Plastic Waste, Plastic Pollution- A Threat to All Nations

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Plastic Waste, Plastic Pollution- A Threat to All Nations!

By Golam Kibria

Plastic waste is ubiquitous and is reported from Arctic to Antarctic, from the surface to sediment [1]. Plastic fragments from open dumping grounds may be blown into streams, rivers or directly into the ocean. Plastic pollution in freshwater and marine environments have been identified as a global problem. It is estimated that plastic debris accounts for 60–80% of marine litter, reaching 90–95% in some area [2]. 80% of plastic pollution originates from land-based sources with the remainder coming from ocean-based sources (fishing nets, fishing ropes) [3]. The major land-based sources are Illegal dumping (mismanaged plastic waste- Figure 1) and inadequate waste management [3]. Global production of plastics is now up to around 300 million tonnes (1) and nondegradable plastic accounts for 73% of litter in any aquatic habitat (4) with roughly 50% disposed of after a single-use [2].

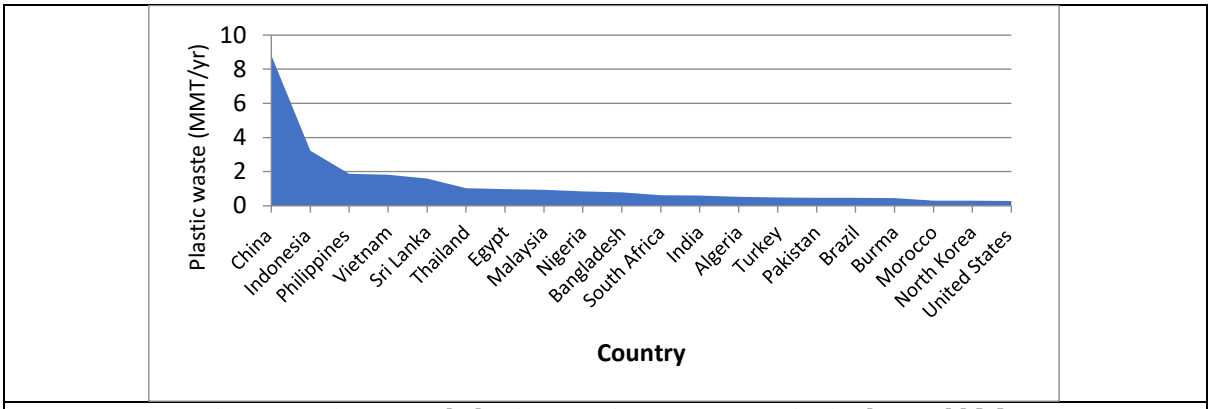

Figure 1. Mismanaged plastic waste in top 20 countries in the world [5].
Mismanaged plastic waste are materials that is either littered or inadequately disposed (not formally managed and includes disposal in dumps or open, uncontrolled landfills, where it is not fully contained). Sixteen of the top 20 mismanaged plastic waste producers are low to upper middle-income countries, where fast economic growth is occurring but waste management infrastructure is lacking [5].

Plastic waste is an emerging contaminant and do not readily biodegrade but persist in the aquatic environment for long periods. An estimated 5 trillion pieces of plastic are floating in the world's oceans [6] from the Arctic to Antarctic [7]. Most chemicals used for producing plastic polymers are derived from non-renewable crude oil, and several are hazardous [8]. Plastics are classified as small micro plastics (0,33-1mm), larger micro plastics (1.01-4.75 mm), meso-plastics (4,76-200 mm) and macro-plastics (> 200 mm) [1]. Six basic types of plastic dominate today's markets: Polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), polyurethane (PUR), and polyethylene terephthalate (PET). Packaging is the world's largest plastics sector, making up about one-quarter of overall production. In the United States, Europe, Australia and Japan, plastics are classified as solid waste [9].

Mismanaged plastic (plastic dumped openly) enter the environment via inland waterways**,** wastewater outflows, and transport by wind or tides [5]. Small plastic particles (micro plastics/microbeads) cannot all be filtered out, making wastewater treatment plants a significant source of micro plastic pollution into aquatic ecosystems [2,3]. Micro plastics once entered the aquatic environment can travel vast distances floating in seawater, or sediment to the seabed [2].

Threats to biodiversity and economy

Large plastic items, such as discarded fishing rope and nets, can cause entanglement of invertebrates, birds, mammals, and turtles, salt-marsh grasses, and corals. Entanglement of aquatic species by plastic debris can cause starvation, suffocation, laceration, infection, reduced reproductive success and mortality. Much smaller micro plastic particles (microbeads) are commonly white or opaque in colour, which are commonly mistaken by many surface feeding fishes as food (plankton). Ingestion of plastics by aquatic organisms is one of the major deleterious environmental impacts in the aquatic environment [2]. Many organisms (whales, turtles, seabirds, shellfish, fish) swallow pieces of plastic, which can accumulate in their digestive system of biota [7,9]. Swallowing of plastic can cause physical damage or blockage of the intestinal tract, which can lead to infection, starvation and even mortality [7]. Of the hundreds of marine species impacted, 17% are IUCN red listed species and at least 10% have ingested plastics [2]. Lab studies reveal that exposure of micro plastics to the Pacific oysters (a filter feeder), had poorer-quality eggs, sperm and produced fewer larvae [10].

