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STATUS OF PLASTIC WASTE MANAGEMENT IN THE CARIBBEAN

A technical brief to inform Caribbean Member States at the INC negotiation meetings for an internationally legally binding instrument on plastic pollution

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Acronyms

ALDFG	Abandoned, Lost or otherwise discarded fishing gear
BUV	Benzotriazole UV
CLME	Caribbean Large Marine Ecosystem
CRFM	Caribbean Regional Fisheries Mechanism
GDP	Gross Domestic Product
INC	International Negotiation Committee
LDPE	Low Density Polyethylene
M	Million
MFA	Material Flow Analysis
MP	Microplastic
Mt	Million tonnes
OPE	Organophosphate ester
PCB	Polychlorinated biphenyl
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
PS	Polystyrene
PVC	Poly vinyl chloride
t	tonnes
UNEP	United Nations Environment Programme
WTO	World Trade Organisation

Introduction

This technical report was prepared to support the Caribbean Member States involved in the intergovernmental negotiation committee (INC) process under the UNEA 5.2 landmark resolution to end plastic pollution and forge an internationally legally binding agreement.

The report compiles available literature on the sources, quantities, transportation pathways, impacts and solutions to plastic pollution in the Caribbean and is compared to global data. Considering the limited existing data from the region, where possible, extrapolation of these dataset was undertaken to obtain a Caribbean wide snapshot. Where this was done, it is clearly indicated either in the text or footnote.

For each section, a brief global summary is given to allow for regional comparability and to signpost the reader to relevant publications. This is followed by an account of the Caribbean's context and finally some identified key knowledge gaps for the region.

Report Structure:

Sources and Quantities – gathers data from various sources to identify the sources and extent of plastic pollution and also provide a Caribbean level perspective to facilitate comparison with global data.

Transportation Pathways – defines the land and sea-based transportation pathways of plastic waste and quantifies extent of influence on the region.

Impacts – provides a snapshot of the studies to date to illustrate the work undertaken and highlight the gaps in regional research data.

Solutions Underway – documents the solutions implemented currently, categorised into regulatory policies, strategies, recycling, alternative and substitutes, energy recovery, deposit refund schemes. Recommendations from scientific literature are also included.

Conclusion

Annex 1 - Other Useful Information – includes a glossary of terms used at the INC global treaty negotiations and illustration of key concepts in the management of plastic pollution.

Sources and Quantities

Global Context

Quantifying plastic waste generation and leakage from contributing sectors relies on waste characterisation surveys and when not available approximated by various methods including data aggregation, extrapolation, modelling and assumptions. Numerous recent reports[1] have provided detailed assessments of the plastic lifecycle therefore in this report only the key figures are presented.

An estimated 60-90 Mt (million tonnes)[2] of mismanaged[3] plastic waste was generated in 2015 and this is anticipated to increase 2.5-fold by 2040.

Only a couple sectors have been able to quantify plastic usage or waste generation. The agriculture sector is one which heavily uses plastics, where at least 12.5 Mt of plastics (in 2019) were used globally in agricultural production, equivalent to 3.5% of global plastic production[4]. The fisheries sector also has high plastics usage where it is estimated roughly 2.1 Mt/year of plastics are used in global fisheries and aquatic production[5],and approximately 0.3 Mt/year of macroplastics are leaked from fisheries and marine activities[6]. A global analysis of lost fishing gear calculated 5.7% of all fishing nets, 8.6% of all traps and 29% of all lines are lost each year[7].

In terms of the composition[8] of plastic waste generated, it is dominated by packaging which is made of short-lived plastics (46%) followed by textiles (15%), consumer products (12%), transportation (6%), building and construction (4%), electrical (4%) and industrial machinery (0.4%). Plastic packaging waste (158 Mt/year) is especially problematic with 40% going to landfills and 32% directly to the environment[9].

Caribbean context

The Caribbean's waste composition incudes an estimated 13% of plastics[10], which is comparable to global trends. Of this, approximately 34.1% are mismanaged resulting in 1.1 Mt entering the environment. This is approximately 1.4% of the globally mismanaged plastics.

At a sectoral level, available field data studies[11] to support national quantification of plastic flows in 3 countries, Antigua and Barbuda, Grenada and Saint Lucia can be considered collectively as a representative

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[1] UNEP 2021 Drowning in Plastics; Geyer et al 2017; UNEP 2023. Turning off the Tap

[2] Lebreton & Andrady 2019

[3] Mismanaged is defined as combined quantities of inadequate (waste that is not managed in a controlled setting, cannot be accounted for and is usually part of other (often informal) methods such as open dumping, burning, or burying) and littered fractions of waste

[4] FAO 2021. The estimate does not consider plastics used in downstream value chains (storage, processing and distribution)

[5] FAO 2021

[6] OECD 2022 Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options

[7] Richardson et al 2019

[8] UNEP 2021 Drowning in Plastics

[9] Geyer et al 2020

[10] Brooks et al 2020 relying on data from Kaza et al 2020 .which is influenced by the sources' age and methods of derivation. Sound field studies will always provide more accurate data and can ground truth these statistics. For example, in 3 countries the Kaza et al 2020 data for % plastics in the waste stream was compared to recent waste characterisation surveys[10] by the national solid waste authorities (in brackets): Jamaica, 12.2% (15%), Antigua and Barbuda, 13% (22%), Barbados, 17% (12%) (Clayton 2021; NSWMA (2021) presentation, BSWMP 2015).

