from [34].

2.2. The scale of plastic use and plastic waste

Human beings produce over 335 million tons of plastic each year and only a small amount of that is recycled (e.g., 26% in the EU, 9% in the USA) [41]. Plastic is a huge driver of the economy; in the EU alone 1.5 million people work in the plastic sector. Plastic is used extensively for the car industry, transport industry, and medical field, among others. However, much of the plastic produced is only used once. For example, 95% of plastic packaging loses economic value after just one cycle of use (i.e. is only used once for a short time) [27, 44].

In 1972 researchers first documented plastic debris in the ocean [45]. In 2004 a seminal research publication showed that the amount of plastic in the ocean was in the millions of tons and increasing each year [42]. Since then, research into marine debris has expanded significantly with dozens of peer-reviewed studies in the last few years [24, 43]. Recent studies suggest that three quarters of all marine debris is made of plastic and that 8 million tons of plastic end up in the ocean each year [46].

There are, however, gaps in research, including the following [28]: lack of information on 'vertical movement' (i.e. sinking and floating) of plastics which makes it hard to predict where plastic will end up [28, 29, 31, 41]; lack of studies in Asia and Africa [28, 32, 48]; and lack of research on how rivers transport plastics into the ocean [32, 35]. In addition, little is known about the exact health effects and environmental impacts of all the plastic waste [26].

Nevertheless, it is well established that microplastics are present in all the world's oceans and in fairly large numbers. Plastics have been found in the South China Sea [48], in Singapore's coastal mangrove systems [49], and even in "extremely high" concentrations in ice cores in the Arctic Ocean [46, p.7]. The estimated lower limits of floating marine plastics is 5 trillion pieces worldwide with a total weight of about 270,000 tons, but this does not factor in sunken or beached plastics and is considered a low estimate [31]. Much of this plastic flows to the ocean through rivers, although some of it gets there through human activities at sea such as fishing [41].

Plastic ends up in rivers due to littering, leakage in the waste management chain, or leakage from landfills. Between 1.15 and 2.41 million tons of plastic waste enters the ocean every year from rivers [32, 33]. While data on plastic pollution from rivers is scarce, research indicates that some rivers contribute a lot more than others and that this is largely correlated with the population density along those rivers. Seven of the world's most polluted rivers flow through China and another eight through ASEAN countries [32, 33, 35]. American researchers made a "top 20" list of countries based on the percentage of waste that is littered or inadequately disposed of. Of that top 20, six are located in ASEAN. Sixteen of the top 20 are middle income countries, where economic growth may have outpaced waste management systems [30]. However, it should be noted that higher income countries use more plastic per capita [30, 34], with the OECD countries generating almost 44% of the world's waste (most of which is plastic) [34].

2.3. Risks and challenges

2.3.1. Environmental risks

Plastic production itself (as well as the waste management of plastic) is a contributor of greenhouse gas as each ton of plastic creates 2 tons of CO^2, roughly the same as a car does in a year [27, 44]. However, the specific impact of microplastics on the environment are not completely clear, but research has shown they can impact ecosystems and that microplastics are abundantly present in the marine environment [28, 41]

Microplastics can change the properties of soil by changing the heat conductivity and water permeability. Those changes in the soil may affect plants and animals in negative ways, but the exact effects have not been mapped by researchers yet. In addition, microplastics may offer homes to bacteria and allow them to thrive in environments they otherwise would not [41, 47]. One study found that snail eggs on microplastics transported a species of sea snail to an environment it was not origi-

nally native to [41]. Microplastics have been found in large quantities in the reservoirs of hydropower dams [32]. While this may pose a risk to the health of fish living in hydropower reservoirs, it could also provide an opportunity to collect and properly dispose of plastic that gets caught in hydropower dam reservoirs.

Microplastics end up inside animals either through direct consumption or indirectly when predators eat smaller creatures that contain microplastics [40]. A study of *Daphna Magnia* (a small crustacean species) showed that nanoplastics and microplastics once consumed stayed detectable in the creatures for at least three generations. Furthermore, the microplastics limited the growth of the *Daphna Magnia* and limited their reproductive capacity [50]. A study on mussels showed that microplastics, once consumed, stayed in the mussels' bodies for at least 48 days and also ended up in their cardiovascular systems [51]. Microplastics have also been found in seals [40], and studies suggest that humans who eat seafood are also likely to have microplastics in their guts [40]. A very recent preliminary study that sampled human stool found that plastic was present in every sample [39].

A study on tap water, bottled water, beer, and sea salt found that 81% of tap water had micro plastics in them. All salt and most beers sampled also had particles in them [36]. Another study showed 93% of bottled water from around the world contained micro or nanoplastics [37]. Studies into Indian salts show that all were contaminated with plastic, with sea water being the primary source [38]. Estimates suggest that the average person in the USA ingests over 5,000 particles per year from bottled water alone [36].

However, while all this shows that plastic is undoubtedly part of our environment, it is hard to determine what the effects are. In part because no (plastic free) control group can be found for comparison [28, 39].

2.3.2. Health risks

The effects on (human) health have received little study and it is unclear whether or not the negative effects observed in mussels and *Daphna Magnia* also apply to humans. In general, there are a number of ways in which microplastics could be dangerous to human health:

- Microplastics are small and numerous, so it is easier for microplastics to absorb contaminants. These contaminants could possibly be released again in the guts of humans who consumed microplastics [24, 36]
- Bacteria could travel into humans through microplastics [36, 41, 46]
- Small plastics (nanoplastics) can end up in the cardiovascular system and might cause blockages [28, 41]
- Some plastics may be intrinsically toxic to humans [28, 41]
- Many plastics have additives added to them to change the color or properties; these additives may leak out while inside a human's body [28, 36, 41]

However, none of these hazards have been conclusively proven to be applicable to humans [28, 41, 42, 43]. In general, the health risk can be expressed by the following formula:

Health risk = hazard X exposure

While we know human are exposed to microplastics, the hazards these microplastics pose are still unclear. More research into the hazards are needed for rational risk-based decision making [28, 43].