Similarly, researchers [11] when exposed the European perch (Perca fluviatilis) larvae to 'environmentally relevant' concentrations of micro plastics found larvae ate the micro plastics and caused fish to grow more slowly and failed to respond to the odour of predators [11].

Plastic along shorelines creates an aesthetic issue, which has negative impacts on tourism. Economic losses are associated with reduced tourism revenues, negative impacts on recreational activities, vessel damage, impairment in marine environments. Stranded shoreline plastic also negatively impact shipping, energy production, fishing, and aquaculture resources.

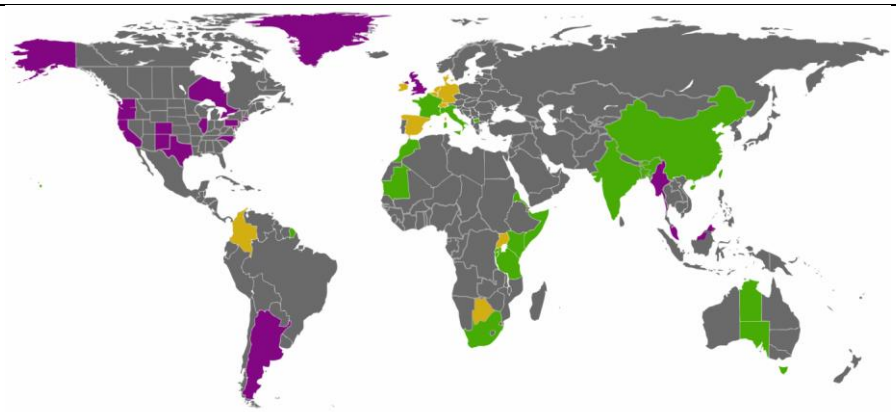

Figure 2. Phase out of plastic bags around the world via **banning**, **taxing** or **both**
[2; https://upload.wikimedia.org/wikipedia/commons/9/94/Plastic_bag_legislation.svg]
Ban: Argentina (2012); Australia (SA, ACT, TAS); Bangladesh (2002); Canada (2007); China (2008); Eretria (2005); India (2005); Italy (2013); Kenya (2007); Mauritania (2013); Morocco (2016); Myanmar (2011); Papua New Guinea (2016); Puerto Rico (2016); Rwanda (2008); South Africa (2003); Taiwan (2003); Tanzania (2006); Uganda (2007), USA (2007); **Levy (tax on plastic bags):** Botswana (2007); Canada (2012); China (2008); Denmark (1994); Germany (1991); Hong Kong (2009); Israel (2016); England (2015); Kenya (2011); Ireland (2009); Malaysia (2011); Netherlands (2016); Scotland (2014); Uganda (2007); USA (2016); Wales (2011); **Partial tax or ban**

Plastic waste is a carrier of 'priority pollutants'

Pesticides and organic pollutants such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDTs) are consistently found in plastic waste (these chemicals adsorb onto due to hydrophobic nature) at harmful concentrations (e.g. 100 times those found in sediments and 1 million times those occurring in sea water). Many of these are 'priority pollutants' These priority pollutants can enter the tissues of aquatic species after they eat debris and can move up the food chain to human consumers (from eating contaminated fish/seafood/shellfish). Seabirds that have consumed plastic waste have polychlorinated biphenyls in their tissues at 300% greater concentrations than in those that have not eaten plastic [9].

Mitigation measures

There are several measures that can be taken to reduce threats and risks of plastic waste and plastic pollution including the following: i) placing clean-up equipment near the coasts where much of the plastic pollution originates; ii) managing mismanaged plastic waste in the 20 top-ranked countries (Figure 1); iii)reducing plastic waste generation; iv) preventing illegal plastic waste dumping; v) curbing the growth of single-use plastics via ban, levy, tax on plastic bags (Figure 2); vi) raising awareness amongst the public of the harm caused by plastic pollution (education and outreach programs to modify behaviour); vii) expanding the use of biodegradable plastics that truly degrade in the ocean; viii) ban of microbeads in personal care products and cosmetics; ix) Collection and removal of old or abandoned nets for recycling); x) reduce, recycle, reprocess, recover plastic use and plastic waste; xi) a reduction in single-use plastic bags [2,3,12].

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