[11] National quantifications of plastics flow including audits were recently conducted in Antigua and Barbuda, Grenada and Saint Lucia by APWC (Plastic Waste-Free Island Project: Plastic Waste National Level Quantification and Sectorial Material Flow Analysis in Saint Lucia, Grenada and Antigua and Barbuda 2021). The extrapolated regional data are broad estimates since it relies on a small dataset (3 countries) and the accuracy and reporting of the audit data contained within.

sample of the quantities of plastic waste generated in the Caribbean in 3 sectors, fisheries, tourism, and household and commercial. To obtain a regional perspective, a straightforward extrapolation of the sample data using regional statistics was undertaken and is presented below (a definition for each sector is given in the Glossary)

- **Fisheries:** Using CRFM annual 2019 statistics[12], the following estimates for the Caribbean region were calculated:
    - 685 t/year of plastic wastes generated by the fisheries sector (consumables and ALDFG)
    - 382 t/year of fishing gear leakage rate
    - 20 t/year of microplastics shed by regional fishing vessels

  The issue of ALDFG is exacerbated by the prevalence of hurricanes in the region[13].

- **Tourism:** Using WTO 2019 regional statistics[14], the following estimates were calculated for the Caribbean region:
    - 22,100 t/year of plastic waste generated by the tourism sector
    - 3,992 t/year leakage rate (mismanaged)
    - Sources of tourism plastic[15]: 53% (land-based), 8% (airline), 22% (cruise ships) and 18% (yachts)
- **Household and Commercial**: Using World Bank population statistics[16], the following estimates were calculated for the Caribbean region:
    - 1,047,200 t/year of plastic waste generated by the household and commercial sectors
    - 254,100 t/year leakage rate (mismanaged)
    - Household generates 2-3.5% times more than the commercial sector

  The estimated percentage of plastics by weight in household and commercial waste in Antigua and Barbuda, Grenada and Saint Lucia ranged from 2.8 – 7.7% and in Belize, a mainland Caribbean country, it was 17 – 25%[17]. These are conservative estimates since the sample data did not consider hygiene products, textiles, e-waste, or construction material.

Other sectors which will contribute to plastic pollution in the region but do not have available data are agriculture and industry.

As regards the composition of plastic wastes, Grenada and Trinidad and Tobago[18] conducted a Material Flow Analysis (MFA) of plastics and found that plastic packaging waste was at higher rates (64% and 55%) than found globally (46%). The mass balance approaches by the MFA supported a more accurate account for plastic flows by including packaging and embedded products which are not captured by trade statistics.

Key Knowledge Gaps

- Updated waste characterisation assessments
- Improved accuracy and reliability of the plastic waste data in the fisheries sector, especially ADLFG

[12] CRFM 2020 Annual Statistics CRFM 2020 Annual Statistics; the 3 countries account for 11% of the CRFM Member States commercial fishing fleet in 2019.
[13] Lovell 2022
[14] WTO Annual Statistics; the 3 countries account for 6% of tourist arrivals in the region in 2019
[15] Will vary according to the policies of each country, for example, cruise ships do not offload waste in Grenada therefore the sectoral contribution will be 0%.
[16] World Bank Statistics; the 3 countries account for 1% of the Caribbean region population in 2019.
[17] APWC 2019. Waste Data Report for Belize
[18] Millette et al 2019; Elgie et al 2021

- Research into plastics and agriculture, its sources and impacts[19]
- Material flow analysis for plastic (whole life cycle) in most countries

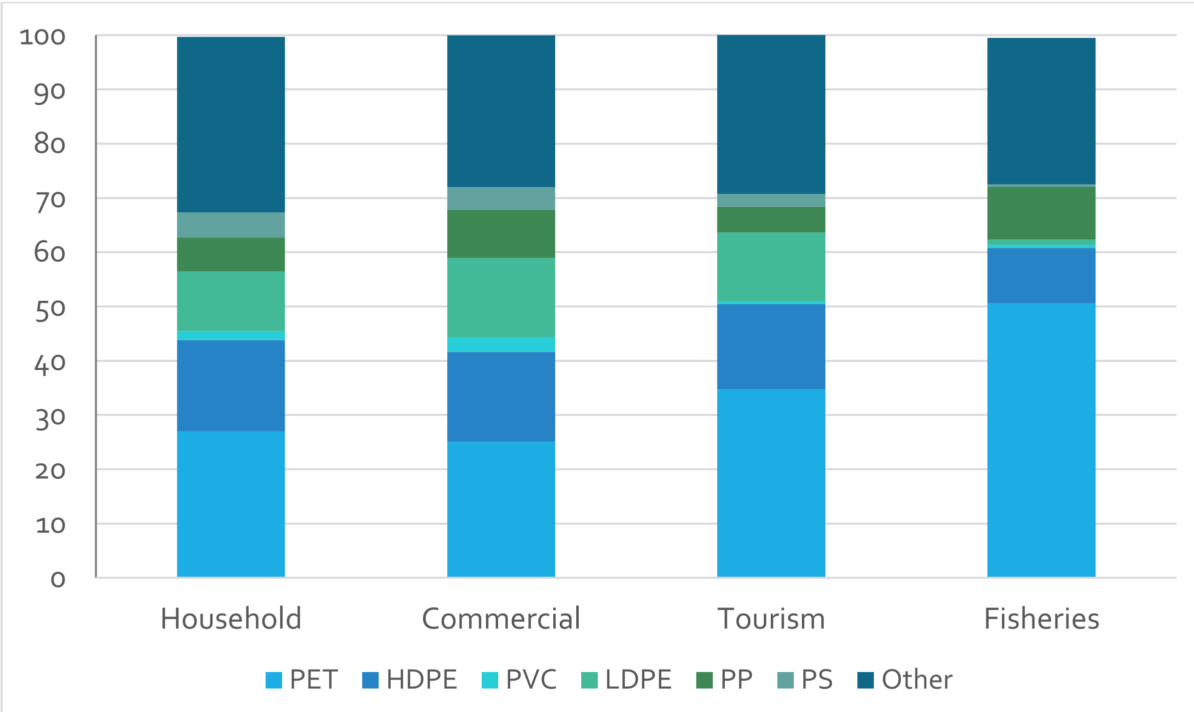

Figure 1: Average plastic waste disposal by plastic polymer type, per sector in Antigua and Barbuda, Grenada and Saint Lucia (Source: APWC 2021. Plastic Waste National Level Quantification and Sectorial Material Flow Analysis in Saint Lucia, Grenada and Antigua and Barbuda 2021)