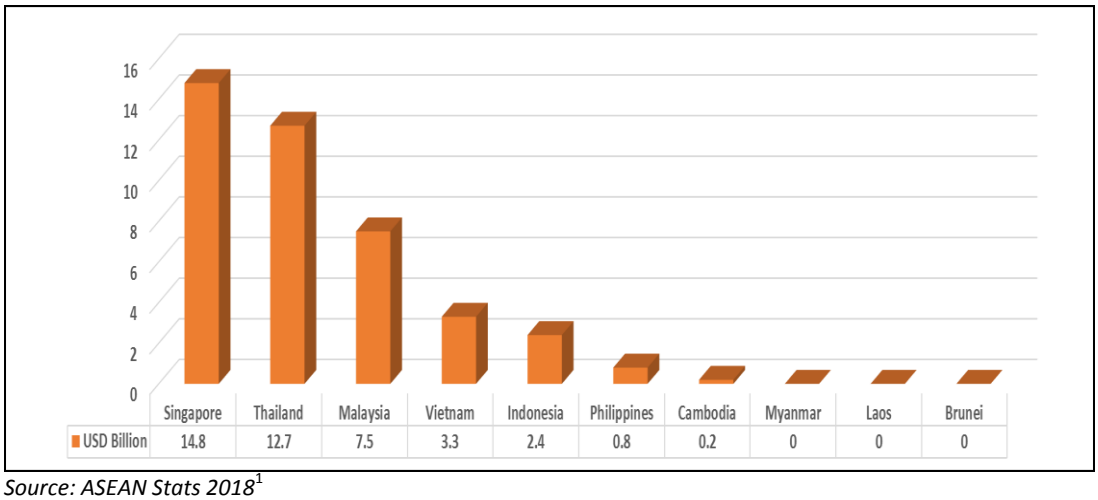
3. The dimensions of plastic in ASEAN

ASEAN draws attention [2] when it comes to marine pollution and plastic because **four of its members are estimated by Ocean Conservancy to dump more than half of the world's marine plastic waste** into the ocean in 2015[11].

3.1. The place of plastic in the ASEAN economy

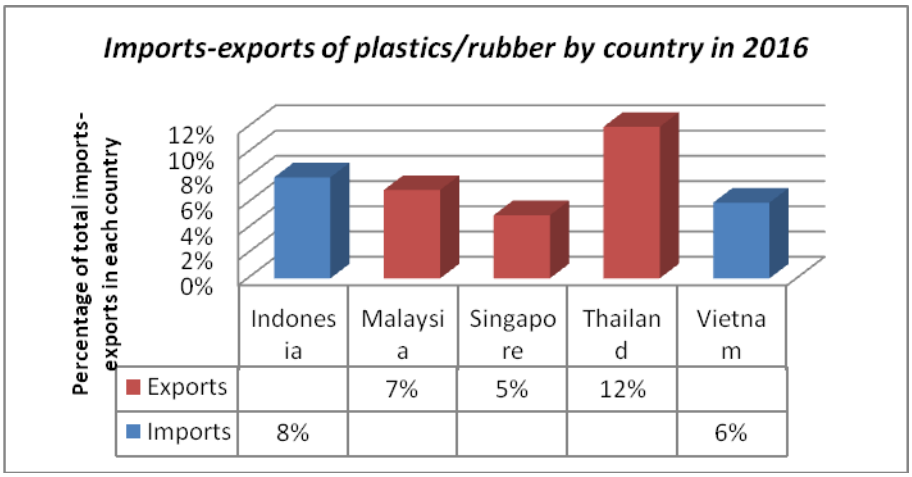
The plastic products sector is one of ASEAN's leading export sectors, in terms of value, with a revenue of **US$41.65 billion in 2017** (see figure 2) [20, p. 2]. Average production rates have steadily increased in recent years, particularly in Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam, who together form **more than 95 per cent of the regional GDP** [3]. Imports and exports of plastics and rubber represent **between 5% and 12%** of the total imports and exports of five ASEAN Member States (see Figure 3).

Figure 2: ASEAN countries' export revenues in 2017



Source: ASEAN Stats 2018[1]

Figure 3: Imports-exports of plastics/rubber by country in 2016



Source: OECD, Economic Outlook for Southeast Asia, China and India 2018: Fostering Growth Through Digitalisation [6, pp. 142, 152, 158, 168, 178, 191].

[1] See: https://data.aseanstats.org/dashboard/imts.hs2 [Accessed 7 Feb. 2019]

Indonesia	In 2014, average per capita plastic consumption was **17 kg** [3]. However, the Indonesian middle class is expected **to double to 141 million within five years**, which will also increase plastic use [3]. Indonesia **imports more than 40%** of its plastic from Malaysia, Thailand, Singapore, Europe, and the United States [5].
Malaysia	In 2014, average per capita plastic consumption was **35 kg** [3]. It has **over 1,500 plastic production companies** and exports to Europe, China, Singapore, Japan, and Thailand [3].
Singapore	As plastics are made by the petrochemical industry [4], Singapore holds a strategic position with its Jurong Island, home to **the world's largest petrochemical companies**. About 95 petrochemical companies are represented, attracting **more than $35 billion[2] (US$26 billion) investments** in 2016 [3].
Thailand	In 2014, average per capita plastic consumption was **40 kg** [3]. The Thai plastics production industry devolved rapidly and has **5,000 active companies** [3]. Unlike in several ASEAN countries, **more than 60% of these companies are relatively small** and do not exceed 30 employees [3].
Vietnam	The plastics sector in Vietnam is relatively recent, but shows **one of the highest growths** as production increased tenfold between 1990 and 2015; from less than 4 to **41 kg** per capita per year [3]. However, Vietnam operates in the **low value-added** part of the plastic sector; mainly exporting plastic bags to Japan [3]. Also, production relies heavily on the import of raw materials, mainly polypropylene and polyethylene resins, which average 4 tons for every ton produced [3].

Low impact of the trade agreement with the United States

Four ASEAN countries (Brunei, Malaysia, Singapore, Vietnam) with Australia, Canada, Chile, Japan, Mexico, New Zealand, Peru and United States signed the **Trans-Pacific Partnership Agreement (TPPA)** in 2016 [7], but on 23 January 2017 the United States (US) **withdrew** from the TPPA [7]. In **April 2018** the US President announced the USA will **will consider rejoining** if the terms are renegotiated. While rejoining would mean US plastics producers would have easier access to Southeast Asian markets as the tariffs (of up to 25%) would be eliminated [5], the TPPA agreement is **unlikely to have a significant impact on US production and trade** (including the plastics and rubber trade) [8, p. 215].

Positive impact of the Chinese trade restrictions

The Chinese government has **banned the import** of eight types of plastic waste from 2018 onwards to protect the environment and public health, as hazardous waste was mixed with imported waste. As imports into China represent **56% (by weight) of global imports** of plastic waste for recycling, this ban caused global concern. Countries that relied on China as an importer of plastic waste, are now seeking to **identify new strategies** to treat plastic waste and strengthen their **domestic recycling industry** [9, p. 6]. The growth of waste stocks in exporting countries forced them to seek out new market opportunities for plastic recycling. This resulted in significantly **larger trade flows for countries such as Thailand, Malaysia, and Vietnam** from the end of 2017. Concerns were raised about the potential health and environmental impacts in these countries, given their underdeveloped plastic recycling facilities and relatively low environmental and treatment standards [10, p. 11].

