

MARINE PLASTIC POLLUTION IN SOUTH ASIA

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Table of Contents

1.	INTRODUCTION.....	8
2.	THE GLOBAL PHENOMENON OF MARINE PLASTIC POLLUTION.....	10
2.1.	<i>Trends in production, consumption, and generation of plastic products</i>	<i>12</i>
2.2.	<i>Drivers for production, consumption, and generation of plastic products.....</i>	<i>15</i>
2.3.	<i>Challenges in recycling and disposal of plastic products</i>	<i>16</i>
3.	MARINE PLASTIC PRODUCTS AND POLLUTION IN SOUTH ASIA.....	18
3.1.	<i>Trends in production, consumption, and generation of plastic products</i>	<i>18</i>
3.2.	<i>Driving force for generation and consumption of plastic products and the generation of plastic waste</i>	<i>19</i>
3.3.	Effects of single-use of plastic products.....	20
3.3.1.	<i>Challenges in recycling and disposal of plastic products</i>	<i>21</i>
3.3.2.	<i>Bans on plastic products</i>	<i>26</i>
3.3.3.	<i>Impacts of marine plastic pollution</i>	<i>27</i>
3.4.	Vertical integration of actions to minimize single-use of plastic products in South Asia	31
3.4.1.	<i>Implementation of plastic bag bans</i>	<i>31</i>
3.4.2.	<i>Promotion of eco-friendly alternatives including bioplastics and other commodities</i>	<i>32</i>
3.4.3.	<i>Community-based approaches in formal/informal sectors, consumer awareness, and voluntary reduction strategies and agreements</i>	<i>33</i>
3.4.4.	<i>Economic instruments to addressing marine plastic litter</i>	<i>34</i>
3.4.5.	<i>Policy instruments and trans-boundary issues, waste trade issues and the Basel convention</i>	<i>35</i>
4.	SELECTED CASE STUDIES FROM SOUTH ASIA	35
4.1.	<i>A case study for Bangladesh: using social pressure to solve plastic and litter problem</i>	<i>35</i>
4.2.	<i>A case study for India: engaging the public to solve plastic and litter problem</i>	<i>36</i>
5.	CONCLUSION AND RECOMMENDATIONS	38
6.	ENDNOTES.....	41

List of tables

Table 1. Plastic intensity per sector (a metric ton of plastic per USD million revenue)	12
Table 2. The plastic recycling rate of SAR countries	23
Table 3. Summary of plastic ban legislation and features in the SAR member States.....	26
Table 4. Weight loss of the different type of plastics in the oceans	33
Table 5. Surface area loss of the different type of plastics in the Oceans	33

List of figures

Figure 1. Plastics in the environment.....	11
Figure 2. Plastic Loss to the oceans across the Plastic Value Chain Stage	13
Figure 3. Production of plastics worldwide 1950-2018.....	14
Figure 4. Distribution of global plastics production	14
Figure 5. Global distribution of mismanaged waste in 2010	16
Figure 6. Cumulative plastic waste generation and disposal (million metric tons).....	17
Figure 7. GDP per capita growth rate from 2000-2018 in South Asia Region.....	19
Figure 8. Past and projected GDP growth rate of different regions.....	20
Figure 9. Plastic waste generation in selected South Asian countries in 2010	21
Figure 10. Urban and Rural Waste Collection Rates by Income Level.....	21
Figure 11. Waste disposal method in South Asia	24
Figure 12. Solid Waste Disposal Methods Practiced in Some South Asian Countries	25
Figure 13. Ecosystem impact of marine plastic on biota	27
Figure 14. Involvement of parties in promoting recycling and municipal solid waste management	34

Foreword

The Development Papers Series of the United Nations ESCAP South and South-West Asia Office (UNESCAP-SSWA) promotes and disseminates policy-relevant research on the development challenges facing South and South-West Asia. It features policy research conducted at UNESCAP-SSWA as well as by outside experts from within the region and beyond. The objective is to foster an informed debate on development policy challenges facing the sub-region and sharing of development experiences and best practices.

This paper is prepared by Chrispin Petro Kapinga and Shing Hin Chung of the UNESCAP-SSWA Office. It provides a brief overview of the global phenomenon of marine plastic pollution; explores the integration of actions to minimize the single-use of plastic products in South Asia, including the effects of single-use plastic products; and presents selected case studies from Bangladesh and India that depict how social pressure and public engagement help to address marine plastic problems in the subregion. Finally, the paper provides recommendations and ways forward.

The analysis from the paper shows that while the global community is beginning to understand the consequences of marine plastic pollution, regional impact studies on the same are still lacking. In many of the South Asian countries, the existing measures to curb marine plastic pollution and strategies for slowing down or alleviating plastic production and consumption patterns are insufficient. Also, based on the current data, the main driving forces behind the severe marine plastic pollution in the South Asia region is primarily due to inadequate waste management systems and practices and weaknesses that exist in the informal plastic recycling sector. Therefore, the production of plastics and consumption in these countries is expected to increase in the coming years.

We hope that the policy lessons drawn in this paper will be useful for designing policies and strategies to address the marine plastic pollution problem in South Asia. In order to increase the ability of countries to curb marine plastic pollution effectively, the paper has proposed several recommendations to be taken and used by policymakers in South Asia.

Also, selected case studies from Bangladesh and India are presented to showcase how social pressure and public engagement could help to address marine plastic problems in the subregion.

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Marine Plastic Pollution in South Asia

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Abstract

Marine plastic pollution has increasingly been a concerning issue around the globe as the initial impact of marine plastic pollution is gradually emerging. But, where does plastic originate? Inadequate and overwhelmed waste management systems, open dumping, storms, and rain cause land-based sources of pollution to leak into rivers, the coastal areas, and oceans. An estimated 80 percent of all plastic waste in the oceans comes from land-based activities, and the remaining 20 percent comes from marine activities. The extent of sea-based sources of pollution, including abandoned, lost and discarded fishing gear and waste from ships and ports and its devastating impacts to ecosystems and marine species remains underexplored.

Footages and news of the extent to which wildlife is being affected by marine plastic litter have shocked the world. The global community is beginning to understand the consequences of marine plastic pollution, but regional impact studies are still lacking. The paper finds that the main driving forces behind the severe marine plastic pollution in the South Asia region are primarily due to poor practices of waste management systems and inefficient informal plastic recycling sector. The consequences of marine plastic pollution in South Asia has been enormous, leading to threats to wildlife, community health concerns, and economic losses due to the severity of plastic litter and associated clean-up cost.

With a loosely implemented partial plastic bans in most of the countries in South Asia, our analysis shows that the existing measures are insufficient to slow down or even alleviate the situation as plastic production and consumption is expected to increase in the coming years. Also, we find that although the impact of plastic pollution in the marine ecosystem and climate change is known in the region, its quantification with respect to baseline at the city, national and regional level is lacking and unable to identify interventions related to technologies, mitigation, and management strategies. Likewise, due to significant income differences between the population in coastal and mainland areas, the socioeconomic impact needs to be assessed in the region because coastal tourism is affected, especially when tourists avoid beaches known to have high concentrations of plastic litter.

In order to increase the ability of countries to curb marine plastic pollution effectively in South Asia, the paper recommends that South Asian countries should: 1) improve and modernize waste management systems; 2) apply better enforcement mechanism on plastic use prohibitions, 3) introduce or straighten economic instruments, e.g., resource tax, technology for recycling mixed plastics, thermosets, alternate materials, etc.; 4) establish baseline data across region, including indicator monitoring, impact assessments across the terrestrial, aquatic, marine ecosystem, health and socio-economics; 5) closely cooperation among each other and between non-government organizations and the governments at local and national levels; and 6) more proactively participate in regional and international initiatives.

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Keywords: Marine Plastic Pollution, South Asia, Plastic Waste, Plastic Recycling, Plastic Disposal, Sustainable Development.

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LIST OF ABBREVIATIONS

- ALDFG – Abandoned, Lost and Discarded Fishing Gear
ASEAN – Association of Southeast Asia Nation
BPA - Bisphenol A
CPCB – Central Pollution Control Board
FAO – Food and Agricultural Organization of the United Nations
GPGP – Great Pacific Garbage Patch
IMF – International Monetary Fund
KKPKP - Kagad Kach Patra Kashtakari Panchayat
MoU – Memorandum of Understanding
MPP – Marine Plastic Pollution
MTs – Metric Tons
NGOs – Non-Government Organizations
PMC - Pune Municipal Corporation
SAARC – South Asia Association for Regional Cooperation
SACEP – South Asian Cooperative Environmental Program
SAR – South Asian Region
SDG – Sustainable Development Goal
SWaCH - Solid Waste Collection and Handling
UNEP – United Nations Environment Programme

1. INTRODUCTION

Marine plastic pollution (MPP)¹ has, over the period, posed an urgent sustainable challenge to the world's environment, South Asia, and Asia and the Pacific region at large. Driven by factors such as the growing production of plastics, increasing dependence on single-use plastic, and weak national waste management systems, addressing the marine plastic pollution problem appears to be a daunting task. The international conventions on marine pollution have raised the need to curb plastic waste, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.² Likewise, the multilateral agreements such as the ASEAN Framework of Action on Marine Debris, South Asian Association for Regional Cooperation (SAARC) on the reduction of plastic use and public awareness-raising on marine plastic pollution, and the South Asia Cooperative Environmental Program (SACEP) for the protection and sustainable management of the marine environment have raised the need to curb plastic waste as well. These transformative actions depend primarily on the development and enforcement of effective national policies and frameworks to fulfill such international instruments.

The United Nations Convention on the Law of the Sea sets a broader framework for the protection and preservation of the marine environment.³ The Convention identifies six types of marine pollution: pollution from land-based sources, seabed activities subject to national jurisdiction, operations in the area, dumping, vessels, and pollution from or through the atmosphere. The document does not have a specific reference to marine debris, as when most member States signed the Convention almost four decades ago, it was not an alarming issue as it is today. Nonetheless, marine debris falls within the overarching types of marine pollution identified, for the most part, from land-based sources. The Convention established the general obligation of States to protect and preserve the marine environment and their liability while also foreseeing global and regional cooperation in this area to formulate international rules, standards, and practices and procedures.⁴ Through SDG 14.1, governments are required "by 2025, (to) prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris⁵ and nutrient pollution".

Marine litter is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.⁶ Marine litter consists of items that have been made or used by people and deliberately dumped into the sea or rivers or on beaches; brought indirectly to the sea through river streams, sewage, stormwater, or winds; or accidentally lost, including material lost at sea in bad weather.⁷ Among the marine litter, plastic is estimated to account for 60 to 80% and may even reach 90 to 95% in some areas.⁸ Marine litter originates from two primary sources: land-based activities and maritime activities, in which the majority of it (80%) comes from land.⁹ Land-based activities contribute mainly to marine pollution via airborne emissions (natural storm or high winds), oceans littering (municipal solid waste which includes the fractions of packaging, consumer and institutional products, electrical/electronics, and textiles, coastal or inland areas like piers and beaches), and runoffs from land (riverine transport of waste from inland source).¹⁰

Maritime activities such as commercial fishing, offshore oil and gas platforms, and aquaculture contribute a relatively much smaller portion (20%) of marine litter.^{11, 12} Shipping, port operations, and shipbuilding or repair use the marine ecosystem as an "input," and its impact

has grown over time. For example, the global seaborne trade increased at an annual average rate of 3.4% between 2000 and 2018, with economic growth being a significant factor supporting the increase.¹³ The slow pace of degradation of most marine litter items, mainly plastics, together with the continuously growing quantity of litter disposed of, gradually increase the marine litter found at sea and on the shores posing a severe threat to fishery resources, habitat, as well as human health and safety.

Plastic is synthetic polymers with thermo-plastic or thermo-set properties (synthesized from hydrocarbon or biomass raw materials), elastomers (e.g., butyl rubber), material fibers, monofilament lines, coatings and ropes, UNEP (2018). Plastics can be divided into thermoplastics - capable of being deformed by heating such as polyethylene, polypropylene and polystyrene, and thermoset - non-deformable, which include polyurethane, paints and epoxy resins. MPP can be further categorized into macroplastics (larger than 5mm) and microplastic (smaller than or equal to 5mm), where the latter can travel long distances in the oceans to as deep as the seabed.

Most marine litter first enter the ocean's environment via smaller rivers, and plastic is the most predominant litter item found in rivers and coastal beaches.¹⁴ The current of oceans can carry the marine litter to a great distance away from where it first entered the sea. The most famous is the Great Pacific Garbage Patch (GPGP), which is an area found in the eastern part of the North Pacific Subtropical Gyre, which has accumulated at least 79,000 tons of plastic floating in the space of 1.6 million km².¹⁵ This area attributes to the significant sources of marine plastic pollution to Asia, via the Kuroshio extension current system and fishing activities.¹⁶ Asia-Pacific alone produces 49.3% of the global plastic volume and consumes 38% of all plastics.¹⁷ The extent of sea-based sources of pollution- abandoned, lost and discarded fishing gear (ALDFG) and waste from ships and ports and its devastating impacts to ecosystems and marine species remains underexplored, but 46% of the marine litter larger than 5 cm are comprised of ALDFG, where litter larger than 5cm consists of 75% of the mass of GPGP.¹⁸

In South Asian Region (SAR), marine litter is more visible in the areas covering the South Asian Seas region, (i.e., the seas bordering Bangladesh, India, Maldives, Pakistan, and Sri Lanka) comprising of the Northern part of the Indian oceans, along with parts of the Bay of Bengal and the Arabian Sea. This region is characterized by high population density (almost a fifth of the world's total population), low-income development indicators, and high dependence upon natural resources for livelihood. Recent studies indicate that among the top ten most polluted rivers in the world, eight of them come from Asia, and two of them are in the South Asia subregion (i.e., 6th – Ganges, and 3rd – Indus).¹⁹ Based on the data, an optimistic model predicts that those top ten plastic polluted rivers are accountable for 88% of the total plastic load in the oceans. Rivers Indus, Meghna, Brahmaputra, and the Ganges in South Asia region account for roughly 22% of the plastic weight of the top ten plastic polluting rivers, which translates into approximately 19% of the global MPP. Given that the SAR accounts for nearly a quarter of the world's population, the subregion needs to understand the importance of solving MPP and join the world to tackle the problem.²⁰

This paper will provide a brief overview of the global phenomenon of marine plastic pollution (in chapter 2). It will, in Chapter 3, explore the integration of actions that help minimize the single-use of plastic products in the South Asian Region, including the effects of single-use plastic products. Later in chapter 4, selected case studies from Bangladesh and India will be

presented depicting how social pressure and public engagement help to address marine plastic problems in the subregion. In the end (chapter five), the paper will provide recommendations and ways forward.