[19] Refer to FAO 2021 Assessment of Agricultural Plastics and their Sustainability and UNEP 2021 Plastics in Agriculture

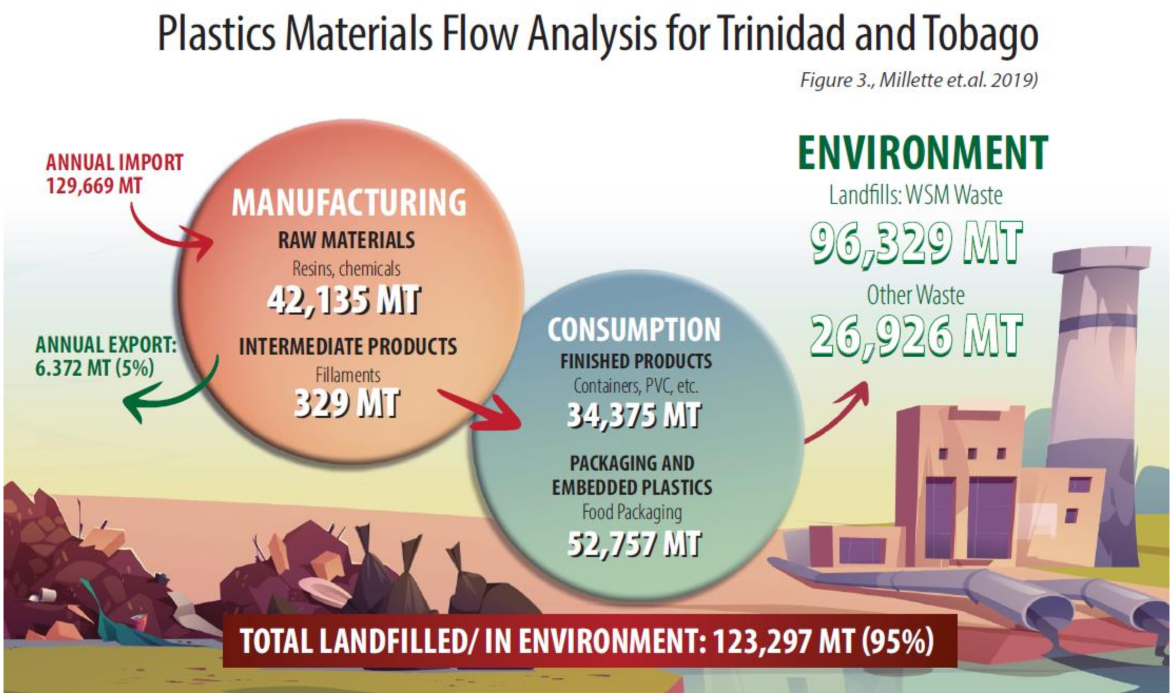

Figure 2: Plastic Materials Flow Analysis for Trinidad and Tobago (Source: Millette et al 2019)

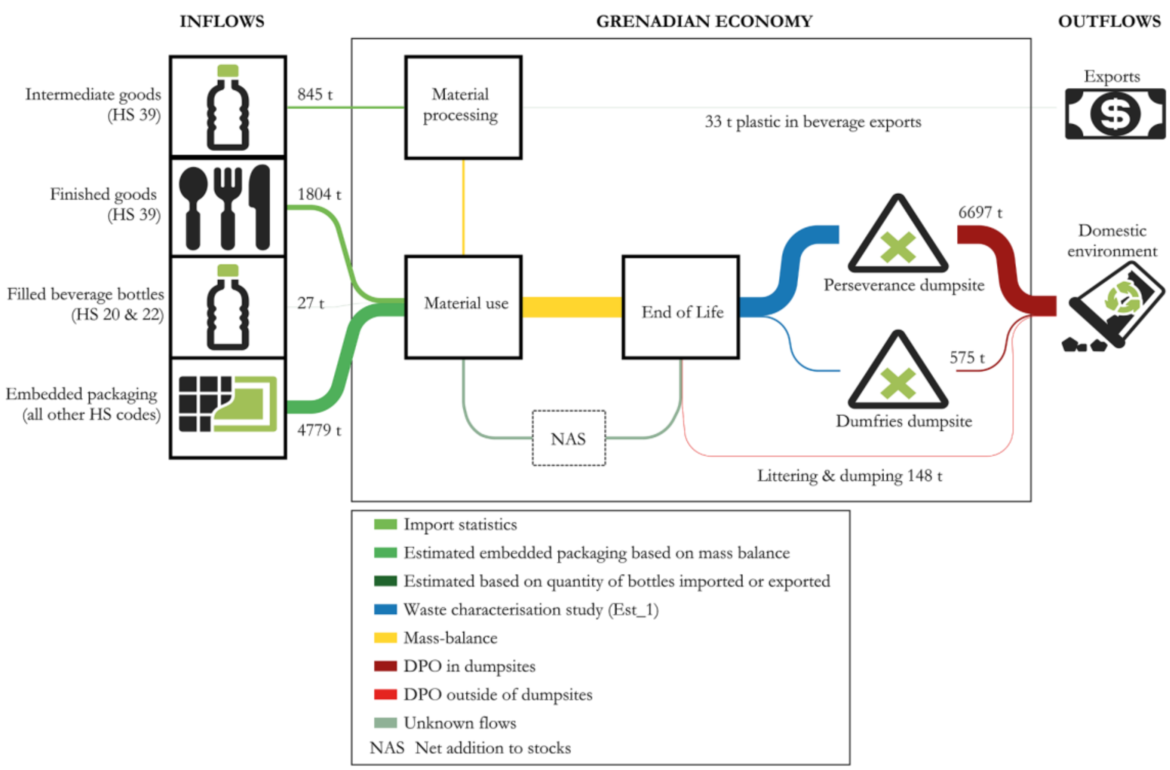

Figure 3: Plastics Material Flow Analysis for Grenada (Source: Elgie et al 2021)

Transportation Pathways

Global context

The transport of mismanaged plastic waste is highly complex and influenced by natural and human-driven dynamics. Globally, the pathways along which mismanaged plastic waste are transported into the environment can be simplified[20] as:

1. Sources to terrestrial systems – disposed of on land
2. Lands to the seas – riverine transport
3. Within the open ocean – coastlines to oceans, sediment, and bioturbation[21]
4. Atmospheric – dry and wet depositions

While much attention has been given to plastic wastes entering the marine environment, it is estimated that 1/3 of all plastic wastes[22] ends up in soils or freshwater systems and that microplastic contamination on land might be 4-23-fold larger than in the marine aquatic environment [23].