[2] Currently, companies such as BASF, ExxonMobil Chemical, Lanxess, Mitsui Chemicals, Shell and Sumitomo Chemicals have plants.

3.2. Assessing the scale of plastic issues

According to research published in *Science* in 2015, **more than half of all plastic waste** that ended up in the ocean came from China, Indonesia, Philippines, Thailand, and Vietnam alone [52]. These States recognize the urgency to act to contain the problem. At the **ASEAN conference in Phuket on 22-23 November 2017**, Thailand, for instance, members reaffirmed the commitment to reduce plastic discharge into the sea from the current 160 million kilograms to 80 million kilograms per year by 2021 [12]. **Most ASEAN countries** (some of which are among the world's largest plastic producers) **do not treat their plastic waste efficiently** (see Table 1 below) and waste generation is high. Singapore has one third of its 1.67 million tons of domestic waste disposed of on its territory. This waste is mainly packaging waste, such as plastic bags and food packaging[3], with 0% of waste managed inadequately [1].

NON-VERIFIED IMPACTS

The Mekong River and marine plastic pollution: 10 rivers carry more than 90% of the plastic waste transported by rivers in the oceans, the **Mekong River** being one of them, carrying 33 431 tons [14]. However, while rivers play an important role in transporting plastic to the oceans, there is still **a considerable lack of studies on freshwater environments**, which makes analysis of freshwater pollution difficult [13].

Table 1: Plastic Waste by ASEAN countries and its treatment in 2015

	KG OF PLASTIC WASTE GENERATED PER DAY	WASTE MANAGED INADEQUATELY
Brunei D.	9 236	1%
Cambodia	91 405	87%
Indonesia	10 660 505	81%
Malaysia	4 505 717	55%
Myanmar	1 416 164	87%
Philippines	6 237 653	81%
Singapore	866 849	0%
Thailand	3 734 630	73%
Timor-Leste	68 416	81%
Vietnam	5 714 578	86%

Source: UNEP, 2018 [13]

3.3. The verified impacts of marine plastic waste: economic and social effects

Plastic floating macro-debris, which can cause injury or death, is a **danger to navigation** [16, pp. 105 and 108]. The main costs to the commercial shipping sector are associated with: accidental loss of cargo; collisions with marine litter; and indirect costs related to operation and maintenance, and service disruption.

Plastic may also hurt the fishing industry as it can **contaminate or damage fish**, reducing their value and requiring more time to clean and repair nets [16, p. 106]. The costs of marine litter for EU fisheries were estimated at nearly 65.7 million US dollars in 2010, representing 0.9% of total revenues [16, p. 108]. In addition, consumers' perception that seafood may contain micro-plastics is likely to lead to a change in behavior and a reduction in seafood consumption [16, p. 106].

[3] To get an idea of the size, this quantity is enough to fill more than 1,000 Olympic sized pools.

The **tourism sector** has the problem of being both significantly affected by marine waste and one of the main causes of this problem. The presence of marine litter may discourage visitors from visiting certain tourist sites. This may have significant consequences, especially when local economies are highly dependent on tourism. In April 2018, the Philippines closed the popular island of Boracay to visitors in order to clean spilled sewage and to improve to its drainage systems. Similarly, Thailand announced the indefinite closure of its famous Maya Bay to allow it to recover from pollution and destruction caused by millions of tourists [2]. Cleaning costs can be significant and, in some cases, be borne by local authorities. Such costs were estimated **at USD 1,500 per ton of marine waste for the APEC region in 2007** [16, p. 231].

The **economic damage in the Asia-Pacific region** has been estimated at **US$1.26 billion per year for the maritime industries** as reported by UNEP [17, p. 83]. APEC estimates are similar, with estimated costs for tourism, fishing and shipping industries at $1.3 billion in 2009 for the whole region [2].

4. Multilevel legal frameworks to address plastic issues

4.1. Existing legal instruments

Global instruments have been put in place to protect biodiversity, manage chemicals and hazardous waste, and prevent pollution of the marine environment.

Perhaps most notable is the 1982 United Nations Convention on the Law of the Sea[4] (UNCLOS) (also known as the Montego Bay Convention), as it provides the general legal framework within which all activities on and in the seas and oceans are governed. The Montego Bay Convention also sets out the general obligation to protect and preserve the marine environment, resulting in the obligation to take the necessary measures to prevent, reduce and control pollution of the marine environment.

Other international conventions deal more specifically with the issues of marine plastic waste and micro-plastics. The scope and objectives of legal instruments are varied (see Tables 2 and 3).

Table 2: Applicable international treaties

Pollution oriented agreements
> The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention)[5] and its 1996 Protocol (the London Protocol)[6] are intended to ensure effective control of all sources of marine pollution and to take the necessary measures to prevent pollution by dumping waste or other matter at sea; only one of the ASEAN Member States is party to this convention and its protocol;
> Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)[7] includes provisions for the prevention of pollution from ship-generated waste. It is therefore prohibited to dump garbage into the ocean from all ships of any type, except in cases provided for by specific regulations;
> Convention on the Law of Non-Navigational Uses of International Watercourses (1997) (United Nations Watercourses Convention)[8]: Parties using an international watercourse in their territories shall "take all appropriate measures to prevent the causing of significant harm to other watercourse States", including the obligation to eliminate or mitigate such harm (art. 1). They are also required to "prevent, reduce and

[4] Available at : http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm [Accessed 7 Feb. 2019]

[5] See: https://treaties.un.org/doc/publication/unts/volume%201046/volume-1046-i-15749-english.pdf [Accessed 7 Feb. 2019]

[6] See: https://www.gc.noaa.gov/documents/gcil_lp.pdf [Accessed 7 Feb. 2019]

[7] See: http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx [Accessed 7 Feb. 2019]

[8] See: http://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf [Accessed 7 Feb. 2019]

control pollution" (art. 21).

Biodiversity and species oriented agreements

> The Convention on Biological Diversity of 1993 (CBD)[9]; Articles 6 and 8 of this Convention relate to the issue of the impact of marine plastic debris and preservation of biological diversity;

> The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (United Nations Fish Stocks Agreement)[10] contains the obligation to: "minimize pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species, in particular endangered species, through measures including, to the extent practicable, the development and use of selective, environmentally safe and cost-effective fishing gear and techniques" (art. 5, f).