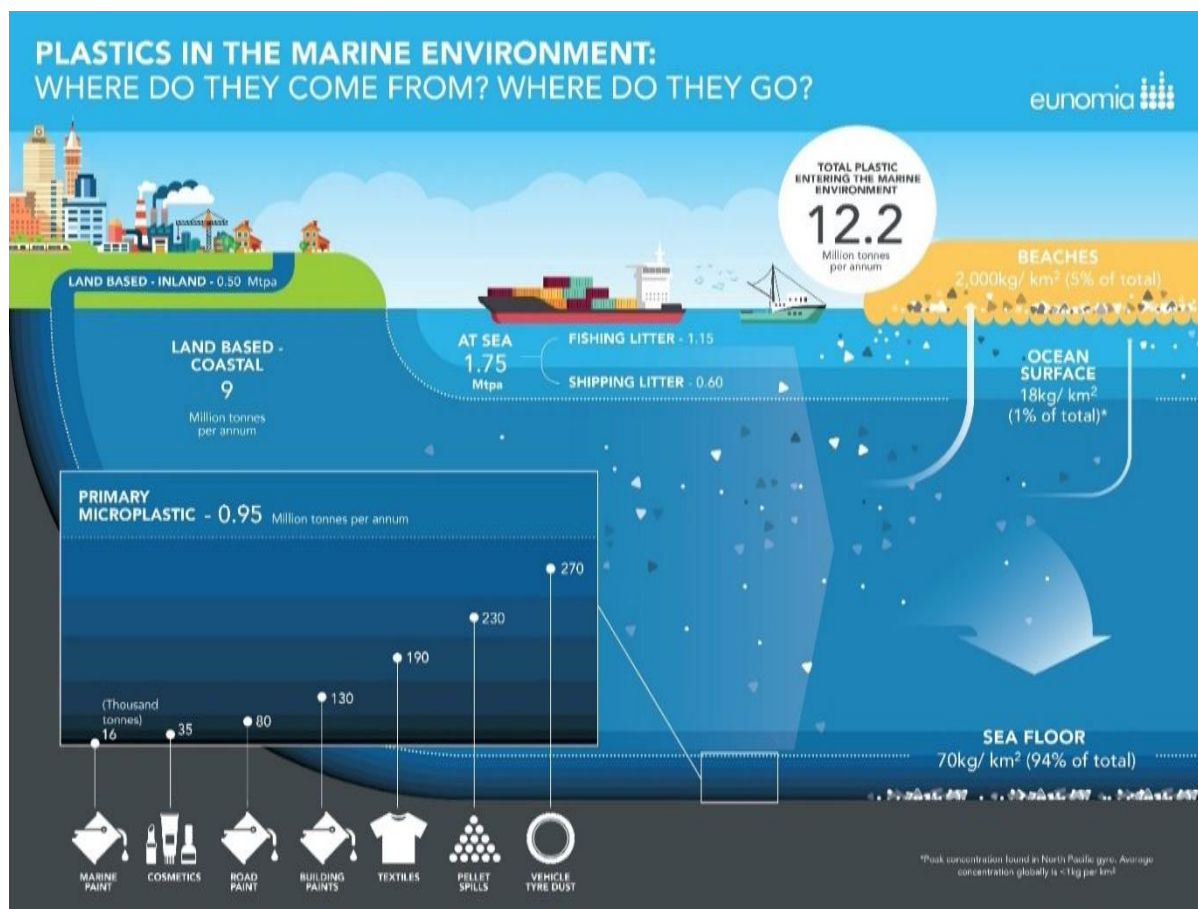
2. THE GLOBAL PHENOMENON OF MARINE PLASTIC POLLUTION

Before 1950, plastic materials were rarely used in consumer products. Since then, the production and consumption of it have increased exponentially. UNEP estimates that between 3.0 and 5.3 million tons of micro- and macro plastics are lost annually to the environment, mainly from abrasion of tires, and city dust, which include abrasion of plastics from, e.g., shoe soles, exterior paints, and road markings. These losses come from mismanaged municipal solid waste (accounting for about half of the macroplastics lost to the environment), littering of plastic waste, and loss of fishing gear and other equipment related to maritime activities (UNEP, 2018a).²¹

As noted above, MPP has become a daunting global challenge that is not bounded by any national borders. Since the 1950s, the production of plastics on large-scale has increased rapidly, responding to increased demand for manufactured goods and packaging to contain or protect foods and products, accompanied by a growing diversification of types and applications of synthetic polymers. Jambeck et al. note that when the issue of MPP first appeared in the scientific literature in the early 1970s, the number of plastics leaking into the oceans every year also increased drastically.²² Some data show that the global production of plastics increased from 1.5 million tonnes in 1950 to 322 million tonnes in 2015.²³

However, due to the many different sources and environmental transport pathways, calculating the absolute amount of global plastic production has been a challenging task. Yet, MPP continues to negatively affect organisms, ecosystems, human wellbeing, and socio-economic sectors such as tourism, aquaculture, and navigation.^{24,25,26} Increasing awareness of the problems associated with MPP is beginning to translate into actions, primarily due to the availability of information to policymakers and other concerned parties that help them to know where to target efforts to yield the most significant impact.²⁷

Figure 1. Plastics in the environment



Source: Eunomia.

Figure 1 above shows the proportion of the total amount of plastic in the oceans that is found at the seabed, the ocean's surface, and beaches. Globally, 94% of the plastics that newly enter the oceans every year are located in the seabed (on average, an estimated 70kg of plastic in each square kilometer of the seabed). Barely 1% of the plastics in the oceans floating at or near the oceans' surface, with an average global concentration of less than $1\text{kg}/\text{km}^2$.²⁸

This concentration increases at specific mid-oceans locations, with the highest level found in the North Pacific Gyre at $18\text{kg}/\text{km}^2$. By contrast, the amount estimated to be on beaches globally is five times greater, and the concentration is much higher, at $2,000\text{kg}/\text{km}^2$.²⁹ These findings have implications on the focus of efforts to tackle the problem. The most significant opportunity to prevent plastic entering the oceans is to take steps to reduce plastic litter on land. Measures like carrier bag charges are proven to be a cost-effective step, and the same approach could be made to other plastic items like takeaway cups and disposable cutlery. Imposing deposit refunds on beverage containers would help incentivize people to return them for recycling and reduce the amount littered.

To understand more about the severity of MPP, we investigate the trends of global plastic production and consumption as well as the drivers behind them.

2.1. Trends in production, consumption, and generation of plastic products

Plastic is now everywhere. But where does it originate? Plastics accumulate due to increased production, consumption patterns, and inadequate and overwhelmed waste management systems, including open dumping, and the storms and rain that cause land-based sources of pollution to leak into rivers, the coastal areas, and oceans.

When single-use or unnecessary packaging products are mismanaged and misappropriated, the potentially favorable qualities of plastic as a durable, light, and non-biodegradable waterproof material become an environmental threat. Unsustainable production and consumption patterns driven by the demand for convenience and affordability and exacerbated by the low price of virgin plastic materials are at the heart of the plastic pollution problem. For example, during the production process, about 0.01 metric tons (MTs) of microplastics may be lost to the surrounding environment.³⁰

Table 1. Plastic intensity per sector (a metric ton of plastic per USD million revenue)

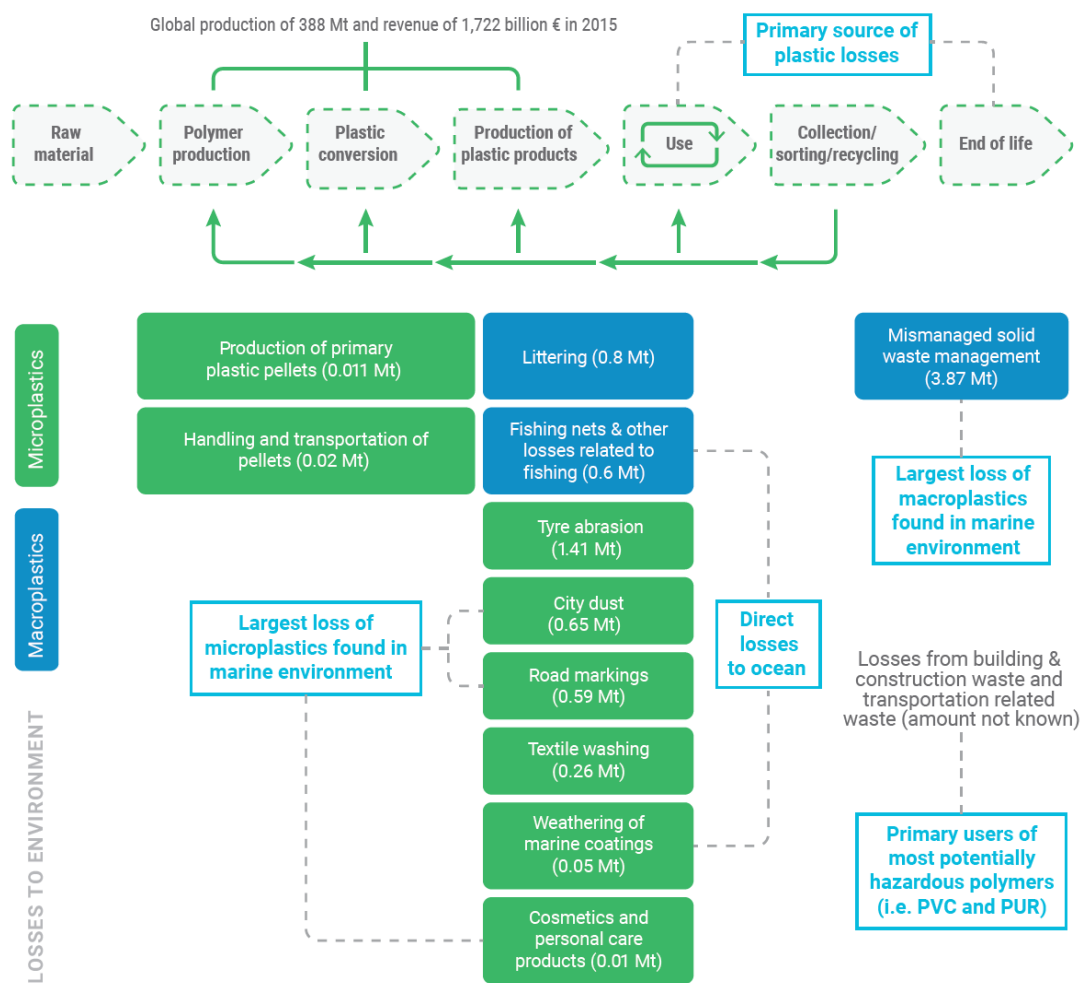
SECTOR	PLASTIC-IN-PACKAGING	PLASTIC-IN-PRODUCT	PLASTIC-IN-SUPPLY-CHAIN	TOTAL
Toys	2.9	37.5	7.6	48.0
Soft drinks	14.9	-	19.7	34.6
Furniture	0.8	15.2	10.9	26.9
Durable household goods	1.6	16.2	7.2	25.0
Footwear	3.6	13.8	6.8	24.2
Athletic goods	0.8	16.7	4.0	21.5
Personal products	5.9	not estimated	10.0	15.9
Non-durable household goods	1.0	9.7	3.8	14.4
Automobiles	0.0	4.5	5.3	9.9
Food	3.2	-	6.3	9.5
Consumer electronics	0.4	4.7	3.6	8.7
Clothing and accessories	0.2	3.3	4.7	8.2
Medical and pharmaceutical products	3.1	-	3.5	6.6
Restaurants	1.2	-	3.2	4.4
Tobacco	0.3	0.7	2.5	3.5
Retail	0.5	-	1.5	2.1

Source: UNEP, 2014.

UNEP has identified 16 business sectors that are particularly intensive in plastic usage, where the most plastic intensive industry, the toy industry, uses 48 MTs of plastic for every USD 1 million revenue.³¹ Table 1 above shows the plastic intensity in the top 16 plastic intensive industries per USD-million in revenue. The soft drinks sector uses massive plastics in terms of plastic used in packaging.

In contrast, plastics used in packaging are almost exclusively single-use, leading to a plastic waste management issue.³² For example, plastic packaging alone is responsible for the majority of plastic used, taking up over 40% of overall plastic usage in both Europe and the USA.³³ With regards to ALDFGs, about 0.6 MT of plastic nets and 303 tons (275 MTs) of dolly rope is left in the sea every year. Even our daily activities such as cloth washing, the use of personal care products, driving (abrasion of the tires and the road surface), and exterior painting at buildings would also release microplastic into the environment.³⁴ Figure 2 estimates micro and macro plastics leaked into the environment/oceans due to daily activities and notes that plastic items of high leakage risk are often site-specific.

Figure 2. Plastic Loss to the oceans across the Plastic Value Chain Stage

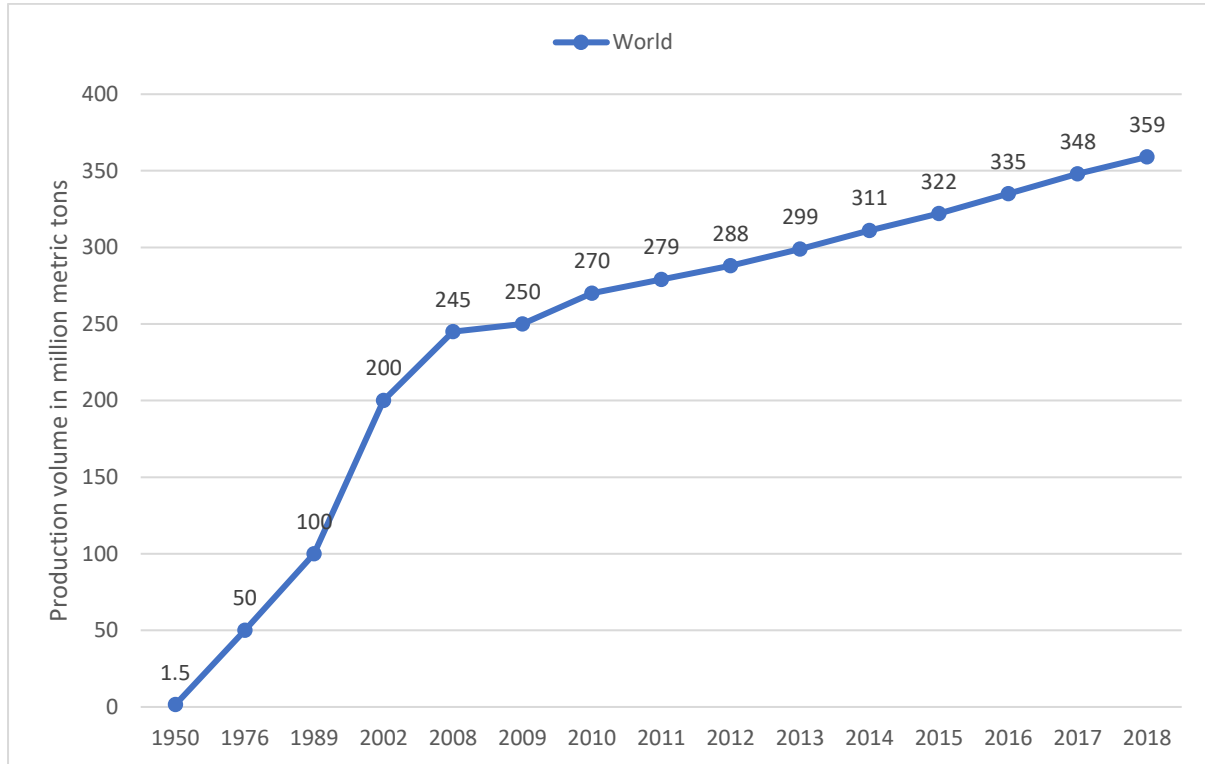


Source: Ryberg, Laurent and Hauschild (2018).
Note Mt: metric tons, PVC, polyvinyl chloride; PUR, polyurethane.