Caribbean context

In the Caribbean, data exists for transportation pathways within two environments – land (consisting of sources to terrestrial systems and lands to the seas pathways) and sea (within the open ocean pathway). Due to the absence of regional data for atmospheric deposition, it is not further considered.

Regional mass flow estimate[24] for mismanaged plastic wastes transported via land-based pathways into the terrestrial environment is 1.1 Mt/year. The main pathways to land are from dumpsites (0.461 Mt/year), from open burning (0.353 Mt/year), terrestrial leakage (0.176 Mt/year), leakage to rivers (0.078 Mt/year), and litter (0.041 Mt/year). The movement of the mismanaged waste after it enters the Caribbean terrestrial environment, i.e. its retention, remobilisation, etc. has not been studied to date.

There are four sea-based transportation pathways for plastic waste to enter environment. They are:

- Caribbean Sea: plastic leakage from maritime activities within coastal and territorial waters around the Caribbean countries is an issue but is not substantially quantified except for the fisheries sector which was considered in the national quantification studies[25] for the 3 countries mentioned in the section on Sources. The Caribbean Sea is also a source of plastic pollution to the North Atlantic subtropical gyre since plastic particles from practically the entire Caribbean chain of islands were identified as potential origins for plastics found near the centre of the gyre, with estimated transport times of 180 – 540 days, depending on the Caribbean country[26]. This suggests a transportation loop between the Caribbean Sea and the gyre (see next bullet point).

[20] Su et al 2022
[21] Bioturbation refers to the disturbance of sediment by moving organisms which can cause the mixing of plastic particles deeper into the sediment
[22] De Souza Machado et al 2018
[23] Horton et al 2017
[24] Estimated Caribbean percentage of global data derived from Brooks et al 2020 ; Global data based on OECD 2021
[25] National quantifications of plastics flow including audits were recently conducted in Antigua and Barbuda, Grenada and Saint Lucia by APWC (Plastic Waste-Free Island Project: Plastic Waste National Level Quantification and Sectorial Material Flow Analysis in Saint Lucia, Grenada and Antigua and Barbuda 2021).
[26] Courtene-Jones et al 2022

- North Atlantic Ocean: Modelled simulations[27], surface water sampling[28] and chemical analyses[29] of samples showed plastics enters the Caribbean region from the coasts of southern Europe, Northwest Africa, and Canada via the North Atlantic Ocean. These preliminary studies indicate that, on average, plastics from the northwest African coast takes the shortest time (est. 0.5-1yr), followed by southern Europe (est. 1.5-2yrs) and then North America (mostly Canada) (est. >3yrs). The archipelagic countries appear to be mostly impacted, especially those along the curve, from Saint Lucia to The Bahamas. Overall, these plastic particles can take from as little as half a year to more than 4 years from their sources to reach the region or they may be incorporated in the subtropical gyre which then leaks a steady stream of plastics towards the Caribbean over time.

- Eastern South American rivers: freshwater from the Amazon and Orinoco rivers (and other smaller rivers) discharges into the Atlantic Ocean and is propagated by the North Brazilian Current along the South American coast where it enters the Caribbean Sea between Grenada and the continent's mainland and becomes the main branch of the Caribbean Current[30]. These South American rivers' freshwater plumes influence almost the entire region, all the way northward to Florida[31]. It takes about 4-6 months for the Amazon plume to reach the Caribbean[32], usually arriving between May to September. This is a significant pathway since approximately 4.8% of global river plastic input originates from South America (all rivers), with the Amazon responsible for an estimated annual input of 38,900 tones/year including moderate to high levels of microplastics[33], and smaller but significant input from the Orinoco River (>2,000 t/per year)[34].

- Wider Caribbean Region: rivers from Central and South America transport significant quantities of plastics each year into the Caribbean Sea, particularly those from Honduras, Guatemala and Colombia[35]. Preliminary studies indicate the transport of plastics was confined to the western Caribbean Sea and did not appear to extend greatly into the northern and eastern areas of the Sea. Over the years they may indirectly reach the Caribbean when leaked from the north Atlantic gyre.

Key Knowledge Gaps for the Caribbean

- Identification (through research) of the priority pathways in the Caribbean, at national and regional levels.
- Understanding of the land based transportation pathways, from source to terrestrial environment and from lands to sea (via water courses). This should consider the topography, land use, vegetation etc. in the region[36].
- Better understanding of the inputs from all sea-based sources: quantities, composition of plastics (polymer types, additives etc), regional distribution patterns, long-term movement, consideration of the entire water column (surface, mid and bottom).