Chemicals and waste oriented agreements

> The Stockholm Convention on Persistent Organic Pollutants of 2001 (Stockholm Convention)[11] aims to protect human life and the environment from chemicals that persist in the environment, accumulate in humans and wildlife, have harmful effects and can travel long distances in the environment; and

> The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal 1989 (Basel Convention)[12]also addresses the issue of plastic waste since a large part of the waste trade concerns plastics and some of them contain relatively high levels of chemical additives.

Source: Compiled by the authors.

Table 3: Status of ratifications by ASEAN countries of international conventions on marine plastic waste and microplastics[13]

International treaties	Number of ASEAN countries being States Parties
United Nations Convention on the Law of the Sea (1982) (UNCLOS)	9 (1 Signatory State)
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) (London Convention)	1
London Protocol (1996)	1
Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)	7
United Nations Watercourses Convention (1997)	1
The Convention on Biological Diversity of 1992	10
The Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (United Nations Fish Stocks Agreement)	4
The Stockholm Convention on Persistent Organic Pollutants of 2001 (Stockholm Convention)	8 (2 Signatory States)
The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal 1989 (Basel Convention)	10

[9] Available at: https://www.cbd.int/convention/ [Accessed 7 Feb. 2019]
[10] Available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N95/274/67/PDF/N9527467.pdf?OpenElement [Accessed 7 Feb. 2019]
[11] Available at: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-15&chapter=27&clang=_en [Accessed 7 Feb. 2019]
[12] Available at: http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx [Accessed 7 Feb. 2019]
[13] See Appendix I.

Source: Compiled by the authors[14]

In addition to these binding international treaties, there are **international guidelines** (see Table 4)[15].

Table 4: International guidelines

INTERNATIONAL SOFT LAW	The FAO Code of Conduct for Responsible Fisheries[16] (1995) is a set of soft law rules for both members and non-members of FAO. It contains a series of provisions and standards, some of which concern marine waste. The Code is voluntary and global in scope. The provisions on marine litter cover the provision of port facilities, the storage of litter on board and the reduction on seas and oceans of the number of abandoned, lost or otherwise discarded fishing gear.
	Marine pollution from land-based sources is also addressed in the voluntary/soft law through the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). The GPA, adopted in 1995, is a voluntary action-oriented, intergovernmental programme led by the UN Environment. It is currently the only global intergovernmental mechanism entirely dedicated to addressing the issue of prevention of the degradation of the marine environment from land-based activities. Marine Litter is one of the priority source categories under the GPA.

Source: Compiled by the authors.

The figure below gives an **overview of the current international legal and policy framework** with relevance to the management of the lifecycle of plastics (see Figure 4). The legal and public policy

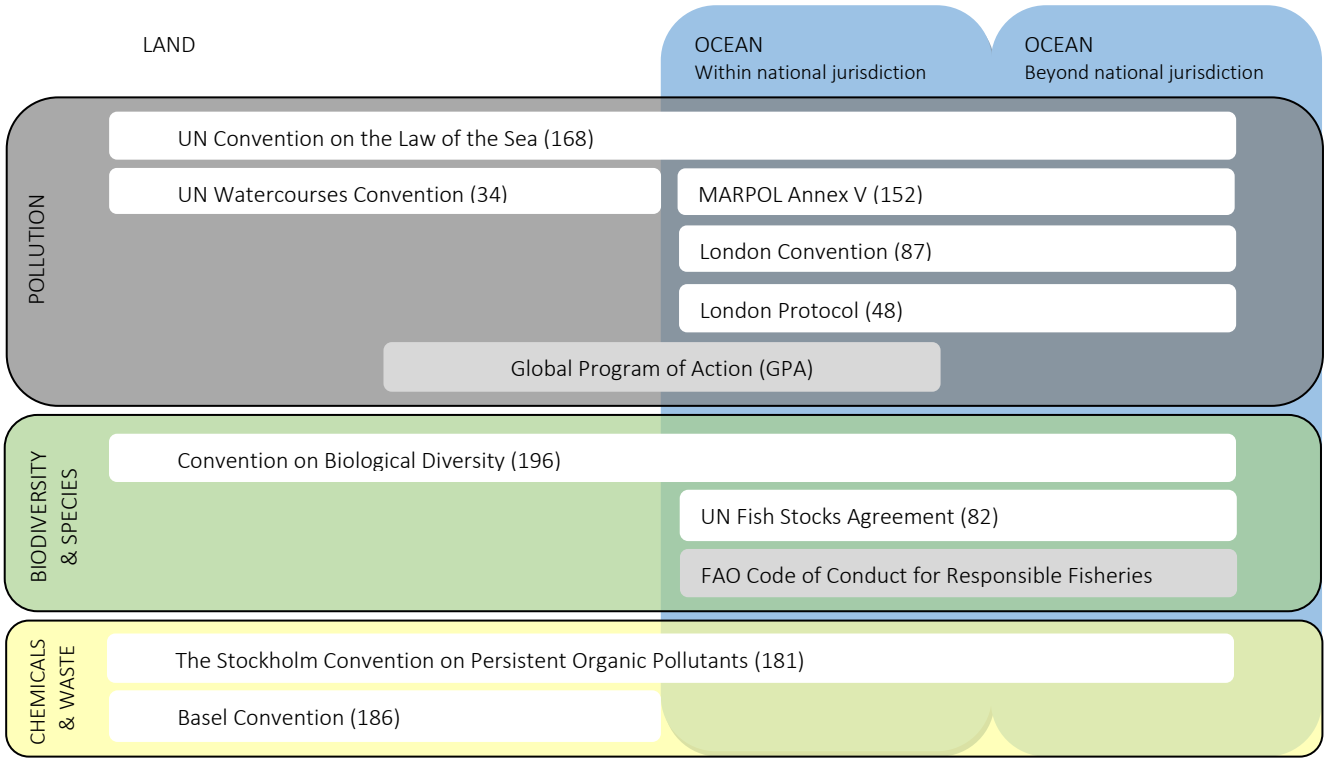
[14] - Status of United Nations Convention on the Law of the Sea available at: https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=UNTSONLINE&mtdsg_no=XXI~6&chapter=21&Temp=mtdsg3&lang=en [Accessed 7 Feb. 2019]
- Status of London Convention available at: https://www.ecolex.org/details/convention-on-the-prevention-of-marine-pollution-by-dumping-of-wastes-and-other-matter-tre-000420/participants/? [Accessed 7 Feb. 2019]
- Status of London Protocol available at: https://www.ecolex.org/details/1996-protocol-to-the-convention-on-the-prevention-of-marine-pollution-by-dumping-of-wastes-and-other-matter-1972-tre-001268/participants/? [Accessed 7 Feb. 2019]
- Status of Marpol Convention available at: http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx [Accessed 7 Feb. 2019]
- Status of United Nations Watercourses Convention available at: https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-12&chapter=27&lang=en [Accessed 7 Feb. 2019]
- Status of Convention on Biological Diversity available at: https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-8&chapter=27&clang=_en [Accessed 7 Feb. 2019]
- Status of United Nations Fish Stocks Agreement available at: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXI-7&chapter=21&clang=_en [Accessed 7 Feb. 2019]
- Status of Stockholm Convention available at: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-15&chapter=27&clang=_en [Accessed 7 Feb. 2019]
- Status of Basel Convention available at: https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-3&chapter=27&clang=_en [Accessed 7 Feb. 2019]