The risk of leakage into the rivers in rural areas may not be negligible due to the consequence of poorly managed open dumps and the absence of a formal waste collection system. Although the informal recycling is active in Asia, waste pickers and recyclers tend to collect and sort out high-value plastic waste, such as polyethylene terephthalate and improperly discarding low-value plastic items, such as plastic shopping bags and colored plastics. These enter waterways and open dumpsites that are prone to flooding during the rainy season. Ensuring the availability of data on plastic pollution and understanding the plastic pathways are crucial in promoting evidence-based policymaking as well as effective measures that lead to the reduction in marine litter and plastic pollution. As long as society and businesses need plastics to produce their goods and services or to suit their daily habits, plastic production will show no sign of declining, but rather increase the number of plastics entering the oceans.

Figure 3 below shows the trend of increasing global plastic production in less than a century. It depicts that the worldwide production of plastics increased from around 1.5 million tonnes in the 1950s to over 359 million tonnes in 2018.^{35,36,37} Furthermore, in 2018, global plastic production grew by 33% compared to 2010, showing a drastic increase in less than a decade time.

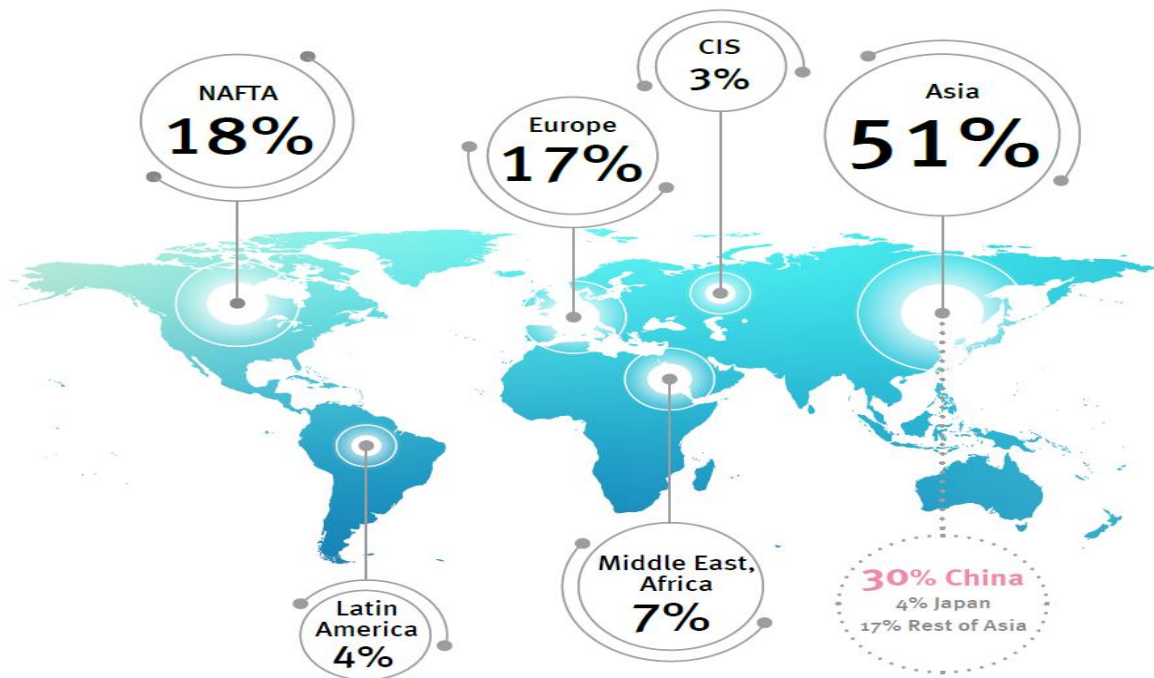
Figure 3. Production of plastics worldwide 1950-2018



Source: Gourmelon, Gaele, 2015

Otherwise, in 2018, Asia produced 51% of the global plastic production (figure 4). In contrast, China alone has already taken up 30% of that, Japan comes second and contributes 4%, and the rest of the Asian countries combined to produce 17%.

Figure 4. Distribution of global plastics production



Source: PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH

Advanced economies in Europe and North America combined to produce 35% of the global plastic production.³⁸ Based on the current level of human activities, plastic production shows no sign of slowing down if concrete measures are not taken. The global production of plastic is expected to be more than 600 million tons by the year 2025 and 2050.³⁹ There is an immediate need for the world to cooperate to stop plastic pollution from further deterioration. The impact of MPP will be further discussed in section 3.3.

2.2. Drivers for production, consumption, and generation of plastic products

Many factors accelerate production, consumption, and generation of plastic products. These include the profitability of the plastic industry, simple technology, and consumption patterns.

The profitability of the plastic industry

The global plastic market revenue was estimated to be over USD 522 billion in 2017, and it would rise to over USD 721 billion by 2025.⁴⁰ Based on the increase in production trends, it is projected that the revenue will continue to increase in the future due to the increasing global demand for plastic and a higher profit margin for the plastics. Therefore, if no additional measures (like carbon emission tax) to curb plastic production are employed, producers will have no economic incentives to scale down their production or to produce in a more socially responsible manner.

Simple technology

Plastic production has a long history, and its technology has been refined over the years. The world now has easy access to plastic production technology, and it is cheap to establish a production line of such.⁴¹ Plastic-related production is often related to economies that are in the initial process of industrialization as the production process involves a relatively low technological and equipment requirement but more of a labor effort.⁴² Comparing with the complicated, expensive technology and equipment involved in producing plastic alternatives, producers have limited financial incentives to abandon traditional plastic production. In some less developed economies, they may not have the capital or skilled labor force to operate in producing plastic alternatives.

Consumption patterns

Different industries' practices and social habits and norms have become united with plastics. For the business sector, for instance, the food and beverage industry has been heavily relying on plastic to maintain the hygiene standard and the convenience to consume their product.⁴³ In 2015, over 36% of the total plastic produced were used as packaging materials, designed to be singly used.^{44,45} Plastic is cheap to produce, light-weighted, durable, and long-lasting due to its application in various goods.⁴⁶ For example, plastic bottles and glass bottles for beverages have almost the same production cost per bottle. But, the weight between the two would significantly increase the transportation cost as well as labor cost, driving up both the operation cost of

businesses and the environmental cost for the society.^{47,48} The newer plastic alternatives are generally more expensive due to a massive investment in research and development, which makes the alternative products up to 3.5 times more expensive than traditional plastic products.⁴⁹

Social habits and norms also play a determining role in plastic consumption. The international community has different social practices and standards for using plastic products and single-use plastics. Even though there are regions that try to advocate for a plastic-free lifestyle or single-use plastic ban, some regions may still face tremendous resistance due to social habits and differences in income levels, state policies, and environmental awareness.^{50, 51}

2.3. Challenges in recycling and disposal of plastic products

Plastics production has increased over the last 60 years leading to several environmental problems because of the levels of use and disposal. Recycling is an essential way used to reduce the impact of plastic pollution.⁵² A significant portion of plastic produced each year is used to make disposable items of packaging or other short-lived products that are discarded quickly after its use or manufacture.⁵³ The current use of plastics is not sustainable but rather accumulate as litter in landfills and natural habitats worldwide. Likewise, recycling and landfilling produce a considerable amount of carbon emissions. Jambeck et al. (2015) estimate that between 4.8-12.7 MTs of plastic enter the oceans from land globally every year.

Figure 5. Global distribution of mismanaged waste in 2010

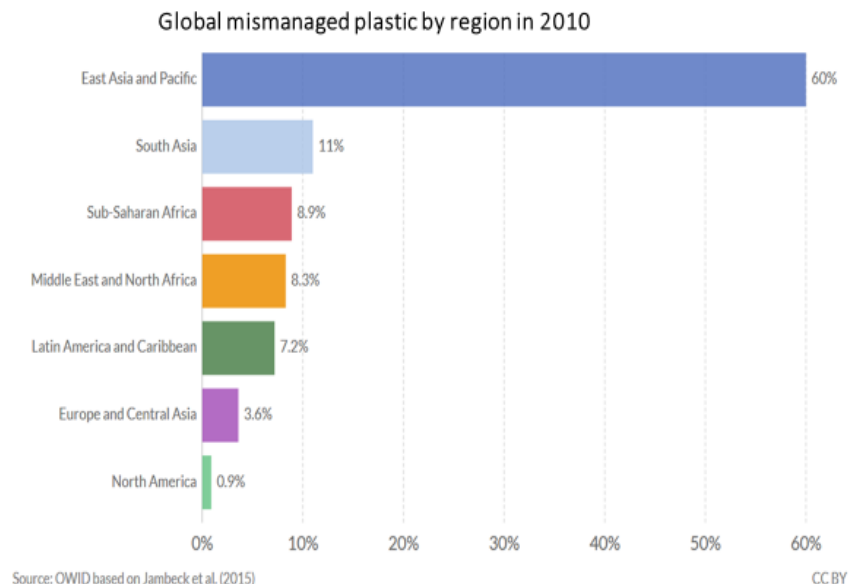
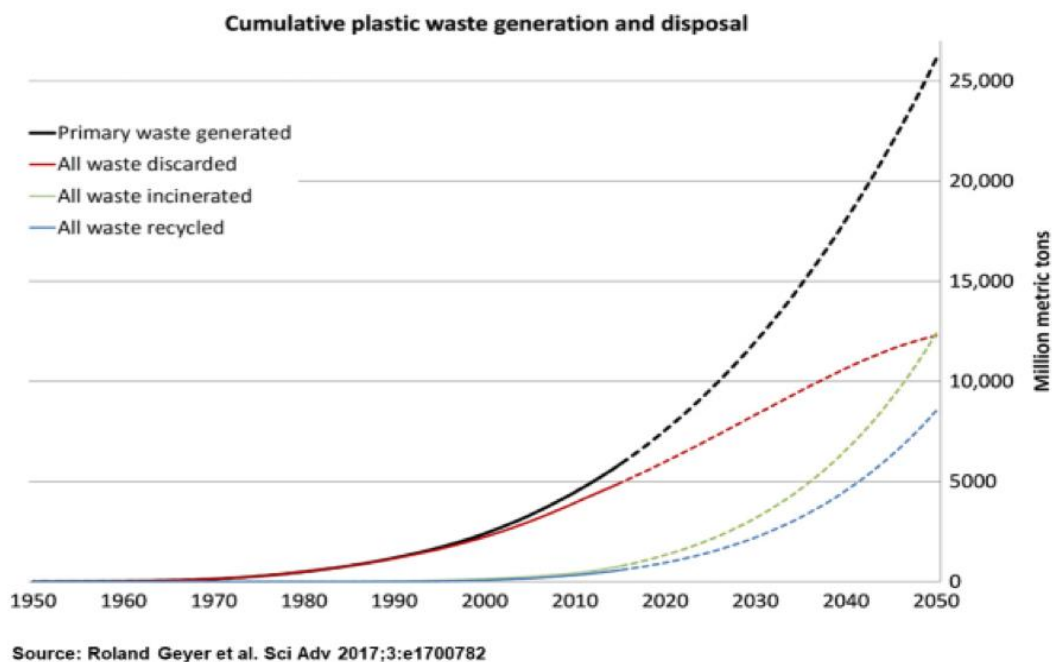


Figure 5 shows that the global distribution of mismanaged waste whereby the East Asia and Pacific region dominates the global mismanaged plastic waste accounting for 60 percent of the world total and SAR ranking second but contributes 11 percent of the total.

Figure 6. Cumulative plastic waste generation and disposal (million metric tons)



The data in figure 6 above highlights the fundamental role of waste management in preventing oceans' pollution, while countries across North America and Europe, generating significant quantities of plastic waste but a tiny portion of mismanaged plastic waste.

Recycling reduces the impacts of plastics and provides opportunities to reduce oil usage, carbon dioxide emissions, and the quantities of waste requiring disposal. Although plastics have been recycled since the 1970s, the amounts that are recycled vary according to the plastic-type and application. Advanced technologies and systems for the collection, sorting, and reprocessing of recyclable plastics have created new opportunities for diverting most of the plastic waste from disposal.⁵⁴ Recent trends demonstrate a substantial increase in the rate of recovery and recycling of plastic wastes. But some significant challenges still exist from both technological and economic or social behavioral factors relating to the collection of recyclable garbage and substitution for virgin material. The primary methods of waste disposal have been by landfill or incineration. Costs of landfill disposal vary considerably among regions according to the underlying geology and land-use patterns. In Japan, for example, the excavation that is necessary for landfills is expensive because of the hard nature of the underlying volcanic bedrock. In the Netherlands, it is costly because of the permeability from the sea. Therefore, high disposal costs are an economic incentive for embarking on recycling or energy recovery.

Roland Geyer *et al.* (Figure 6 above) describes the primary plastics production data to have a robust time trend throughout its entire history. They predict that if production were to continue with this curve, 26,000 MTs of resins, 6000 MTs of PP&A fibers, and 2000 MTs of additives would have been produced by the end of 2050.