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[27] Courtene-Jones et al 2022 ; Lachmann et al 2017
[28] Courtene-Jones et al 2021
[29] Davranche et al 2020
[30] Cherubin & Richardson 2007
[31] Seijo-Ellis et al 2023
[32] Johns et al 2014 ; Grodsky et al 2015; Schmidt et al 2019
[33] Quieroz et al 2022
[34] Lebreton et al 2017. Note, the predictions are modelled on only 30 records from 13 rivers.
[35] Lebreton et al 2017; Finska et al 2018; Kikaki et al 2020
[36] Refer to global research of plastics in rivers, Nyberg et al 2023; van Emmerick et al 2022

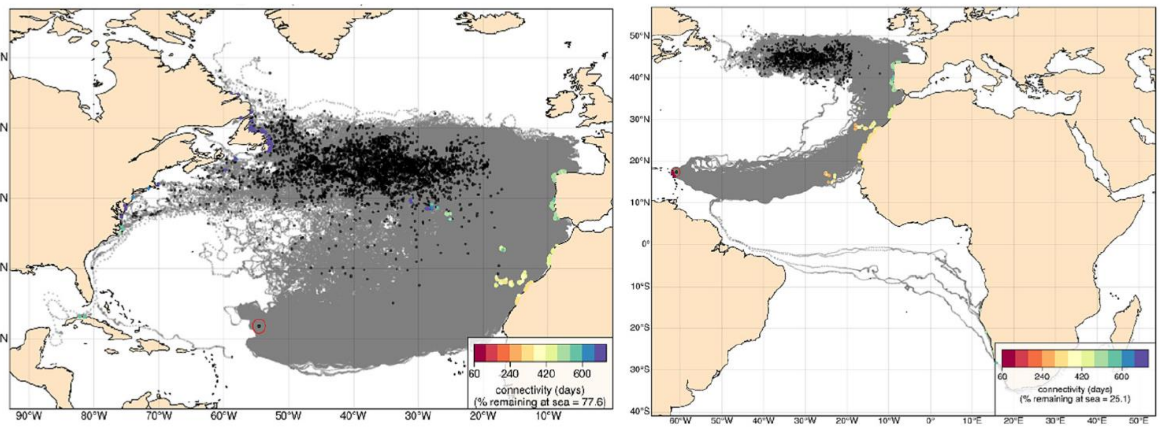

Figure 4: Modelled origin of plastic particles based on surficial water sampling data (red circles). The black dots represent particles that were not tracked back to land within 2 years (Source: [Courtene-Jones 2022](#))

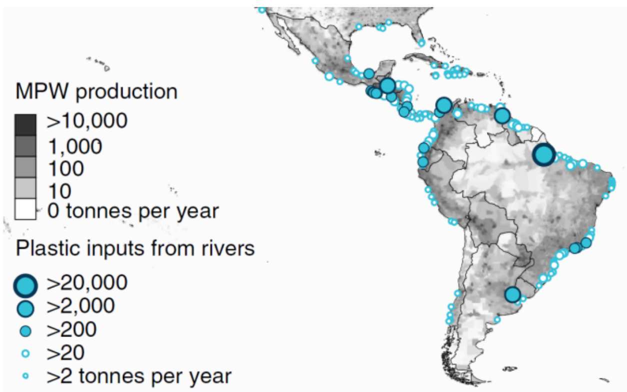

Figure 5: Mass of river plastics flowing into the ocean, focussing on Central and South America (Source: [Lebreton et al 2017](#))

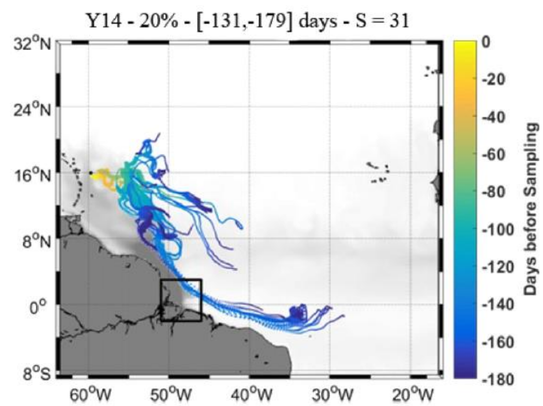

Figure 6: Modelled water mass backward trajectories for Lesser Antilles sampling point (Source: [Schmidt et al (2019)](#))

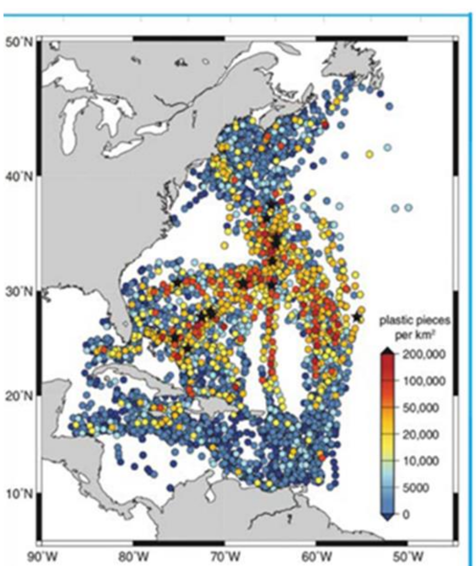

Figure 7: Plastic densities in marine waters across the Caribbean (Source: [Diez et al 2019](#))

Impacts

Global Context

Plastic pollution negatively impacts human health, the environment, social and economic sectors. An information document[37] to support the INC negotiations neatly summarises the evidentiary impacts on these four sectors. There are also some recent key publications which delve deeper into key areas of impacts like human health[38] and climate change[39] and on specific topics such as hazardous chemicals[40].

The assessment of the impacts of plastic pollution is complex because it is influenced by many factors – particle size (macro, micro, nano), lifecycle stage of release, chemicals additives and within the surrounding environment, polymer type and makeup, environmental conditions (sunlight, wave action etc.), and exposure pathways.

Caribbean context

To date, research on the impacts of plastic pollution in the region focussed on its presence in the physical environment, presence in biota, chemical contamination, and the economy. Table 1 compiles the regional research data according to the study country, sampling medium, the key findings and the data source. A summary of the research data is given below.

The majority of the research focused on the marine environment. In relation to its presence in the physical environment, plastic pollution was ubiquitous, found on coastlines, near and offshore waters, near and deep-sea sediments, and riverine sediments. Based on the limited datasets, the densities are similar to global data.