[15] In the context of soft international law, it is also worth mentioning the resolutions of the UNEP General Assembly on marine plastic debris and microplastics. Available at: https://papersmart.unon.org/resolution/uploads/unep_aheg_2018_inf2_unea_resolutions_en.pdf#overlay-context=adhoc-oeeg-information-documents [Accessed 7 Feb. 2019]

[16] See: http://www.fao.org/3/a-v9878e.htm [Accessed 7 Feb. 2019]

instruments are grouped thematically based on their primary objective of the management of pollution, biodiversity and species, and chemicals and waste. In addition, it sets out the range of coverage on land or oceans of each of these instruments. Numbers in parentheses indicate ratifications/accessions as of September 2017[17].

Figure 4: International legal and policy framework applicable to ASEAN country(ies)



Source: Extracted from UNEP report[18] (2018)

It may be noted that there is no binding agreement at the international level with the reduction of marine plastic waste and microplastics as a priority [18, p. 10]. Also, there is **no instrument for regional cooperation in Southeast Asia** for marine waste management, unlike other regions (Northeast Atlantic, Baltic Sea, Mediterranean Sea, Northwest Pacific, South Pacific, Wider Caribbean) [19, pp. 19-20].

Finally, it should be added that **at the national level**, in each ASEAN Member State, **national legislation** has developed **public policies** in response to the challenges posed by plastics (see Appendix IV).

4.2. Analytical framework of policy responses

The prevention and the combating of marine pollution of plastics and microplastics contributes to the achievement of the **UN sustainable development objectives 11 (sustainable cities and communities), 12 (responsible production and consumption) and 14 (life below water)** [18, pp. 89-90][19].

[17] See: UNEP, (2018). *Combating Marine Plastic Litter and Microplastics: An Assessment of the Effectiveness of Relevant International, Regional and Subregional Governance Strategies and Approaches.* [online] Nairobi: UNEP/EA.3/INF/5. Available at: http://undocs.org/unep/ea.3/inf/5 [Accessed 7 Feb. 2019]

[18] See: UNEP, (2018). *Combating Marine Plastic Litter and Microplastics: An Assessment of the Effectiveness of Relevant International, Regional and Subregional Governance Strategies and Approaches. Ibid.*

[19] See : https://www.un.org/sustainabledevelopment/sustainable-development-goals/ [Accessed 7 Feb. 2019]

UNEP resolution UNEP/EA.3/L.20[20] specifically addresses marine litter and microplastics by encouraging Member States to reduce unnecessary plastic use and promote the use of environmentally sound alternatives while prioritizing policies to reduce the amount of plastics entering the marine environment. Most ASEAN Member States have tried to follow these recommendations to reduce plastic consumption (see Table 5 and Appendix IV). Several Asian countries **regulated** the manufacture and use of plastic bags through levies, and some governments have, for the past decade, simply banned plastic bags. There is also a regulation on expanded polystyrene (which is a rigid cellular plastic with multitude shapes and applications [53, p. 2]) that is gradual and specifically **adjusted at the sub-national level**. For example, in three ASEAN countries the **ban on plastic bags** is enforced in the **Philippines in 27 cities/provinces**, in **Indonesia in less than 20 cities**, and in **Myanmar in 3 cities** [9, p. 26].

Nevertheless, **enforcement has often been inefficient** and single-use plastic bags have persisted **despite bans and levies** [9, p. 24].

Table 5: The most implemented policy instruments by ASEAN Member States

Policy tools		Features
Regulatory instruments	Ban	Prohibition of a particular type or combination of single-use plastics (including plastic bags, foamed plastic products, etc.). The ban can be total or partial (for those of certain specifications, e.g. plastic bags <30µ thickness)
Economic instruments	Levy on suppliers	Levy paid by suppliers of plastic bags (domestic producers or importers). For such a tax to be effective in inducing behavioral change, it should be fully passed on from suppliers to retailers, enticing the latter to (i) charge consumers for plastic bags or (ii) offer a rebate/reward to consumers who do not ask for plastic bags, promoting the use of reusable ones.
	Levy on retailers	Levy to be paid by the retailer when purchasing plastic bags. The retailers are not obligated to convey the tax to the consumers
	Levy on consumers	Charge on each bag sold at the point of sale; standard price defined by law
Combination of regulatory and economic instruments	Ban and levy	Combination of ban and levy (for instance a ban on thin plastic bags and a levy on thicker ones)

Source: UNEP (2018), Single-Use Plastics: A Roadmap for Sustainability [9]

Adequate waste collection: There is no single solution for waste management that can be applied consistently and strictly in all countries. Each country's public policy in this area needs to take into account the constraints specific to each of the ways in which waste is managed. Indeed, most solid waste landfills are prone to soil and groundwater contamination if not properly managed. Waste recycling is favored, but faces constraints associated with **risks of future contamination**, while, waste incineration poses problems of odor and air pollution [22, p. 7]. In all cases, appropriate waste collection is essential for proper waste management. A report from a civil society organization encourages governments, despite these constraints, to continue their efforts to collect waste. According to the same report, there would be a **23% reduction** in plastic waste in the ocean if the **waste collection** rate in China, Indonesia, Philippines, Thailand and Vietnam averaged about 80% [11, p.

[20] See : https://www.google.com/search?q=Resolution+UNEP%2FEA.3%2FL.20&rlz=1C1GCEU_enKH819KH819&oq=Resolution+UNEP%2FEA.3%2FL.20&aqs=chrome..69i57.647j0j4&sourceid=chrome&ie=UTF-8 [Accessed 7 Feb. 2019]

26]. However, the cost of implementing this initiative in the five countries would be between **$4.5 and $5 billion per year** (based on a 10-year average to achieve and maintain this rate) [11, p. 26]. This would represent an average **increase in the waste management budget of more than 75%** in these five countries [11, p. 26].