Assuming consistent use patterns and projecting current global waste management trends to 2050 (figure 6), 9000 MTs of plastic waste will have been recycled, 12,000 MTs incinerated, and 12,000 MTs discarded in landfills or the natural environment.⁵⁵ The predicted increase in

plastic waste poses a considerable challenge to the global waste management system capacity, even in the "business as usual" scenario.

3. MARINE PLASTIC PRODUCTS AND POLLUTION IN SOUTH ASIA

The SAR consists of 8 countries and has nearly a quarter of the world's population residing in the region. With two of the world's most plastic polluted rivers located in SAR, the region plays a vital role in MPP. Due to the increase in the production of plastics, dependence on single-use plastic, and weak national systems for waste management facing many governments in SAR, marine plastic pollution poses a sustainable challenge on both oceans and the environment. The ambition for curbing plastic waste in SAR is expressed in the international Convention and multilateral agreements on marine pollution. It includes the Basel Convention to Control the Transboundary Movements of Hazardous Wastes and Their Disposal and frameworks/multilateral agreements such as the SAARC on the reduction of plastic use and public awareness-raising on marine plastic pollution. The SACEP for the protection and sustainable management of the marine environment is another framework aimed to curb plastic waste as well. These transformative actions depend primarily on the development and enforcement of effective national policies and structures to fulfill such international instruments.

In this chapter, we examine the current status of plastic products and their usage within the region, including the impact and corresponding policies implemented to alleviate the marine pollution problem in the area.

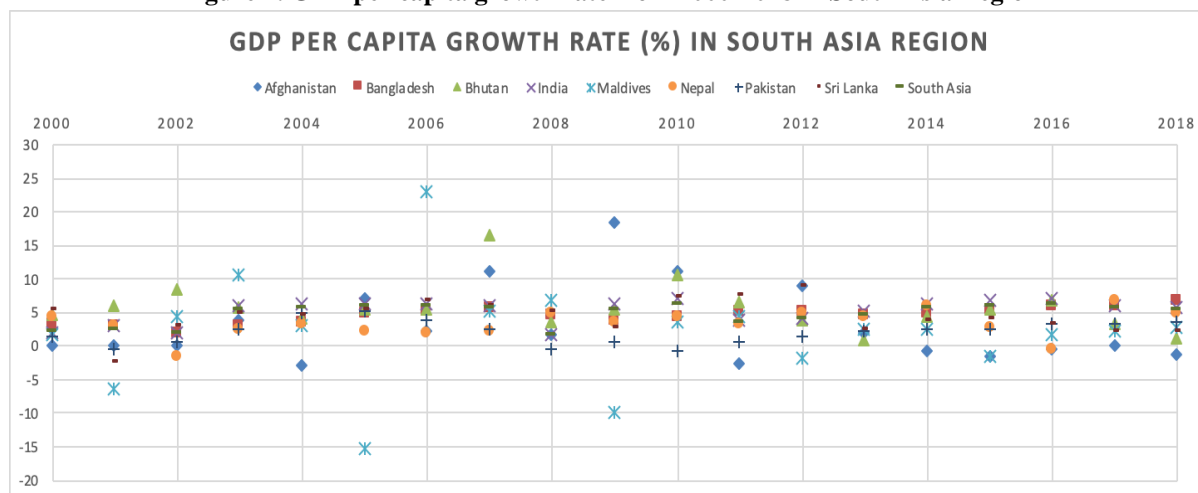
3.1. Trends in production, consumption, and generation of plastic products

There is no exact figure for plastic production reported solely for the SAR. But according to the Central Pollution Control Board (CPCB) of India data for the year 2012, India generated almost 26,000 tonnes of plastic per day. Likewise, in 2019 the CPCB found that 80 percent of the total plastic produced in India landed up in the garbage.⁵⁶ The World Bank Group has also estimated that India would produce 20 million tonnes of plastic in 2020.⁵⁷ Being the largest economy and most populated country in the SAR, such an amount of plastics produced by India represents a large portion of the plastic production volume in the SAR. India is also the only country with positive net export on processed plastic products (SITC-3 Category 58 and 893) among the SAR countries, mainly exporting to Eastern Asia and developed European countries.

Furthermore, India has increased its investment in technology and plastic producing facilities to cope with the rapid development of the other sectors.⁵⁸ Other countries in the SAR have also increased their production of plastics and experienced a high growth rate over recent years, with Bangladesh logging a stunning 20% growth rate since the 1990s.⁵⁹ SAR is estimated to be producing 17-20 million MTs of plastics annually in 2018.^{60,61,62,63} Reports indicate that since the largest producer of plastics in the SAR has also increased investment in this sector, the output of plastics will continue to grow in the coming future.

Another research has found that the SAR is dumping at least 26.72 million MTs of plastic waste every year since 2016 (roughly 11% of the world's total plastic waste), and the residue isn't discarded adequately.^{64,65} Also research has found that SAR has a net export deficit in plastic products. This means that the amount of plastics consumed in the region is likely higher than what the region can produce.⁶⁶ Also, although the amount of plastic waste per capita in the SAR is relatively lower than in other parts of the world, the presence of plastic in the region may likely be higher. Due to China's enforcement of a new policy to stop most of the plastic waste import for reprocessing, this act immediately resulted in a surge in plastic waste import in Asia, including the SAR.⁶⁷

Figure 7. GDP per capita growth rate from 2000-2018 in South Asia Region



Source: World Bank Group, 2020a

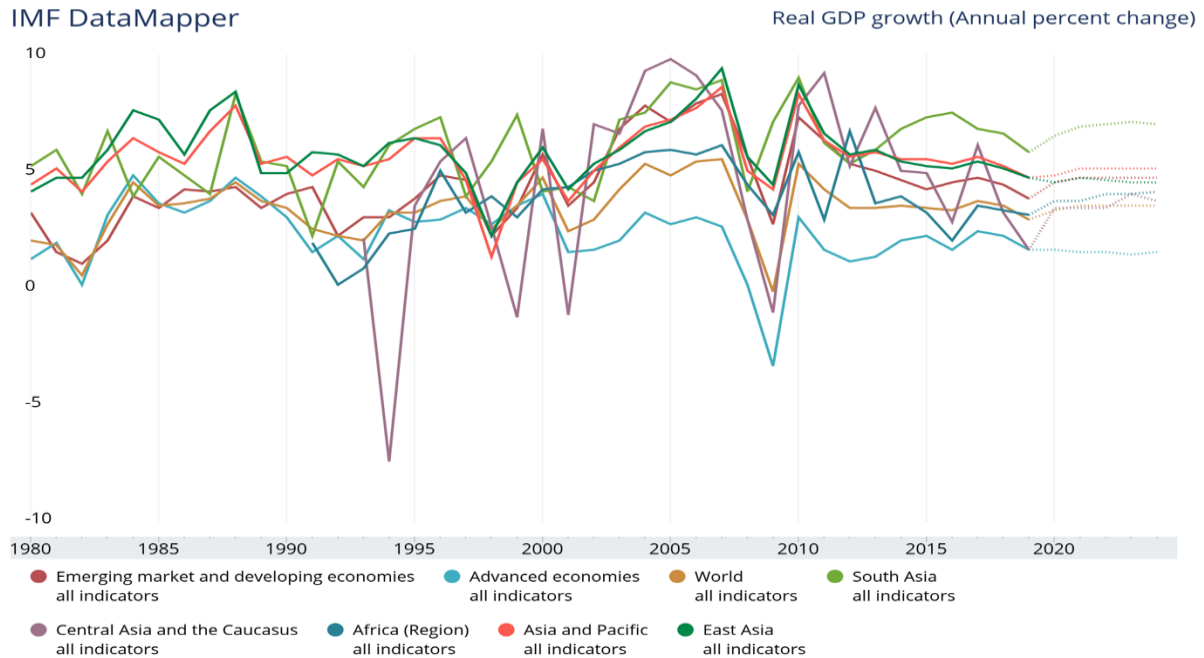
Figure 7 above shows that apart from the Maldives showing a more fluctuating growth rate due to heavy dependence on the highly seasonal tourism industry, the GDP per capita growth rate in the SAR since 2000 showed a positive annual growth rate of 4.75% over the two decades and 7.2% for last decade.⁶⁸ We can foresee that the region will continue its economic growth, and that may accompany by a rise in plastic consumption.

3.2. Driving force for generation and consumption of plastic products and the generation of plastic waste

Plastic has become an essential material in the process of industrialization. Different forms of industrialization will play a vital and accelerating role in the growing economies. The economic and development characteristics of the SAR permit relatively primitive manufacturing industries to develop, such as garment, leather goods, and footwear industries.⁶⁹ However, in larger economies like India, the growth of various sectors like the automotive and consumer electronics industry has also led to increasing demand for plastic components in the production process.⁷⁰ India has now become an essential player in the international plastic reprocessing industry, employing 3 million people to continue the growth of the sector.⁷¹ For the South Asian countries to achieve industrialization and develop their economies, they will inevitably need to produce more plastics in the future to facilitate the production of other goods.

IMF projects that the SAR will have the highest economic growth rate in the world. Figure 8 below projects the real GDP growth rate of different groups and indicates that the SAR will maintain a more than 6% growth rate for the coming years.⁷² With the increasing income level, the population will have more disposable income, thus increasing the plastic consumption.

Figure 8. Past and projected GDP growth rate of different regions



©IMF, 2019, Source: World Economic Outlook (October 2019)

Source: International Monetary Fund, 2019

Textiles, consumer durables, and general packaging industries are a plastic-intensive industry that would benefit under economic growth.⁷³ The World Bank found that there is a six-fold increase in waste production once the country moves from low income to lower-middle-income groups.⁷⁴ Therefore, as the countries in the SAR improve their income levels, we can expect a surge of plastic consumption in the coming years.

3.3. Effects of single-use of plastic products

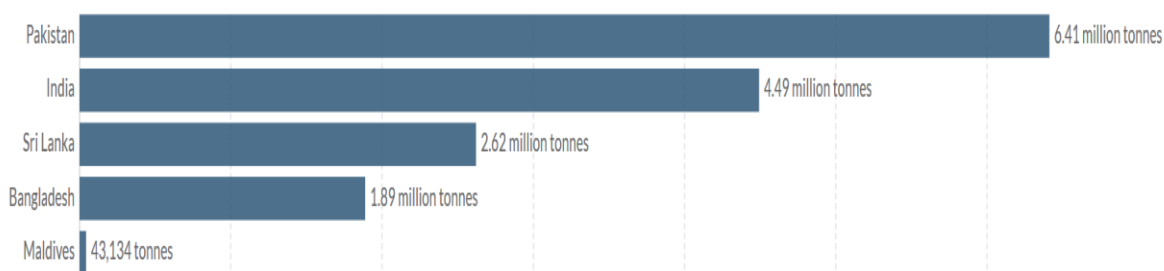
Plastic packaging has been one of the significant usages of plastic produced and takes up to around 36% of the global plastic consumption, mostly designed to be singly used.^{75,76} Plastic packages have taken up almost half of the global total plastic waste as their "in-use" lifetime designed to be short, contrary to other durable plastic use such as the plastic used in building and construction, furniture, and transportations.⁷⁷ However, the properties of single-use plastic are no different from plastics designed for a more extended period of use. Also, single-use plastics get dumped into the landfills where they never get decomposed and later find their way into the oceans. Plastic products affect every living organism directly or indirectly, and the effects of single-use plastic on humans and other living organisms is currently well documented. This section will explore the challenges in handling plastic products after use, and some impact plastics cause to the environment and society.

3.3.1. Challenges in recycling and disposal of plastic products

Plastic waste generation and collection

As shown in figure 9 below, Pakistan and India were leading in the production of plastic waste in 2010.⁷⁸ Without waste management infrastructure improvements and increased coverage of essential waste related service, the increasing amount of plastic waste that enters the oceans from land will increase by order of magnitude by 2025.

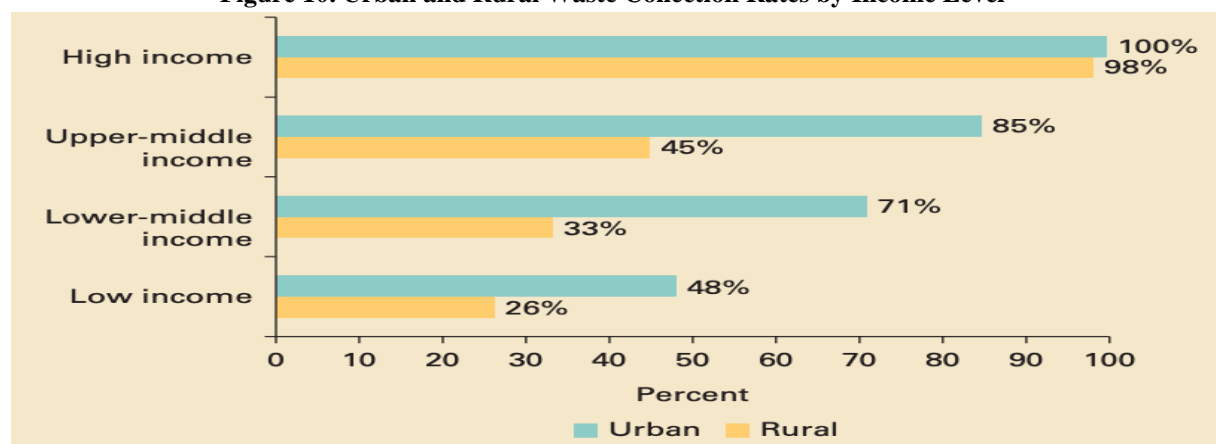
Figure 9. Plastic waste generation in selected South Asian countries in 2010



Source: Modified from OWID based on Jambeck et al. (2015) & World Bank

As shown in figure 10, the plastic waste collection rate around the world varies greatly and mostly dependent on income level and the urban/rural area set up.⁷⁹ In the SAR, where the majority of the countries lie in lower-middle-income or low-income groups, the waste collection rate is 51% and 39% in lower-middle-income and low-income countries, respectively.⁸⁰

Figure 10. Urban and Rural Waste Collection Rates by Income Level



Source: World Bank Group, 2018

Waste collection is more developed in the municipal area than in rural areas as waste collection rates tend to be higher in urban areas than in rural areas. Likewise, in lower-middle-income countries, waste collection rates are more than twice as high in cities as in rural areas. A considerable portion of the waste collection lies in the informal sector that relies on waste picking to make a living.⁸¹ Since the informal sector relies on waste picking to earn a living, they are likely to pick those valuable waste out of the piles of garbage only, leaving out those

that are less useful. Thin plastic bags from food packaging and certain plastic types are usually left uncollected as they do not have a high resale value in the recycling market.⁸² Also, there are often transport restrictions, which increase the cost of collecting and transporting plastic waste, thereby putting a higher burden on less financially capable countries.⁸³ Geographical issues may also hinder waste collection efforts in countries like the Maldives, where the communities are settled at different islands and arrangements for ferries to collect and transport wastes from all the islands is rather complicated and expensive.