The research also demonstrated evidence of the presence of plastics in many organisms in the Caribbean marine ecosystem – seagrass, marine fish, corals, oysters, queen conch and seabirds. There is also evidence of related chemical pollution (Persistent Organic Pollutants (POPs) and Organophosphate ester (OPEs)) arising from primary and secondary plastics from land-based and long-range sea-based transport.

A preliminary economic assessment in 3 countries indicated there is a negative toll on the revenue from the fisheries and tourism sectors from plastic pollution. In the case of the fisheries sector, it was due to dumped catch, net repairs, fouling incidents and time lost clearing nets. For tourism it arose from the need to conduct beach clean ups and decrease in visitors who are deterred by the plastic-ridden beaches.

Key Knowledge Gaps for the Caribbean

- Continued and wider research on the impacts to the regional marine ecosystem by expanding and diversifying the species studied across all trophic levels
- Impacts to the region's terrestrial ecosystems especially soil physico-chemisty, terrestrial food webs, growth reduction and toxicity[41]
- Environmental and human health risks associated with chemicals making up or adsorbed onto plastic
- Economic and trade impact on GDP and important revenue sectors
- Economic and social costs to human health
- Cost of inaction

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[37] UNEP/PP/INC.1/7 - Plastic Science
[38] Minderoo-Monaco commission on plastic waste and human health (2023)
[39] Forde et al 2023
[40] UNEP 2023. Chemicals in Plastics
[41] Refer to de Souza Machado et al 2018

Table 1: Research to assess impacts of plastic pollution in the Caribbean

Country	Sampling Medium	Finding	Source
Presence			
Jamaica	Surface seawater	Microplastics concentrations in Kingston harbour: 0-5.73 particles/m^3. Composition: fragments (86%), fibres (13%), foam (0.92%) and beads (0.31%). PE and PP dominated the fragments.	Rose & Webber (2019)
Aruba, Bonaire and Curacao	Deepsea sediment	Marine litter density: 0.27 objects per $100m^2$ and macroplastics accounted for 28%. The highest accumulations were at 300-600m on shallow sloping sand and silt bottoms. The findings were elevated compared to deepwater debris studies from elsewhere, ascribed in part, to the bathymetry around volcanic islands (deep water depths close to shore).	Debrot et al (2014)
The Bahamas	Sandy beaches	Microplastic concentrations: 667 MP/dw kg. Relatively high MP value[42].	Fernander and Welsh-Unwala (2021)
	Beaches	Plastics accounted for 93% of all debris. Most commonly collected plastics were fragments of <2.5cm (69%) followed by fishing gear and plastic bags and film (8% each). Higher densities of debris were found on the Atlantic Coast beaches.	Ambrose et al (2019)
	Surface seawater	Density of floating plastics at Exuma Sound: 22,500-125,000 pieces/km^2. This is comparable with the Atlantic Ocean.	Moore et al (2015)
Lesser Antilles (Anguilla, St. Barts, St. Eustatius and St. Martin	Sandy beaches	Microplastic concentrations: 68-620 MP/ dw kg; average: 261 MP/dw kg. Overwhelming majority were fibres (97%). Relatively high MP value[43]. No difference between windward and leeward coasts.	Bosker et al (2018)

[42] Mesquita et al 2022
[43] Ibid

Aruba	Sandy beaches	Macroplastic debris density: 0.12 – 0.89 debris/m^2 at 10 study sites. Higher levels of meso- and macroplastics were found on windward beaches compared to leeward beaches which suggests local land-based and distal sea-based sources.	De Scisciolo et al (2016)
Belize	Coastal	Macroplastics accounted for 58 – 85% all marine debris found at 4 coastal sites.	Bennett-Martin et al (2016)
	Coastal	Macroplastics accounted for 68% of all marine debris found at 7 study sites across the southern cayes.	Blanke et al (2021)
	Riverine sediments, city and vegetated coasts.	Plastics accounted for 74% of all debris at all sites. The most common category was unidentifiable plastic pieces (fragments). There was an increasing litter load from catchment to coast. Fishing gear occurrence was similar to Pacific countries and much lower than European countries. Microplastics were detected at all 4 sample sites along the Belize River, concentrations from 200 – 6500 particles/ dw kg. This is a similar order of magnitude to concentrations reported in large Amazon Rivers.	Silburn et al (2022)
Antigua and Barbuda, Bonaire and Aruba	Surface sea water, Sub-surface (25m) sea water, Seabed sediment	Surface sea water: low-density polymers (polyethylene (PE), followed by polypropylene (PP)) dominated the samples. Inshore waters showed high variability in their polymer compositions and on average contained numerically higher quantities of microplastics than open ocean samples. Subsurface sea water: Across all the countries, the quantities of synthetic microplastics were two orders of magnitude greater in subsurface water samples (33 MP/m^3) than in surface waters (0.40 ± 1.21 MP/m^3). Microplastics concentration in sediment: 0.05-0.11 MP/g (Antigua and Barbuda) and 0.13 MP/g (Aruba). Polypropylene was in highest abundance. Discoloured plastic pellets (0.01 pellets/m^3) were found in surface water samples around Antigua and Barbuda suggesting long range transport.	Courtene-Jones et al (2022) and (2021)
Trinidad and Tobago	Sediment – wetlands	Analysis of a sediment core sample showed microplastics found in all layers dating back to 1982. The highest concentration was in 1987.	IMA (2022)