***Research and development*:** Thailand's strategy for action consists of **impact studies**, establishing a **database** on the origin of plastic waste, and encouraging **environmentally friendly products**. Thai officials aims to create "plastic-free geographical areas", especially in seaside tourism regions [21]. From 2009 to 2016, Thailand invested US$60 million, 80% of which was injected by the government, to **develop bioplastics** [5]. **ASEAN Technical Working Groups** are currently working on the environmental issue by studying and communicating/sharing data on the interconnectivity of marine areas in ASEAN countries [2].

International cooperation: UNEP has published a **list of challenges** that it considers to be key at the international, regional and sub-regional levels. Some of these shortcomings include the following: [18, pp. 11-12]:

- lack of global standards for national **monitoring and reporting** of emissions from consumption, use, final treatment and trade in plastic waste;
- lack of global industry standards for environmental **quality control**;
- gaps in the development of **legally binding instruments in key regions** to manage land-based marine pollution;
- waste management at the regional level, including wastewater treatment, is **fragmented**;
- **lack of data** in some regions on the sources and extent of plastics and microplastics in the marine environment, organisms and associated health and ecosystem risks;
- incorrect application of the **polluter pays principle** in the various sectors of the plastics industry and, overall, no liability and compensation mechanism for plastic pollution;
- failure to establish sustainable and **profitable end markets** for all end-of-life products;
- lack of effective compliance and **enforcement mechanisms**.

UNEP also invited international and regional organizations and states (including the OECD and its members) that are parties to international conventions applicable to marine plastic and microplastics, **to coordinate their action**[21]. It established an **Open Ended Expert Group**[22] to further explore obstacles and opportunities to combat marine plastic waste and microplastics from all sources, particularly land-based, and decided that this group shall **include representatives of regional organizations**.

Initiatives from private and public sectors: While **public-private agreements** can also strengthen the authorities' action (see Table 5), there are **also initiatives from the private sector alone** that can contribute to positive action. For example, an **industrial alliance**, called Alliance to End Plastic Waste[23], with nearly 30 global companies, including Procter & Gamble, Shell, BASF and ExxonMobil, recently announced its intention to invest **US$1.5 billion** to address plastic waste from the oceans (research and development of new recycling technologies, construction of infrastructure for waste collection and recycling and cleaning of areas where plastic waste is concentrated, such as rivers) [23]. Its focus covers the whole world, with a particular emphasis on regions with the greatest needs, such as South-East Asia[24]. **Investment funds** are also being created. *Circulate Capital*, "an impact-focused investment management firm headquartered in New York and dedicated to financing inno-

[21] See: https://undocs.org/UNEP/EA.3/Res.7 (p. 3) [Accessed 7 Feb. 2019]
[22] See: *Ibid.* (para. 10 , c) [Accessed 7 Feb. 2019]
[23] See: https://endplasticwaste.org/ [Accessed 7 Feb. 2019]
[24] See: https://endplasticwaste.org/wp-content/uploads/2019/01/AEPW_FactSheet.pdf [Accessed 7 Feb. 2019]

vation, companies, and infrastructure that prevent the flow of plastic waste into the world's ocean"[25], is a new investment instrument that aims to address the problem of oceans plastic waste by creating a mixed financing mechanism to remove access to capital as an obstacle to the development of waste management and recycling infrastructure. *Circulate Capital* plans to identify, incubate and invest in opportunities designed to intercept ocean plastics at source by collecting, sorting, treating and recycling waste in South and Southeast Asian countries. At the 2018 Our Ocean Conference in Bali (Indonesia), *Circulate Capital* announced **more than $100 million** in funding to combat ocean plastics from PepsiCo, Procter & Gamble, Dow, Danone, Unilever, and The Coca-Cola Company[26].

[25] See: https://www.circulatecapital.com/ [Accessed 7 Feb. 2019]
[26] See: https://www.circulatecapital.com/ [Accessed 7 Feb. 2019]

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Appendix I: Status of ratifications by ASEAN countries of international conventions on marine plastic waste and microplastics

United Convention on the Law of the Sea

Participants	Signature, Succession to signature(d)	Formal confirmation(c), Accession(a), Succes-sion(d), Ratification
Brunei Darussalam	5 Dec. 1984	5 Nov. 1996
Cambodia	1 Jul. 1983	-
Indonesia	10 Dec. 1982	3 Feb 1986
Lao People's Democratic Republic	10 Dec. 1982	5 June 1998
Malaysia	10 Dec. 1982	14 Oct. 1996
Myanmar	10 Dec. 1982	21 May 1996
Philippines	10 Dec. 1982	8 May 1984
Singapore	10 Dec. 1982	17 Nov. 1994
Thailand	10 Dec. 1982	15 May 2011
Viet Nam	10 Dec. 1982	25 Jul. 1994

London Convention

** [1] Ratification [2] Accession/approbation [3] Acceptance/approval [4] Succession [5] Consent to be bound [6] Definite signature*

Countries/Territories	Entry into force	Ratification *	Simple signature
Brunei Darussalam	-	-	-
Cambodia	-	-	-
Indonesia	-	-	-
Lao PDR	-	-	-
Malaysia	-	-	-
Myanmar	-	-	-
Philippines	Aug. 30, 1975	Aug. 10, 1973 [1]	Dec. 29, 1972
Singapore	-	-	-
Thailand	-	-	-
Viet Nam	-	-	-

London Protocol

Participants	Entry into force	Ratification	Simple signature
Brunei Darussalam	-	-	-
Cambodia	-	-	-
Indonesia	-	-	-
Lao PDR	-	-	-
Malaysia	-	-	-
Myanmar	-	-	-
Philippines	June 8, 2012	May 9, 2012 [2]	-
Singapore	-	-	-
Thailand	-	-	-
Viet Nam	-	-	-

Marpol

As at 11/02/2019	MARPOL 73/78 (Annex V)
Brunei Darussalam	
Cambodia	x
Indonesia	x
Lao People's Dem. Rep.	
Malaysia	x
Myanmar	x
Philippines	x
Singapore	x
Thailand	
Viet Nam	x
x= ratification	
d=denunciation	

United Nations Watercourses Convention

Participants	Signature	Approval(AA), Acceptance(A), Accession(a), Ratification
Brunei Darussalam	-	-
Cambodia	-	-
Indonesia	-	-
Lao PDR	-	-
Malaysia	-	-
Myanmar	-	-
Philippines	-	-
Singapore	-	-
Thailand	-	-
Viet Nam	-	19 May 2014 a