The conventional methods for waste collection in the SAR include door-to-door collection where trucks, small vehicles, handcarts, or donkeys pick up garbage outside of households at a predetermined frequency. Another technique is disposing of waste in a central container or at a collection point where it may be picked up by the municipality and transported to final disposal sites. It is worth noting that population size and the existence of quality waste management systems largely determine the contribution of the high mass of uncaptured waste that becomes plastic marine litter.

Recycling

Feedstock quality

Plastic waste is the feedstock of secondary plastic production. The industry has minimal ability to control the quality of feedstocks as it requires a considerable amount of capital and labor to process food waste, paper, and other miscellaneous materials to extract and clean the plastic component among them for secondary plastic production.⁸⁴ In SAR, such function is mostly carried out by the informal sector.⁸⁵ Without proper training on how to correctly categorize the plastic waste and cleaning them, the quality of the plastic-feedstock for secondary plastic production is often inadequate, resulting in inferior secondary plastic products.⁸⁶ In India, for example, where there is increasing use of biodegradable plastics, the informal workers are sometimes unable to distinguish them from traditional fossil-based plastics, especially when the recycling plants face more than one kind of plastics during the recycling process.⁸⁷ Without a proper sorting facility that is operated by trained workers, the recycled plastic products would usually be below the European and North American requirements, lowering the chances to export the recycled plastic products to the Global North and also limits the application of the secondary plastic product as some uses may require higher reliability, i.e., recycled plastic as construction materials.⁸⁸

Recycling technology

Plastic recycling requires a certain level of technology and equipment. For instance, when different kinds of plastics are combined within the product, to depolymerize the plastic, separate and extract the target type of plastic for recycling would be highly challenging.⁸⁹ The technical capability has been the single most significant barrier in the formal sector of the Indian plastic recycling industry, followed by governmental support and the lack of plastic waste collection facilities.⁹⁰

In India, the plastic recycling industry mainly consists of a large number of informal enterprises that invest a very minimum level of fixed capital for machinery and other necessary

equipment.⁹¹ Generally, in SAR, the most commonly recycled plastic-type is Polyethylene Terephthalate (PET). The recycling process of this material involves relatively less complicated technology and skills from the untrained informal sector workers. While other regions have been rapidly developing and inventing new technology to recycle plastic and filing patents, the SAR lags in technological development and innovation for plastic waste recycling. The SAR countries have only filed at most, 12 related patents, (just 1.4%) of the global registered plastic patents, whereas China alone has filed 343 associated patents.⁹² It would be highly challenging for the industry to acquire the technology to recycle relatively complicated mixed plastic feedstocks in the long run, due to complicated production techniques emerging in modern manufacturing that involves a mix of plastic materials and more additives.

Table 2. The plastic recycling rate of SAR countries

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Plastic recycling rate	<4% ⁹³	12% ⁹⁴	No data	27% ⁹⁵	4% ⁹⁶	No data	No data	30% ⁹⁷
Statistic year	2012	2015	N/A	2016	2008	N/A	N/A	2019

Table 2 above shows, plastic waste recycling rates in the majority of the countries in the SAR are well below the world average of 20%, indicating a considerable room to increase the plastic recycling capacity in the region.⁹⁸ The lack of and underdevelopment of plastic-recycling infrastructures and technology has hindered the potential ability of recycling industries in the SAR to produce economically competitive products from recycled plastics.

Economic competitiveness

The SAR recycled plastic products are facing fierce competition with the virgin plastic industry as well as the higher quality recycled plastic products from other advanced economies. Most of the plastic recycling plants in the SAR are in the informal sector and rely on primitive feedstocks and low processing efficiency. The recycled plastic products are of more reduced performance than virgin plastic products. The sole motivation for businesses to adopt these recycled plastic products is to take advantage of their cost-performance ratio. The plastic recycling industry in the SAR requires a prompt update in its technology to increase production quality and efficiency. In contrast, governments would need to coordinate the effort to aid the growth of this vital green industry to strengthen its economic competitiveness to tackle MPP.

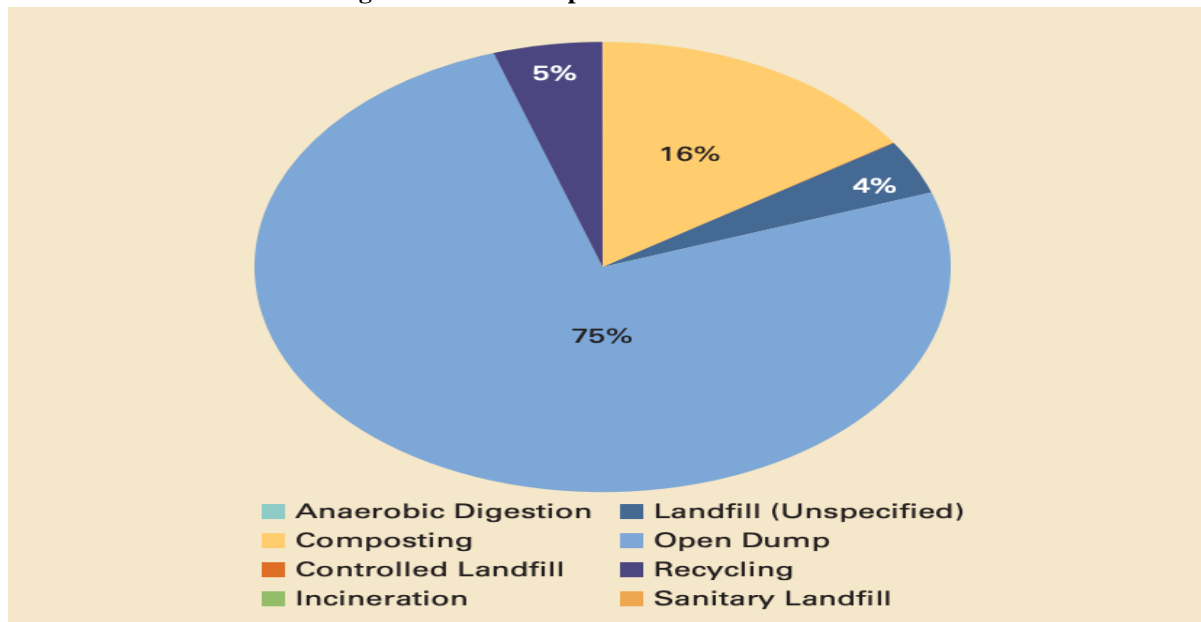
In terms of the production cost, SAR produces some of the cheapest recycled plastic products in the world, notably India.⁹⁹ Recycling plastic involves the collection and transportation cost of virgin plastic feedstock, which increases the manufacturing cost of recycled plastics.¹⁰⁰ However, in the SAR, where there is a massive labor force in the informal sector, these costs are much lower than in other countries. Yet, the price of virgin plastic has been decreasing due to technological advancement and economies of scale. As of 2019, the cost of purchasing virgin plastic is already cheaper than recycled plastics¹⁰¹. With the oil price plummeting to decade's low in 2020, the cost of virgin plastic would go further down, competing aggressively with the recycled plastic industry. The cheap SAR recycled plastic product may lose its competitive price edge towards the virgin plastic products.

In terms of recycled plastic performance, the SAR's recycled synthetic product is less competitive than in other countries due to the relatively primitive recycling techniques and production technology. Study findings by ESCAP (2019 Pune case study) show that due to the lack of technological development in recycled plastic, processing, and standardization of quality, the quality of recycled plastic in Pune tended to be lower, less profitable, and competitive.¹⁰² Given the inferior quality, producers targeting the upper or middle class would likely choose virgin plastic products over inferior recycled plastics due to the plastic performance. Dramatically, this narrows down the market for recycled plastic products for the local market, especially in the emerging economies like in the SAR.

Disposal

Plastic waste that is not recycled is left for disposal, ending the life of the product. With proper waste management, disposed plastics is transported to landfills or incineration sites for disposal. Figure 11 below shows how much of the collected waste is disposed of at the open dump in the SAR, characterized by open dumping (75%), sanitary landfills (16%), and less recycling (5%).

Figure 11. Waste disposal method in South Asia



Source: World Bank Group, 2018

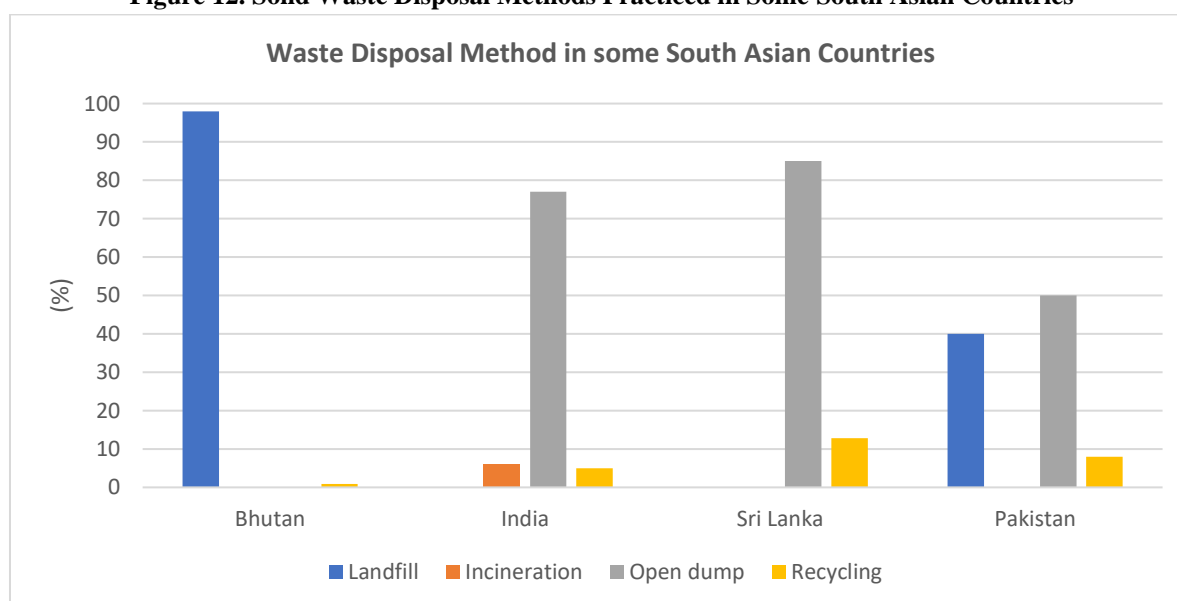
Without any artificial process before dumping or being buried in the landfill, plastics will take a very long time to breakdown and take up more space inside the dumpsite, forcing authorities to identify a new dumping site in a shorter than expected period.¹⁰³ Also, numerous studies have shown open dumping leads to contamination of the soil as well as a threat to water quality, often with toxic pollutants.^{104,105,106}

These are not solely caused by plastic waste at the open dumping sites, but the characteristics of open dumping would easily allow plastic waste to leak to the surrounding environment given how light-weighted and buoyancy plastics materials have. The leaked plastic waste would often be in rivers, which would then flow along the stream and enter the oceans or being washed on shores, making open dumpsites a source of marine plastic litter.

Even with a proper disposal management system in place, disposing plastic is still challenging. The main issues about the disposal of plastic waste are the limited space for landfills and the environmental debate surrounding incineration. Landfill/sanitary landfill has been the primary waste disposal method in the world. Although landfills could be managed appropriately to reduce its harmful impact on the environment, this does not work well in South Asia. The "Not in my backyard" syndrome in South Asia has led to growing opposition from the public, and the unavailability of land posing considerable challenges to the authority to find a suitable landfill location.¹⁰⁷ The higher population density in the SAR is also another factor, increasing the difficulty of identifying a suitable site. Landfilling is particularly unsuitable for island countries like the Maldives. In 2013, Nepal had only six municipals disposing of waste in sanitary landfills, and the other 45 municipals were still disposing of garbage in open dumps due to the difficulties in identifying a proper site.¹⁰⁸

Incineration has been the alternative for landfills in different countries, a practice that is uncommon in the SAR. Incineration can reduce the volume of plastic waste to be deposited by 80 to 95% and save valuable space in the landfill. However, when it comes to handling plastic waste, the incineration process will release noxious gasses like dioxin and furans into the environment.^{109,110,111} In the Maldives, where incineration is practiced, even plastic waste is only a minimal component in the overall waste; the impact of burning plastic waste is also noticeable.¹¹² Combustion of other waste creates other toxic pollutants such as lead and mercury. With already seasonal extreme poor air quality in the SAR due to manufacturing and crops residual burning activities, introducing waste incineration may worsen an already severe problem.¹¹³ Nonetheless, due to the high population density in the SAR, we may see an increase in incineration in the future. By then, the authorities will have to consider the significant investments in the filtration systems to minimize the pollutants from incinerators and the public oppositions.

Figure 12. Solid Waste Disposal Methods Practiced in Some South Asian Countries



Source: World Bank, 2018

Figure 12 above shows that incineration was first adopted in the SAR in 2000. India incinerated about 5% of its waste. Although the statistics may have changed over the years, the challenges of incineration remain unchanged.

3.3.2. Bans on plastic products

Bangladesh first introduced policies on plastic products ban in South Asia in 2002.^{114,115} Today, seven out of the eight-member States in the SAR have implemented some degree of the plastic ban at either municipal or national level.¹¹⁶ Nepal introduced a plastic bag ban in 1995 but was implemented ineffectively due to the outbreak of the civil war. Efforts to impose the ban in the previous decade by different municipals were in vain due to poor implementation and execution by the local authorities.¹¹⁷

Table 3. Summary of plastic ban legislation and features in the SAR member States

Member State	Earliest year of introduction	UNEP recognition and implementation level ¹¹⁸	Legislation Content ¹¹⁹
Afghanistan	2012	No, National	Ban the import and usage of plastic bags in all shops in the cities and provinces across the Country.
Bangladesh	2002	Yes, National	Ban on polyethylene plastic bags.
Bhutan	2009	Yes, National	Ban on plastic bags.
India	1998	Yes, National and Municipal	Ban on non-compostable plastic bags <50 μ .
Maldives	N/A	N/A	N/A
Nepal	1995	No, Municipal ¹²⁰	No persons can import, produce, store, sale and distribute plastic bags of thickness less than 30 μ ; Retailers need to collect and return all plastic bags to importers; Individuals and retailers have to reduce unnecessary use of plastic bags, depending on municipals.
Pakistan	2013	Yes, Municipal	Ban on manufacture, sales, importation, purchase, and use of non-biodegradable plastic bags, depending on municipals.
Sri Lanka	2017	Yes, National	Ban on the import, sale, and use of polyethylene bag <20 μ and Styrofoam containers

Source: UNEP, 2018.