Biota			
Belize	Riverine red head cichlid (*Cichlasoma Synspilum*)	Microplastics were detected in 36% of fish samples (n=22) with an average abundance of 0.7 items/fish (lower than other reported data). PE and cellophane were the most common polymer.	Silburn et al (2022)
	Seagrass (*Thalassia testudinum*)	Microplastics were found on the surfaces of 75% of the leaves (n=16), with a composition of microfibres (81%), microbeads (16%) and plastic chips (3%).	Goss et al (2018)
Grenada	Demersal, semi- and pelagic fish	Microplastics were found in 98% of the fish guts (n=42) of which 97% contained fibres and 29% contained film pieces.	Morrall et al (2018)
St. Eustatius	Red-billed Tropicbird *Phaethon aethereus*	Regurgitate revealed plastic ingestion by the red-billed tropicbird, a seabird with a wide distribution the Caribbean, particularly from Tobago northwards to BVI.	Madden & Eggermont (2020)
Guadeloupe	Oysters (*Isognomon alatus*)	Toxicity responses in oysters (commonly found in Caribbean mangroves) were triggered when exposed to nanoplastics combined with arsenic (laboratory study). Demonstrated relevance of using NPs from environmental sources in toxicity studies.	Arini et al (2022)
The Bahamas	Fish: King mackerel, mahi mahi, wahoo, yellow fin tuna	Plastics were found in 19% of the fish stomachs (n=64), in mahi mahi, wahoo and yellow fin tuna. Average number of plastics were 0 – 2.4 pieces/fish. Microplastics dominated (83-100%).	Moore et al (2015)
Wider Caribbean Sea (Belize, Barbados and Guadeloupe)	Queen conch	Overall, 100% detection of microplastics in queen conch samples (n=175, 11 sites). Average concentration in the region: 136±77 MP/organism. At sites in Caribbean countries, Belize (270) (highest abundance), Barbados (~160) and Guadeloupe (~75). Average composition: 79% fibres, 11% films and 10% spheres.	Aldana Aranda et al (2022)
Wider Caribbean Sea (Panama)	Caribbean scleractinian coral	Laboratory experiments demonstrated corals (*Monstastraea cavernosa* and *Orbicella faveolata)* ingested microplastics and egested most within 48h. No demonstrable impact on calcification.	Hankins et al (2020)
Chemical			

Guadeloupe	Chlordecone on microplastics along the coast	Microplastics were found at all 12 coastal sampling sites, the distribution suggests local land based and sea-based sources. Evidence of chlordecone contamination adsorbed on microplastics from marine sediments suggesting another pathway of transfer of the chemical into marine trophic food-webs. Chlordecone is a Persistent Organic Pollutant pesticide, used extensively on the island between 1972-1993.	Sandre et al (2019)
Jamaica	PCBs and BUVs on plastic pellets	PCB concentration was 27 ng/g-pellet and considered lightly polluted. BUVs concentrations: the 2nd highest BUV concentration among 23 countries (value not given).	Karlsson et al (2021) (IPEN)
Lesser Antilles	Organic plastic additives in sea water: Organophosphate ester (OPE), bisphenols and perfluorinated compounds	Total OPE concentrations: 106 ng L^{-1} and 74 ng L^{-1} (lowest among the 14 stations from Lesser Antilles to west coast of Africa). Bisphenols and Perfluorinated compounds were not detected at the 2 stations. Contaminant levels at sampling points and modelling of water masses strongly suggest that the Amazon River could be a major source of contaminants to the Atlantic Ocean.	Schmidt et al (2019)
Economic			
Antigua and Barbuda, Saint Lucia and Grenada	Fisheries	Estimated 3.7-9.2% reduction in fisheries revenue in 2019 (dumped catch, net repairs, fouling incidents, time lost clearing nets). This equated to US $308,781 – $ 1,428,980.	Mittermpergher et al (2022), Raes et al (2022a,b) IUCN Plastic Waste Free Islands
	Tourism	For beach-going tourism countries, there is a higher than global average impact value (tourists not willing to visit due to plastic on beaches). A very rough estimation (likely an overestimation) puts the potential loss equivalent to 32 – 61% of GDP. Coastal clean-up costs (to avoid loss of visitors) were roughly estimated to be US$ 431,913 – $4,762,590. This is also likely an overestimation as it considers cleaning up of every plastic item from all coasts.	

Solutions Underway

Global Context

Within the past few years significant reports were published on how to address various dimensions of plastics pollution. Some key ones are:

- **Turning off the Tap**[44] focussed on the economic solutions/models and concluded that systems changes/shifts are needed in 3 areas, reuse, recycle and reorient and diversity.
- **Plastic Pollution: The pressing case for natural and environmentally friendly substitutes to plastics**[45] that considered sustainable and effective substitutes and alternatives through the lens of trade and economic viability.
- **Pathways out of Plastic Pollution: where is the value chain**[46] focussed on policies to implement along the plastic value chain to move toward a circular model.
- **Breaking the Plastic Wave**[47] evaluated possible scenarios for tackling ocean plastic pollution and their related economic, environmental and social implications.

More recently, global efforts are directed towards the development of an international legally binding instrument on plastic pollution which addresses the full life cycle of plastics[48]. The anticipated instrument is expected to be completed and approved by end of 2024.

Caribbean Context

In the Caribbean, several solutions are currently being implemented to manage plastic pollution via regional and national strategies and action plans, plastics substitutes and alternatives, deposit refund schemes, energy recovery and certification and information awareness campaigns.

Given the economic profile of the region, import dependency and with low manufacturing capacity, most of the interventions are occurring at the mid- and downstream stages of the plastic lifecycle.

An overview of the different solutions implemented in the Caribbean region is given in Table 2.

Key Knowledge Gaps for the Caribbean

- Effectiveness assessment of the implemented solutions
- Identification and feasibility assessments of regional solutions especially at the downstream stage
- Identification and assessment of interventions at the midstream stage, including meaningful engagement by the manufacturing and distribution sectors
- Understanding of the upstream stage in the Caribbean
- Assessment of potential microplastic pollution from plastic waste collection and recycling facilities[49]
- Study on solutions to manage non-recyclable and hazardous plastic waste fractions.
- Feasibility assessment of environmentally and economically viable plastics substitutes and alternatives, including local supply chains.