Convention on Biological Diversity

Participants	Signature	Ratification, Accession(a), Acceptance(A), Approval(AA), Succession(d)
Brunei Darussalam		28 Apr. 2008 a
Cambodia		9 Feb. 1995 a
Indonesia	5 June 1992	23 Aug. 1994
Lao People's Democratic Republic		20 Sep. 1996 a
Malaysia	12 June 1992	24 June 1994
Myanmar	11 June 1992	25 Nov. 1994
Philippines	12 June 1992	8 Oct. 1993
Singapore	10 Mar. 1993	21 Dec. 1995
Thailand	12 June 1992	31 Oct. 2003
Viet Nam	28 May 1993	16 Nov. 1994

United Nations Fish Stocks Agreement

Participants	Signature	Accession(a), Ratification
Brunei Darussalam	-	-
Cambodia	-	-
Indonesia	4 Dec. 1995	28 Sep. 2009
Lao PDR	-	-
Malaysia	-	-
Myanmar	-	-
Philippines	30 Aug. 1996	24 Sep. 2014
Singapore	-	-
Thailand	-	28 Apr. 2017 a
Viet Nam	-	18 Dec. 2018 a

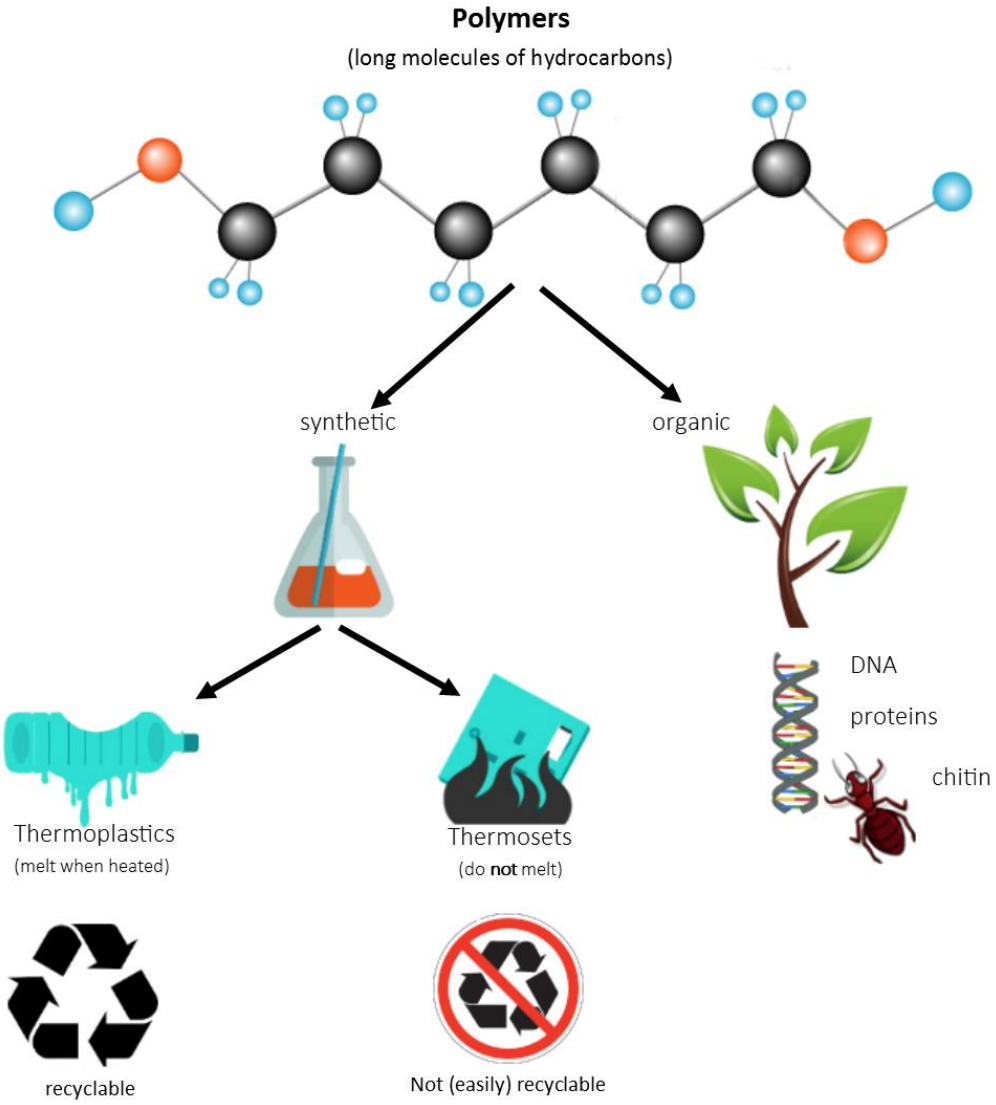
Stockholm Convention

Participants	**Signature, Succession to signature(d)**	**Ratification, Acceptance(A), Approval(AA), Accession(a)**
Brunei Darussalam	21 May 2002	-
Cambodia	23 May 2001	25 Aug. 2006
Indonesia	23 May 2001	28 Sep. 2009
Lao People's Democratic Republic	5 Mar 2002	28 Jun. 2006
Malaysia	16 May 2002	-
Myanmar	-	19 Apr. 2004 a
Philippines	23 May 2001	27 Feb. 2004
Singapore	23 May 2001	24 May 2005
Thailand	22 May 2002	31 Jan. 2005
Viet Nam	23 May 2001	22 Jul. 2002

Basel Convention

Participants	Signature	Approval(AA), Formal confirmation(c), Acceptance(A), Accession(a), Succession(d), Ratification
Brunei Darussalam	-	16 Dec. 2002 a
Cambodia	-	2 Mar. 2001 a
Indonesia	-	20 Sep. 1993 a
Lao People's Democratic Republic	-	21 Sep. 2010 a
Malaysia	-	8 Oct. 1993 a
Myanmar	-	6 Jan. 2015 a
Philippines	22 Mar. 1989	21 Oct. 1993
Singapore	-	2 Jan. 1996 a
Thailand	22 Mar. 1990	24 Nov. 1997
Viet Nam	-	13 Mar. 1995 a

Appendix II: Polymers and plastics



Appendix III: Table of different plastics

acronym	name	Common uses	% of studies marine sediments
PE	Polyethelene	Plastic bags, storage containters	79%
PP	Polypropylene	Bottle caps, rope, strapping	64%
PS	Polystyrene	Utensils, cups, coolers, food containers	40%
PA	Polyamide or Nylon	Rope, fishing nets, textiles	17%
PES	Polyester	Textiles, boats	10%
AC	Acrylic	Latex paint, medical equipment	10%
POM	Polyoximethylene	Electronics, car parts	10%
PVA	Polyvinylalcohol	Laundry detergent, fishing bait	7%
PVC	Polyvinylchloride	(water)pipes, film	5%
PMA	Polymethylacrylate	Safety glass (e.g. car windshields)	5%
PET	Polyethylene terephthalate	Drinking bottles, textile fibers	2%
AKD	Alkyd	Resins, paints	2%
PUR	Polyurethane	Construction, car parts	2%