Afghanistan and Bhutan imposed total prohibitions on the imports and distribution of plastic bags, but the former did not have a proper implementation plan.^{121,122} The Maldives remains the only member State in the SAR that has not imposed any kind of ban on plastic bags but has set out the standards for imported plastic bags.¹²³ The prohibitions mostly focus on the material, thickness, and the degradability of the single-use plastic bags.¹²⁴ Table 3 above summarizes the law and implementation status in SAR member States.

3.3.3. Impacts of marine plastic pollution

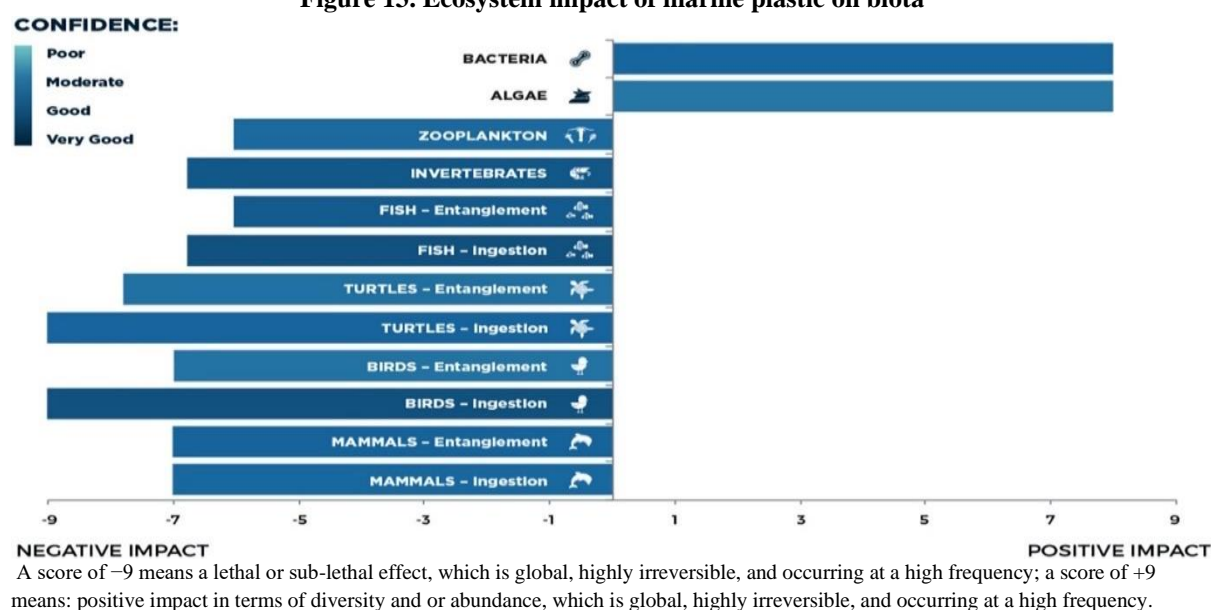
Plastic entering the world's oceans has a significant effect on our aquatic life but also has a far-reaching impact on human health and the economy. MPP first impacts the environment and gradually translate into social and economic issues.¹²⁵ Below, we will evaluate the ecological, social, and health, and environmental impact caused by MPP in the SAR.

3.3.3.1. Ecological impacts

The marine ecosystem provides a lot of essential functions to the world, including food provision, carbon storage, waste detoxification, and cultural benefits.¹²⁶ With plastic more commonly spotted in the oceans and more and more microplastic content leaking into the oceans, these plastics are threatening the marine ecosystem greatly, and some scientists are also discussing whether it would escalate to become a planetary threat.¹²⁷

The most apparent ecological threat that MPP is causing is the loss of wildlife. Different species are suffering due to entanglement with massive plastic objects in the Oceans like fishnets, ingesting plastic objects, and eventually lead to organ failure, bioaccumulation of toxic chemicals contained in the plastic products, and changes the integrity and functioning of the habitats.^{128,129} The SAR is the home of 6% of the global coral reefs, which serves as essential habitat for the 250 species of coral species and 1200 reef-associated fish species.¹³⁰ Marine plastic litter can directly damage the coral reef physically or indirectly damage them by obstructing the microorganisms from the sun and hinder photosynthesis, leading to a low oxygen level in the reef.¹³¹ By 2018, the coastal reefs in the SAR suffered a 25% such loss, with 20% and 25% being at a critical stage and threatening stage, respectively.¹³² The impact does not only affect marine wildlife but the entire ecological food chain that is linked to the marine life, creating a massive chain effect and significantly threaten wildlife as a whole.¹³³

Figure 13. Ecosystem impact of marine plastic on biota



Source: Beaumont, Nicola J., et al. 2019

Figure 13 shows a summary of how MPP has threatened wildlife with a medium or high degree of irreversibility.¹³⁴ The only two positively impacted species, bacteria, and algae may create further risk to the broader ecosystem as they could travel further and grow with the help of the marine plastic litter and potentially spreading invasive species and diseases.^{135,136} Together with the effects of extreme climate change, MPP will undoubtedly accelerate the loss of biodiversity if no prompt actions are taken.

Aside from MPP affecting humanity via the food chain, plastic litter can choke waterways and exacerbate natural disasters. For example, in 1988, Bangladesh suffered from clogging drains during a severe flood, which led to two-third of the country underwater.¹³⁷ In developing regions like SAR, where the extreme climate is increasing, we can expect a similar scenario to happen again if the plastic waste problem is not contained, but instead, continue to rise in the future. MPP is also accelerating the carbon concentration in the atmosphere. Oceans are the largest reduced carbon pools on Earth, and it is roughly 80% of the atmospheric size.¹³⁸ In other words, oceans help to dissolve and store a considerable amount of organic carbon, which serves as food for microorganisms and starts the global carbon cycle and food chain.¹³⁹ However, the time taken to degrade the plastic in the oceans fully and to re-enter the food chain could be more than 50 years.¹⁴⁰ Also, during this process, a small fraction of the dissolved organic carbon will transform into refractory dissolved organic carbon that could weaken the global overturning circulation, providing negative feedback to the increasing concentration of atmospheric carbon dioxide and exacerbate climate change.¹⁴¹

3.3.3.2. *Social and health impacts*

The ecological impact caused by MPP translates into various social issues as the human race relies on the oceans as a source of the food supply. Seafood is a significant source of protein and makes up more than 20% of food intake by weight for some 1.4 billion people.¹⁴² Marine wildlife is ingesting microplastics, including invertebrates, fish, and filter-feeding organisms, which poses a health risk to the community that consumes plastic contaminated seafood.¹⁴³ In the European countries where shellfish are consumed widely, it is estimated that consumers may have ingested up to 11,000 microplastic particles annually.¹⁴⁴ What is even more worrying is the evidence of microplastic's presence in commercial salt. The amount of microplastic in industrial salt poses negligible health risks to humans.¹⁴⁵ But, the increasing trend of plastic presence in the oceans might further increase and accumulate more microplastic in the human body.¹⁴⁶ The health effects of chemical additives in plastic products, including Bisphenol A (BPA) and endocrine disrupters, antioxidants, UV-stabilizers, flame retardants, and plasticizers, remain underexplored but are a cause for concern. Plastic particles and marine litter may act as carriers and breeding grounds for pathogens, diseases, and contaminants.

To date, the exact effect of ingesting microplastic in the human body is still controversial and not well understood. Plastics often contain BPA, and evidence shows that BPA is associated with obesity, cardiovascular diseases, and reproductive and developmental damages for males and neurobehavioral disorders and early sexual maturation for females. BPA is also found in 94.3% of the urine samples from the South-East Asian population, suggesting how the community might have ingested microplastic in their daily lives.¹⁴⁷ Microplastics may lead to adverse impacts on the immune system and oxidative stress that might cause brain damage.¹⁴⁸

With the heavily polluted oceans, fishery products in the SAR may contain higher components of microplastic and cause harm to the public. According to the statistics from FAO, fish contribute over 20% of the animal protein in a daily diet in Bangladesh, Maldives, and Sri Lanka.¹⁴⁹ With rapid economic development in the SAR, the public may afford more seafood in the longer-term, exposing a health risk to these populations. Airborne microplastics in the atmosphere are also believed to be a potential source of the airway and interstitial lung disease.¹⁵⁰ As the SAR uses open dumpsites to dispose of the waste, the likelihood of having a higher microplastics content in the atmosphere is imminent. While the toxicity of microplastic in the human body is not well understood, the impact it has on the food chain and habitat cannot be underestimated.

Plastic wastes ought to be appropriately managed so that they do not end up in the landfill, incinerator, or recycling sites. However, experience has shown that even with proper waste management procedures, these different channels of handling plastic waste would still create a negative social impact. For example, when plastic waste is incinerated, the flying ash and toxic air particles directly affecting public health. Hazardous levels of contaminants are usually found in food nearby incineration sites, directly affecting human health.¹⁵¹ Evidence has shown the toxic compounds generated from incineration may affect the immune and respiratory system, causing eye and skin irritation and even causing adverse effects to the bone marrow and liver.¹⁵² In the SAR, where incineration is not commonly practiced, the most concerned member State would be the Maldives. Due to the weak coordination in the waste management system in the Maldives, small scale incinerators are carried out in different islands.¹⁵³ These incinerators are not equipped with the proper filters and do not serve the purpose of waste volume reduction but release the toxic substance to the surrounding environment, causing harm to the community and the tourists. As of 2016, about 14% of plastic waste was incinerated in the Maldives.¹⁵⁴

For communities living near landfill sites, they are threatened by the polluted water source and the strong odor.¹⁵⁵ Even with sanitary landfills, air pollutants are found, and the facility to capture the harmful landfill gases generated from decomposition only captures a part of the gases.^{156,157} In the SAR, open dumpsites are more commonly found than landfills, which releases more odor and harmful gases than controlled landfills. What worsens the matter is the practice of dumpsite burning, intended to minimize the waste volume in the dumpsites.¹⁵⁸ A high level of harmful content like dioxin is found after dumpsite burns and later being internalized by the community via the atmosphere and food consumption. These toxic substances were also found in the breast milk of residents living nearby the dumpsite, posing a considerable threat to both the infants and the community.¹⁵⁹

Workers who sort and collect waste in informal recycling are more likely exposed to volatile organic compounds that subject them to the risk of getting cancer. Persistent exposures to plastic particles may inflict lung and gut injuries, which causes cell damages, inflammation, and impairment of energy allocation functions. Research in Denmark found that women are particularly affected by plastic by having higher chances of having breast cancer and reproductive problems.¹⁶⁰ The waste pickers in the informal sector in the SAR are particularly exposed to these health risks as they often work without any precaution equipment at all. Informal waste pickers with limited access to occupational health and safety equipment or social and health services are also exposed to and disproportionately impacted by plastic pollution. Waste picking in open dumps poses considerable health threats to the urban poor in

many South Asian settlements resulting in lower life expectancy and higher infant mortality rates compared to the general population.¹⁶¹

Populations living in remote and poor areas with limited income opportunities and weak waste management systems, such as islands, are particularly vulnerable to pollution from marine plastic litter that may have traveled along oceans currents. In addition to contamination of drinking water sources and impacts of consuming seafood exposed to degrading plastics, fishing communities may experience personal injuries from the floating litter that may also damage fishing equipment and vessels essential for food security and income generation.¹⁶²

3.3.3.3. *Economic impacts*

Translating from its ecological and social implications, MPP cause economic damages, mainly in the tourism and fishery industry. At the same time, the authorities would have to spend extra effort to reverse the impact caused by MPP, especially those coastal and inland regions. MPP's effects on different industries that rely on the oceans are hard to quantify as there is so much indirect loss involved directly.¹⁶³ Yet, these industries have suffered from substantial impacts. It was once estimated the damage caused to the APEC economies by marine litter is expected to be \$1.26 billion.¹⁶⁴

The tourism industry, mainly those that depend on water activities such as beach resorts or diving spots as attractions, are severely affected by MPP. Tourists will consider their destination by the perception of the quality of the surrounding environment.¹⁶⁵ For instance, when it was found that one-third of the coral reef in Asia-Pacific was entangled with visible plastic objects, this undoubtedly altered the tourists' choice of destination and affected the entire tourism industry supply chain-from hotel sector to retail sector.¹⁶⁶ Therefore, this caused an estimated US\$622 million of loss in the tourism industry in the Asia-Pacific region annually.¹⁶⁷ The Maldives's economy relies heavily on tourism (24.4% of GDP in 2018) industry.¹⁶⁸ However, due to the severe presence of MPP in the region, the Maldives is now facing a declining tourist number and associated revenue, making MPP a considerable threat to the national economy if this situation remains unsolved in the long run.¹⁶⁹

The fishery industry, which relies heavily on wildlife habitat, is also severely affected. The quality and quantity of the catch have been declining, directly lowering the income and sustainability of the industry. The vessels and fishing equipment are often damaged by marine litter, leading to high maintenance and repair costs.¹⁷⁰ Fisheries continue to play a vital role in the SAR. India, for example, is the 6th largest fishing giant in the world in terms of marine captured and significant aquaculture industry.¹⁷¹ The Maldives and Sri Lanka also rely on fisheries as a source of food, contributing 3.9% (2014) and 1.3% (2017) of their respective GDP.^{172,173} Some models suggest that every country is suffering a 0.3%-5% loss in fishery due to plastic pollution. Some studies observed a decline in the growth rate in fishing in the three countries above mentioned, ranging from 9% (India) to 6.3% (Maldives).^{174,175} Although the decline is hard to explain as being due to plastic pollution, plastic pollution is one of the major contributing factors. In 2008, 286 cases of fishing vessels required coastguard rescue due to marine litter damage on their propellers in the United Kingdom alone, costing around \$2.8 million¹⁷⁶. The cost of maintenance of the fishing vessels and rescue missions could be much higher than that in SAR due to a more polluted ocean.

Aside from the economic loss on different industries, the financial cost incurred on the society to fix the negative impact of MPP must also be included. Estimations on the economic value spent by SAR authorities to alleviate MPP are not available, but the SAR has been working closely with other international organizations to tackle the issue. The World Bank has supported the SAR on a plastic-free river and sea initiative with \$40 million.¹⁷⁷ Numerous Non-Government Organizations (NGOs) have engaged in unquantifiable clean-ups voluntary work. Studies have suggested that each ton of plastic litter in the oceans would lead to an annual marine nature capital loss of \$3300-33,000. In 2010 alone, Bangladesh, India, Pakistan, and Sri Lanka combined leaked 3.46 million MTs to the oceans equivalent to a marine nature capital loss of \$11.4 billion.^{178,179} While the authorities ought to clean up all the accumulated mismanaged plastic in the oceans over the years, the associated economic resources and natural capital loss would remain a staggering number.

3.4. Vertical integration of actions to minimize single-use of plastic products in South Asia

Given the impact of MPP in the region, the SAR countries have been actively implementing different measures to reduce single-use plastic products. The authorities have employed economic and regulatory tools while simultaneously cooperating with the civil society and NGOs to promote it to the community. Below we examine how the SAR has been using different tools and engaging diverse stakeholders to tackle MPP, including their challenges.

3.4.1. Implementation of plastic bag bans

As mentioned in section 3.3.2, seven out of eight SAR countries have laws that ban single-use plastics. However, measures that were taken by Afghanistan and Nepal proved ineffective due to poor implementation. Experience showed that having the plastic ban law passed in the parliament is only the first step to establish the regulatory tool. Still, there are plenty of hurdles that must be overcome before a plastic ban policy itself can be practical and useful.

Enforcement and its challenges

Plastic bag ban policies can be a complete or a partial ban that is of a particular type or thickness. In the SAR, the partial ban is more common. While a full ban is relatively easier to enforce (as the enforcement shall expect to see no plastic bags at all), a partial ban requires the enforcement agents to spend more effort in verifying the material and thickness of the plastic bags. Data shows that 4 out of 8 member States (Bangladesh, Bhutan, India, and Pakistan) have relevant data showing a lack of enforcement to implement the plastic bag regulations.¹⁸⁰ The main reason behind the lack of enforcement is that the national governments only inform the local governments to enforce the law without foreseeing the resources and training required at the local government level.^{181,182} While all SAR Members with plastic regulations have quite a severe penalty on the plastic bag ban regulation if broken (from a fine to 10 years of a prison sentence), the behavior of the public is unlikely to change due to the severity of the penalty.¹⁸³ Instead, increasing the probability of detecting the wrongdoing (actual enforcement and arrest) will have a much higher impact on changing the behavior of the public.¹⁸⁴ If plastic bag

regulations are to achieve what they were set out to do, the authorities need the proper amount of resources and sound execution plans to make it useful.

Informal sector

A large portion of the economy of the general public in the SAR is the informal sector. In 2014, 82% of the non-agricultural employment in SAR was in the informal sector, making it the largest informal sector in the world.¹⁸⁵ Given how enforcement is weak, particularly in enforcing the plastic ban regulations, regulating the informal sector is even harder. For example, Bhattacharya et al. found that hawkers and roadside vendors tend to store cheaper or banned plastic bags during the transition period and continue to find ways to purchase and distribute them in the market illegally.¹⁸⁶ Since the informal sector is mainly outside the purview of the official regulation, it increases the difficulty for the authority to monitor their activities.¹⁸⁷ Also, the informal sector, which is financially vulnerable, is struggling to find a cheap alternative to plastic bags.¹⁸⁸ Storing and importing banned plastic bags illegally to sustain their profitability in business cannot be avoided unless the plastic options are made significantly cheaper and available to the public by the authorities.

For plastic recycling in the informal sector, they may have a limited understanding of the information concerning the plastic ban. The implementation of the plastic ban has made scrap shops and large dealers to cease purchasing all flexible packaging plastics as the prohibition is also applicable to these entities. It has led to a significant impact on the livelihood of those waste pickers who primarily rely on selling valuable plastics wastes to the recycling factories or plastic dealers.¹⁸⁹ The implementation of the plastic ban without clear information disseminated to the society would lead to confusion and a potential halt of the recycling industry in SAR.

3.4.2. Promotion of eco-friendly alternatives including bioplastics and other commodities

At the legislative level, SAR countries are often banning non-biodegradable plastic by indirectly promoting other eco-friendly plastic options.¹⁹⁰ The Indian government, for example, has set out an aggressive plan to ban all single-use plastic products by 2022, accelerating and forcing the nation to use plastic options by then.¹⁹¹ Traditional methods and innovations that have the potential to replace conventional plastic usage exist in the SAR. However, governments lack deliberate efforts to promote and encourage further research and develop affordable plastic alternatives, although the community has been quite proactive in researching plastic alternatives by making use of natural materials, including jute fibers and water hyacinth.¹⁹² What is worrying is not the lack of plastic options but the rebound effect of the plastic ban, where plastic alternatives users may have a feeling of fulfilling their duty to the environment as a green consumer and further increase marine littering.¹⁹³ Although plastic alternatives are made to be more dissolvable than normal plastics, they require a relatively long period of time to be fully dissolved in the environment. Plastic alternatives would also require extra infrastructures and technology to process these plastic alternative wastes before disposing

or recycling. These technologies are, unfortunately, not readily available in the SAR yet. Tables 4 and 5 below summarize the dissolving performance of the different types of plastics in the oceans. The findings show that even plastic alternatives will accumulate in the oceans despite dissolving slightly faster than traditional plastic, which implies the promotion of plastic options alone will not solve the issue of MPP, as emphasized by the UNEP.¹⁹⁴

Table 4. Weight loss of the different type of plastics in the oceans

	Traditional Plastic		Biodegradable Plastic	Oxo-degradable Plastics	Bioplastics
	1.5mm thick Low-Density PE	1.5mm thick High-Density PE			
Duration in the oceans	6 months	6 months	N/A*	N/A	600 days
Weight Loss	1.5-2.5%	0.5-0.8%	N/A*	N/A	2.5%

* Depends on the inorganic component in the water, water temperature and the chemical structure of the biodegradable plastic

Source: Lambert, S & Wagner, M, 2017¹⁹⁵

Table 5. Surface area loss of the different type of plastics in the Oceans

	Traditional plastic with 33% recycled plastic	Biodegradable Plastic	Oxo-degradable Plastics	Bioplastics
Duration in the oceans	40 weeks			
Surface Area Lost	<0%	<2%	<2%	100%

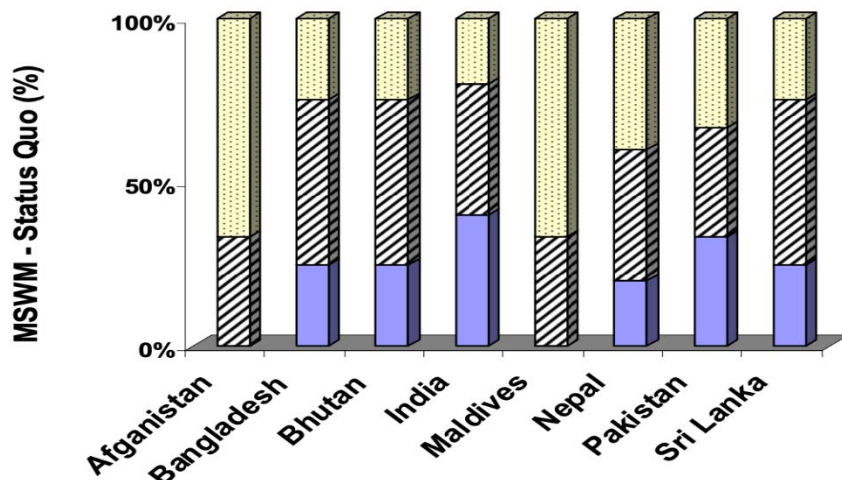
Source: O'Brien, T & Thompson, R. C, 2010¹⁹⁶

3.4.3. Community-based approaches in formal/informal sectors, consumer awareness, and voluntary reduction strategies and agreements

In the SAR, the community and informal sectors have been the leading force to minimize the use of single-use plastics. Countries in the SAR rely on the informal sector to some degree to support the recycling industry and reduce single-use plastic, given the size of the informal sector in the SAR and the minimal support from the authorities.¹⁹⁷ The industry provides labor and economic incentives for waste picking, sorting, and small scale enterprises that purchase plastic waste.¹⁹⁸ Although workers in the informal recycling sector do not do it purely for environmentally friendly reasons, they do so for their economic livelihood. NGOs and the private sector play a significant part in raising community awareness and education in waste management (Figure 14 below). They have spearheaded the campaigns against single-use plastic and promoted recycling and municipal solid waste management before the authorities could take action to tackle single plastic use. In India, for example, NGOs have led the efforts in waste collection and recycling in some municipalities.¹⁹⁹ In turn, the Indian government introduced the "Clean India campaign," which intended to integrate government, private, and traditional waste handlers to promote a more effective and efficient recycling system, in which this role was first taken up by the local NGOs.²⁰⁰

Figure 14. Involvement of parties in promoting recycling and municipal solid waste management

■ Government ▨ NGOs & Pvt. Sect ▩ International Organizations



Source: Visvanathan, C., and Tenzin Norbu, 2006

As early as 1993, the Kagad Kach Patra Kashtakari Panchayat (KKPKP) was established in the city of Pune, Maharashtra State in India, as a union to advocate for the rights, livelihood, and recognition of informal waste pickers in Pune. They contribute significantly to the plastics recycling value chain in the city.²⁰¹ Since establishing, KKPKP has been working closely with the Pune Municipal Corporation (PMC) to decentralize waste management in the city by securing contracts with PMC for informal waste pickers to provide door-to-door waste collection service across the city via a Solid Waste Collection and Handling (SWaCH) model (see Section 4.2 for details). A similar case occurred in Bangladesh, where NGOs took actions that drew the authorities' attention and effort.²⁰²

3.4.4. Economic instruments to addressing marine plastic litter

Traditionally, tools that used to curb MPP problems include levy or a tax on commercial agents that facilitate single-use plastics, including importers, distributors, and users of any of single-use plastic products.²⁰³ Nonetheless, as most South Asian countries implement a partial ban on single-use plastics based on its thickness or materials, imposing a levy further to reduce the use of single-use plastic products would be beneficial. A combination of a partial ban and tax is found in 7 out of 127 countries that have plastic regulations across the world.²⁰⁴ The reason behind this could be due to the lack of affordable plastic alternatives at the moment, and implementing such an aggressive policy mix may induce pressures from different industries to the authorities. When the trend of plastic reduction become more robust in the society, the dynamics of policymaking may change, and the governments may have fewer hurdles in imposing a combination of partial ban and levy, or even a complete ban.

3.4.5. Policy instruments and trans-boundary issues, waste trade issues and the Basel convention

Since MPP is a trans-boundary issue, the SAR is also participating in different regional and international led actions to solve the problem. The establishment of the SAARC in 1985 has provided the platform for SAR countries to share information and collectively deal with South Asia regional issues.^{205,206} The SAARC has launched campaigns to reduce plastic usage and raise awareness of the public in MPP, although the regional agreement or action plan is still lacking.²⁰⁷ Before the establishment of the SAARC, the eight countries of the SAR also established the SACEP to promote regional effort in battling environmental issues. SACEP helped to organize workshops and national clean-up campaigns in the region throughout the years. Also, SACEP collaborated with international bodies and provided support to the SAARC members.²⁰⁸

All countries in the SAR are also parties to the Basel Convention. This international agreement aims at establishing a legally binding framework to control transboundary movements of hazardous wastes and their disposal, including plastic waste.²⁰⁹ Since the SAR has been mostly mistreating dangerous litter, including plastic waste that leads to MPP, the participation of the SAR countries allows them to acquire the technology and to adopt a sound waste management practice.^{210,211} Complying with the guideline as set out in the Basel Convention would benefit not only the SAR but also provides an essential contribution to the global effort in the battle against MPP.

4. SELECTED CASE STUDIES FROM SOUTH ASIA

This section discusses two selected countries from the SAR (Bangladesh and India) as case studies on how a bottom-up approach can tackle MPP. The two have one of the most polluted rivers in the world, the Ganges Delta (Meghna, Brahmaputra, and the Ganges). Also, both countries have made a vital breakthrough in tackling MPP using a bottom-up approach. We, therefore, briefly examine how these countries generated significant social momentum to address MPP.

4.1. A case study for Bangladesh: using social pressure to solve plastic and litter problem

Bangladesh learned the lesson about marine plastic pollution the hard way following the unprecedented scale of a high flood in 1988, where at least 55% of the country's area was submerged, affecting 45 million people and over 2000 deaths.²¹² The Bangladesh government and the international community investigated the reasons behind the floods. They found that the drains in most parts of the city have been blocked by plastic bag litter, exacerbating further the severity of the floods.²¹³ The floods destroyed homes, derailed trains, disrupted traffic, and posed health risks to the city.

The Environment and Social Development Organization launched the first anti-plastic bag campaign in 1990 and kickstarted the first nation-wide cleanup campaign.²¹⁴ At that time, only

10-15% of the 9.3 million plastic bags used annually were placed into dustbins, with the rest mismanaged and likely to have flowed to the drainage system and rivers.²¹⁵ The motion of a plastic ban was first submitted to the parliament in 1993 but was not successful. Because of the intense public pressure arising from users, manufacturers, and exporters after the 1998 flood, the notion for a plastic ban was again taken up seriously by the Ministry of Environment and Forest of Bangladesh, where the senate and parliament finally agreed to.²¹⁶ The ban was designed to be enforced in the capital area only. Yet, due to the strong public support, the campaign spread across the nation and eventually resulted in the national-wide ban on the single-use of plastic bags on 1 January 2002.²¹⁷ According to the ban, the penalty and punishment were imposed on the production, import, and marketing, with ten years sentence of vigorous prison, or 1 million takas fine, or both penalties. As for the sale, exhibition, store, distribution, transportation, or use of plastic bags for commercial purposes, a six months sentence of vigorous prison or 10 thousand takas fine, or both punishments were imposed.²¹⁸

In order to further strengthen the effectiveness of the plastic bag ban and ensure environmental compliance, alternative packaging materials such as cloth bags were also promoted, introducing fines on improper use and disposal of polythene bags and enforcing environmental laws as regards to polythene production and consumption and absorbing workers in the plastic manufacturing units into jute and textile sectors (Mugisha et al., 2015).²¹⁹ Owing to these measures, the majority of the people in Dhaka continued to throw waste and use polybags in the city's streets or open spaces. Household trash was often packed in polybags and disposed of anywhere. The factory owners filed a petition which was later rejected by the High Court on the ground that the lives of Bangladeshi outweighed the employment of a few thousand employees in polythene factories. Instead, the government extended loans and other financial benefits to the affected factory owners to switch to other enterprises and oversaw the rehabilitation of the laid-off workers.