Data from GESAMP (2015). Sources, fate and effects of microplastics in the marine environment: a global assessment, Kershaw, P. J., ed. IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection. Rep. Stud. GESAMP No. 90, 96

Appendix IV: Domestic legal and policy frameworks in ASEAN countries

ASEAN COUNTRIES	LEGAL FRAMEWORK & POLICIES ON PLASTIC WASTE MANAGEMENT
Brunei Darussalam	- Plastic bags restriction from Friday to Sunday [20, p. 7] - Plastic bags forbiddance in all the supermarkets by 2019 [20, p. 7]
Cambodia	- Sub-Decree No. 168 GNKR.BK on the Management of Plastic Bags (October 2017): Plastic bags are prohibited for import, local production, distribution and use unless their thickness is 0.03 millimeters and their base width is 25 centimeters (art. 14) [20, p. 7]. - KHR 400 (USD 0.10) for one plastic bag charged by the supermarkets [20, p. 7].
Indonesia	- National Action Plan on Marine Debris (2017-2025): it recommends efforts to reduce marine plastic debris by 70% (from the 2017 baseline) by the end of 2025. - Tax on plastic bags (200 rupees per bag - USD 0.01) for a "3-month trial period" (2016) covering 23 cities [20, p. 7]. - Plastic bags ban o Banjarmasin city (2016) [9, p. 33] o Bogor city (2018) [20, p. 7]. - Islamic organizations' – Nahdlatul Ulama (NU) and Muhammadiyah – new initiative on "Ngaji Sampah (Sermons on Waste)" [20, p. 7]. - Bio-based plastic consumption encouraged by the Ministry of Industry [20, p. 7].
Lao PDR	- "Recyclable bags" usage in the cafés and markets [20, p. 7].
Malaysia	- Plastic Tax [20, p. 7]. - Forbiddance on plastic bags and "polystyrene containers" (Selangor and Federal territories) [20, p. 7]. - "Unforgettable bag" Campaign of Tesco company: Consumers bring barcode bags and receive 0.20 ringgit (US$0.05) in cash per bag [20, p. 7].
Myanmar	- Plastic bags ban o Mandalay city (2009) [20, p. 7] o Nay Pyi Taw [9, p. 33] o Yangon (2011) [20, p. 7] - "No plastic bag day" of City Mart company (2013): Customers bring their own bag, either buy a reusable bag or pay 100 Kyat (US$0.07) per single-use plastic bag. [20, p. 7]
Philippines	- Disposable avoidance of plastic products (Department of Environment and Natural Resource)[27] - Ordinance No. SP-2140 on Plastic Bag Reduction in Quezon City (2012) - Proposed bills o Senate Bill No. 1866 – Plastic Straw and Stirrer Ban (2018) o Plastic Bags Regulation Act and Senate Bill No. 2759 – Total Plastic Ban Act (2011) o Philippine National Standards (PNS) 2097:2014 on Plastic Shopping Bags o PNS 2092:2011 on biodegradable plastics

[27] *ASEAN Joins Movement to Beat Plastic Pollution*. https://asean.org/asean-joins-movement-beat-plastic-pollution/.

	- Single-use plastic[28] products avoidance (Dipolog City and Cebu City) [29] - "Bring Your Own Bag (BYOB)" campaign for consumers to bring reusable bags [30]
Singapore	- Singapore Packaging Agreement for reducing packaging waste (2007)[31]
Thailand	- 20-Year Pollution Management Strategy Pollution Management Plan 2017-2021 [21] - Master Plan on Waste Management 2016-2021 [21] - Plastic Debris Management Plan (announced by the Ministry of Nature Resources and Environment – MoNRE - in 2017) [21] - "Say No to Plastic Bag" campaign (11,000 mini-markets and convenience stores) - MoU between the MoNRE and 16 enterprises regarding "no plastic bags distribution to the customers on 15th and 30th each month" - "No plastic cap seals of drinking water bottles" campaigns (2018) - Plastic bags ban in the national parks (Department of National Parks, Wildlife and Plant Conservation, 2018) - No plastic bags in hospitals (Department of Medical Services, Ministry of Public Health, 2018) - Sustainable University Network (SUN) campaign regarding "single-use plastic" reduction on campuses - Initiative on "Public-Private Partnership for Sustainable Plastic and Waste Management" (2018)[32]
Vietnam	- Plastic bags tax from VND 30,000 to VND 50,000 (USD 1.3 to USD 2.1) for one kilogram of plastic bags (Art.3 of Environment Protection Tax Law - Decree No. 67/2011/ND-CP)[33] - Circular No. 07/2012/BTNMT on Eco-friendly Plastic Bags - Decision No. 582/QD-TTg on Enhancing the Control of Environmental Pollution (2013) - Restriction on plastic scraps import (2018)[34]

Source: Compiled by the authors.

[28] Single-use plastics or disposable plastics are used only once before they have thrown away or recycled. These items are things like plastic bags, straws, coffee stirrers, soda and water bottles and most food packaging. People produce roughly 300 million tons of plastic each year and half of it is single-use. *(Plastic Free Challenge Organization http://www.plasticfreechallenge.org/what-is-single-use-plastic/,* accessed 7 Feb. 2019)

[29] *Managing Packaging Waste in the ASEAN Region*. https://www.giz.de/de/downloads/giz2018_ASEAN-Packaging-Waste_web.pdf.

[30] *ASEAN Joins Movement to Beat Plastic Pollution*. https://asean.org/asean-joins-movement-beat-plastic-pollution/.

[31] *Singapore Packaging Agreement and 3R Packaging Awards.* http://www.nas.gov.sg/archivesonline/data/pdfdoc/20111012004/press_kit_-_annexes.pdf.

[32] *ASEAN Joins Movement to Beat Plastic Pollution*. https://asean.org/asean-joins-movement-beat-plastic-pollution/.

[33] *Law on Environmental Protection Tax.* http://moj.gov.vn/vbpq/en/lists/vn%20bn%20php%20lut/view_detail.aspx?itemid=10487.

[34] *Managing Packaging Waste in the ASEAN Region*. https://www.giz.de/de/downloads/giz2018_ASEAN-Packaging-Waste_web.pdf.