4.2. A case study for India: engaging the public to solve plastic and litter problem

India is the "Land of Rivers," but not a single river flowing in its soil is free from pollution.²²⁰ Many rivers in India are generally not fit for bathing, according to the CPCB and the Centre for Science and Environment. Indian cities generate 10 billion gallons or 38 billion liters of municipal wastewater every day, out of which only 29% is treated. Ganga is the most polluted river in India, where 1 billion liters of raw and untreated sewage are dumped in the Ganga river regularly.²²¹

At the World Environment Day on 5 June 2018, Prime Minister Narendra Modi affirmed the start of a global movement to defeat single-use plastics.²²² India announced to eliminate all single-use plastic in the country in 2022, an unprecedented ambitious move against disposable of plastic, which drastically stems the flow of plastics from 1.3 billion people and businesses in the fasted growing economy in the world. India uses 14 million tons of plastic annually, and lacks an organized system for management of plastic waste, leading to widespread littering.²²³ Experts estimate that the annual waste generation in India will increase to 165 million tons by 2030, needing 66,000 hectares of land as a landfill site of 10 meters high to hold up to 20 years' waste.²²⁴ Currently, India generates around 56,000 tons of plastic waste annually, where Delhi

alone accounts for 9,600 metric tons per day. India's contribution to plastic waste dumped into the oceans every year may be close to 60%.²²⁵ Despite efforts to address the problem of plastics, including introducing bans, levies, penalties, alternatives to plastics, etc., the implementation of these measures has been minimal or ineffective. The enforcement of the law has been weak as the usage of plastic bags in India has continued to remain high because the ban is not implemented on all types of plastics.

To reach the 2022 target, the Government of India addressed the improvements of the waste management system, promotion of eco-friendly alternatives to plastic use, technological innovation, public actions and awareness, and challenges on pollution by single-use plastics. In New Delhi, for example, the NGT had directed all the concerned civic bodies¹ to reduce the dumping of plastic waste effectively. Also, the government launched a radical and vigorous policy to ban all non-biodegradable plastics in the country. Before the plastic ban, the plastic bags were given out for free by retailers, from large scale supermarkets, small stores to street-side vendors, leading to a high consumption rate of plastic bags in India.²²⁶ Given the vast population of India and poor waste management practices, MPP became an apparent social problem in India. Forty percent of the plastic wastes in India are neither collected nor recycled but end up polluting the water and the soil.²²⁷ River Ganges which serves over 400 million people, is heavily polluted while the free-roaming cows starve to death as they ingest the plastics and have their digestive system clogged.^{228,229}

The clear link between plastic bag uses and public safety, as well as natural habitat, has immediately sparked the public attention. Municipals are gradually passing plastic ban regulations, with the Sikkim State being the first state to adopt the plastic ban regulation in India in 1998.²³⁰ In 2003, a national-wide ban on non-compostable plastic waste was passed, but, due to the poor implementation, it was virtually ineffective.²³¹ Surprisingly, there were just a handful of NGOs that were leading the effort to reduce plastic waste at the national level.²³² However, in 2015, Afroz Shah, a young Indian lawyer, and environmentalist from Mumbai, who was frustrated by the rotting waste on Versova beach, decided to clean the beach using a cleanliness drive called "dates with the oceans," inspiring thousands of volunteers to join. Shah organized door to door campaigns to explain to the residents about the damages caused by marine litter. Over two years, the volunteers removed 13,000 MTs of waste, mostly plastics.²³³ He then started his own NGO to work on MPP and managed to mobilize over 5,000 people to join his campaign during weekends. He collected 20 tons of litter on nine beach fronts, the action which was recognized by the United Nations as the largest beach cleanup project ever.^{234,235} The solidarity and responses from the community have become one of the most powerful tools to spread the message and increase community engagement in the fight towards MPP in Mumbai.

In Pune²³⁶, the second largest city of Maharashtra State, waste recycling is carried out via a hybrid model involving the collaboration between PMC and a network of informal waste pickers. These waste pickers play an essential role in transforming the city's plastic value chain

¹ The Municipal Corporation of Delhi (MCD), Delhi Development Authority (DDA), local bodies of Delhi – East, South and North Municipal Corporation Bodies, Delhi Pollution Control Committee, New Delhi Municipal Corporation, Central Pollution Control Board and the Ministry of Environment, Forest and Climate Change.

into a more circular one. In 2000, the Municipal Solid Waste Rules introduced to the municipality mandated municipal authorities to implement door-to-door waste collection, segregation, and recycling to divert waste from landfills. With the PMC having insufficient labor to carry out the mandate, KKKPKP established the first door-step collection system for approximately 50,000 properties across Pune and introduced a waste-collection user fee for their service as an alternate form of income.

In 2008, PMC authorized the SWaCH cooperative launched by informal waste pickers of KKKPKP to provide door-to-door waste collection, segregating recyclable material and disposing any remaining waste in designated points for secondary waste processing under a 5-year Memorandum of Understanding (MOU). This sustainable model allows waste pickers to sort and sell the collected recyclable materials to 600 small and medium scrap shops across Pune, where the plastic is further classified, sold to be processed as pellets, and traded as raw materials for new recycled products. PMC facilitates work identification and equipment to demonstrate the recognition of SWaCH waste pickers. As a result, 30,000 tons of plastic waste is estimated to be collected annually by SWaCH waste pickers. Their effort successfully diverted 52% of Pune's plastic waste from landfills to recycling while saving 160 million rupees annually for PMC in waste management. Upon recognizing the sustainability and successes of the SWaCH model during the first MOU, PMC renewed contract with SWaCH in 2016 for another five years. As of 2018, SWaCH expanded with 3076 waste pickers servicing approximately 640,000 properties across Pune – collecting 52.5% of municipal solid waste in Pune. The experience of Pune demonstrates that partnerships between municipalities and informal waste collectors are highly effective in the valorization of resources - providing a sustainable source of livelihood for casual workers and a low-cost solution to tackle MPP.

5. CONCLUSION AND RECOMMENDATIONS

Marine plastic pollution is a transboundary issue; therefore, individual efforts by one country are essential but may be insufficient. Countries in the SAR need to react promptly to accelerate progress on the implementation of SDG 14.1 to achieve it. While the awareness on MPP in the SAR is rising, to sufficiently address the MPP problem in the region, transformative actions that change the paradigm shift for both consumers and producers, supported by adequate regulations that provide for transitional mechanisms to phase out plastics is required. Different parties will have to be involved in deploying a more comprehensive strategy. The paper concludes that to achieve SDG 14.1, countries in SAR must:

- Develop the baseline data on MPP at the city, national, and regional levels to identify interventions related to technologies and mitigation and management strategies.
- Assess and address the income differences between coastal and mainland population, as tourists seek to avoid beaches known to have high concentrations of plastics litter
- Introduce and strengthen policy and regulatory frameworks that ban items such as single-use, ban from landfill, statutory targets for recycling rate, etc.
- Strengthen economic instruments, e.g., resource tax, technology for recycling mixed plastics, thermosets, alternate materials, etc.

- The region should create a knowledge base, data, and information by establishing the indicator monitoring and baseline data, and conduct impact assessments across the terrestrial, aquatic, and marine ecosystem.
- Ensure capacity building and sharing of best practices across the region, etc.; and
- Take voluntary measures such as industry-led market transforming interventions or projects, better labeling and declarations of packaging, and sustainability reporting on SDGs 12 and 14.

Also, the paper identifies rooms for improving and strengthening the SAR's ability to address marine plastic litter problem. It presents several recommendations that will facilitate the countries to tackle marine plastic pollution as follows:

Support structures that help improve waste management systems

As most SAR countries implement single-use plastic bag bans, embarking on waste management systems, and legislation for handling waste to prevent leakage that would later result in MPP is critical. Countries should, therefore, establish and enhance more systematic waste management systems in both urban and rural areas. In particular, the opening of dumping sites should be replaced by proper landfills and sanitary landfills because open dumping sites cause leakage and environmental pollution. Incineration with energy recovery could be considered at sites far away from residential areas. Also, if the technology is not available, funding should be made available for research and development to help address waste disposal in the long term. Authorities should also intervene in the recycling industry by providing subsidies and performance bonuses, thereby facilitating the waste management system.

Ensure better enforcement of plastic bans

With partial plastic bans in place in most of the SAR countries, it is necessary to ensure that the prohibitions are implemented fully. To achieve that, national governments should identify the gaps between the existing policy support and what it takes to make the ban applied effectively. Resources should be made available to local governments so that the officers can receive sufficient training on how to enforce the plastic ban. Consistent monitoring by the enforcement units across the nations and strict enforcement of fines when violations are detected is the key to ensuring plastic bans are effectively implemented. It is likely that if the plastic ban is applied thoroughly, the communities will naturally find ways to seek for alternatives to plastics to avoid the penalty faced when violating the plastic ban.

Closer cooperation between NGOs and government

Governments must cooperate with community leaders, NGOs, and the private sector to address the MPP problem. NGOs play an essential role in increasing public awareness. They are more effective than the government, as they are closer to the communities and understand better the actual situation the society faces every day. NGOs can serve as a mediator in sending the messages to the informal sector while achieving the common goal of reducing MPP problem. They can act as agents for a bottom-up approach in bringing about social change using social pressure.

Proactive participation in regional and international initiatives

Since MPP is a transboundary issue, the SAR must participate in local, regional, and global campaigns in the fight against MPP. The existing regional cooperation has set the frameworks and platform for further collaboration, but the frequency of such is insufficient to tackle the increasingly tricky MPP situation in the region. The SAARC has dedicated its effort to economic cooperation and development while SACEP leads the effort towards environmental issues in the SAR. Internationally, the SAR shall remain active in learning from other regions regarding methods and technologies to reduce MPP. The international community is also willing to share the resources and technology involved. For instance, the World Bank has granted SACEP \$40 million to formulate a project aimed at achieving plastic-free rivers and seas in the SAR in the long term.²³⁷ The active participation in international campaigns would allow for a global oceans governance framework and monitoring to have a unified standard on oceans protection.

Establishing baseline data across the region

More national and regional data need to be gathered and published by the SAR to tailor a suitable strategy regionally and coordinate with international players towards tackling the MPP problem. The region should create a knowledge base, data, and information by establishing the indicator monitoring and baseline data, and conduct impact assessments across the terrestrial, aquatic, and marine ecosystem.

Straighten economic incentives and instruments

The SAR countries should consider introducing more vigorous economic incentives and instruments to curb MPP when the sentiment and awareness in their respective countries. The financial instruments can be used to discourage irresponsible plastic usage and, at the same time, gather the economic resources needed to improve technologies that could alleviate marine plastic pollution or to subsidize alternative plastic industries. Achieving a circular-plastic economy is critical as the ultimate goal for the SAR region to utilize plastic sustainably. However, the lack of recycling and waste management infrastructures has created an enormous hurdle to introduce a circular plastic economy in SAR. SAARC countries may provide economic incentives to allow businesses to privatize these critical infrastructures and accelerate the development of the plastic-circular economy.

6. ENDNOTES

¹ The term ‘marine pollution’ refers to the introduction of harmful or potentially harmful substances into the sea, but it can be politically ambiguous, referring either to the substances themselves or to the moral responsibility for the harm caused by pollution. The use of ‘marine plastic pollution’ (rather than plastic litter or plastic debris) highlights this socio-political nature of the material. It meant to refer to the situation of plastic pollution in the marine environment in this chapter.

² Convention On Biological Diversity General, UNEP/CBD/ICCP/2/12 at <https://www.cbd.int/doc/meetings/bs/iccp-02/official/iccp-02-12-en.doc>

³ United Nations Convention on the Law of the Sea of 10 December 1982, Part XII, art.192-237.

⁴ Ibidem, art. 192, art, 235(1), art. 197-201.

⁵ In the literature, the terms “marine debris” and “marine litter” are used interchangeably in many cases. Depending on the nationality and native language of writers, there is a tendency to use the former or the latter. For instance, the European Union tends to use the term marine litter (See for example: Directive on the reduction of the impact of certain plastic products on the environment, Official Journal of the European Union, L 155/1, 12.6.2019). Some readers may interpret the term litter as being human induced, whereas debris could be construed as something caused either by humans or by nature. "Debris." Merriam-Webster.com. 2019. <https://www.merriam-webster.com> (14 November 2019). This chapter will use the construct marine litter to describe the pollution of plastics and other solids into the oceans, directly or indirectly related to human behaviour and activities.

⁶ UNEP, “Marine Litter”, 2020a. Available at <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/marine-litter>

⁷ Ibid.

⁸ Xanthos, Dirk, and Tony R. Walker. "International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): a review." *Marine pollution bulletin* 118.1-2 (2017): 17-26.

⁹ UNEP, “Land-based pollution”, 2020b. Available at <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/land-based-pollution>

¹⁰ Jeftic, Ljubomir, et al. “Marine litter: a global challenge”. UNEP. 2009.

¹¹ Ibid.

¹² Ibid.

¹³ ESCAP’s Theme Study for the Seventy-sixth Session of the Commission: Changing Sails: Accelerating Regional Action for Sustainable Oceans in Asia and the Pacific, (2020). ISBN: 978-92-1-120812-2; e-ISBN: 978-92-1-004977-1, ST/ESCAP/2905.

¹⁴ Rech, S., et al. "Rivers as a source of marine litter—a study from the SE Pacific." *Marine pollution bulletin* 82.1-2 (2014): 66-75.

¹⁵ Oceans Cruising Club, “The Great Pacific Garbage Patch is Growing Exponentially”. Available at <https://oceanscruisingclub.org/newsitem/394/The-Great-Pacific-Garbage-Patch-is-Growing-Exponentially>

¹⁶ Lebreton, L., et al. "Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic." *Scientific reports* 8.1 (2018): 1-15.

¹⁷ Ryberg, Morten, Alexis Laurent, and Michael Zwicky Hauschild. "Mapping of global plastic value chain and plastic losses to the environment: with a particular focus on environment." (2018).

¹⁸ Lebreton, L., et al. 2018. Op cit.

¹⁹ The Thaiger, “Top 10 most plastic polluted rivers in the world (2019)”. 2019. Available at <https://thethaiger.com/thai-life/top-10-most-plastic-polluted-rivers-in-the-world-2019>

²⁰ World Bank Group, World Bank Open Data, 2020a. Available at <https://data.worldbank.org/>

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