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[44] UNEP 2023. Turning off the Tap
[45] UNCTAD 2023. Plastic Pollution and Alternatives and Substitutes
[46] World Bank 2022. Pathways out of Plastic Pollution
[47] Pew Charitable Trusts and SystemIQ 2020. Breaking the Plastic Wave
[48] UNEP Plastic Treaty website
[49] Refer to studies by Brown et al 2023 and Suzuki et al 2022

Table 2: Solutions currently implemented to combat plastic pollution in the Caribbean region

Solution	Example of Application
Legal and Economic Instruments	
Bans on single use plastics (with exemptions)	14 countries
Environmental tax on imported plastics (specified)	Grenada and St. Vincent and the Grenadines
No (0%) imported tariff on biodegradable products (specified)	Saint Lucia and Dominica
Standard on biodegradable products (labelling and specification)	Belize
Strategies and Action Plans specifically focussed on plastic management	
Marine Litter: • Harmonised marine litter monitoring for the WCR – Action Plan 2021 • Regional Marine Litter Management Strategy for the Wider Caribbean Region • Regional Action Plan to prevent ADLFG • National Marine Litter Management Action Plans – Saint Lucia (2022) and Belize (2019)	 GPML Ali et al 2021 Ghost Gear Project Saint Lucia and Belize
Recycling Policy	Trinidad and Tobago
Recycling	
Converting plastic waste into various products using machines from plasticpreneur and Precious Plastics. Products include flowerpots, benches, combs etc.	e.g WI Sail Heritage Foundation, Full Circle Belize, Hope Town Assoc.
Conversion of plastic waste into plastic lumber	e.g A3 Cooperative Cuba, Flying Tree (TT)
Conversion of plastic waste generated by the banana production process into raw material for the recycling industry	ABP of Azua Valley (Dominican Republic)
Conversion of plastic waste into tools to be used by persons with disabilities community	National Centre for Persons with Disabilities (TT)
Plastic centres where locals can exchange plastic waste for money, goods or services. Plastics are recycled and sold as Social Plastic to companies for manufacturing	Haiti
Post industrial plastic wastes (rejected bottles) repurposed by filling with a safe product (liquid hand soap) or converted to plants pots for container agriculture	Flying Tree Environmental Management and plastic bottle producer

Sequestration of waste plastics into concrete blocks by replacing much of the aggregate with plastic chips. Products include benches, highway dividers, pavers, pots and construction of walls and flooring	e.g. Flying Tree Environmental Management
Material Recovery Facilities (MRFs)	e.g Barbados
Collection, baling and or granulating and then exporting.	e.g AMRECO, EMA , B's Recycling , AWBREC , All Islands Recycling , RePLAST project
Regional or sub-regional approach for plastic collection and recycling	Recycle OECS project with pilot projects in Dominica and Grenada
Reuse	
Reusable food service containers for takeaway	Saint Lucia (PWFI)
Plastic Substitutes and Alternatives	
Packaging - beeswax, banana leaves, newspaper etc.	e.g ARCTT Trinidad and Tobago , SureSur
Utensils – edible utensils, biodegradable	e.g CGCC, BAMBUSA
Bioplastics – including sargassum, sweet potato	JA Bioplastic, Kelpy & SOS Carbon, UWI e.g Mohammed et al 2023, Bovell 2019
Deposit Refund Schemes	
Schemes driven by national legislation	e.g Barbados, Grenada, St. Vincent and the Grenadines
Schemes driven by voluntary initiatives and reliant on voluntary contributions from the manufacturers involved.	e.g Every Bottle Back TT, Recycle Partners of Jamaica
Energy Recovery	
Waste as Fuel	Saint Lucia (implemented), St. Kitts and Nevis and Barbados (discussion)
Co-processing as alternative fuel in cement kilns – legacy wastes (including plastics) with option to discuss other sources of feedstock	Trinidad and Tobago (MOU)
Prevention of plastic waste from entering the ocean	

Barrier technology at the mouth of rivers and harbours to collect plastic waste	Ocean Cleanup Jamaica
Certification Initiatives and Information, Education and Communication Campaigns	
Green Globe certification for hotels	92 hotels across the region
Global Plastic Tourism Initiative by UNEP, UNTWO and the Ellen MacArthur Foundation	Across the region
Tide Turners	GEF ISLANDS Project
National Campaigns focussed on plastics	Jamaica
Community and NGO Campaigns focussed on awareness and behavioural change	Multiple across the region, largely driven or seeded by GEF SGP funding
Recommendations from Scientific Literature	
1. Banning of PS is a more feasible strategy than attempting to recycle due to small percentage generated as waste. 2. PET recycling is sufficient to justify domestic recycling facility based on the supply of PET. The feasibility depends either on the expansion of domestic PET use or export of excess PET feedstock. 3. LDPE in co-processing in the cement kiln. Estimated, based on MFA, LDPE can substitute 19% of the energy requirements.	Millette et al 2019 MFA of plastics in Trinidad and Tobago
Plug gaps in Environmental Levy – for example the import of empty plastic bottles and plastic preforms should be charged the same levy currently charged on imported beverage products	Elgie et al 2021 MFA of solid waste (including plastics) for Grenada
Improvements to the legal, regulatory and policy framework for the management of ALDFG together with targeted research to inform the policy decisions.	Lovell 2022. Managing ALDFG in the Eastern Caribbean

Conclusion

This report presents a useful synthesis of existing literature on the sources, quantities, transportation pathways, impacts and solutions to support the Caribbean Member States at the INC negotiations for the international legal binding instrument addressing plastic pollution.

Even with modest availability of datasets compared to rest of the world, there were some important takeaways:

- The Caribbean's contribution to globally mismanaged waste is estimated to be very low (1.4%)
- Managing plastic packaging waste is a high priority for the region.
- There is already a good foundation with waste characterisation assessments and material flow analyses to refine the region's understanding of sources and quantities generated. As more of these are undertaken in across the region, it will be prudent to standardise the approach and methodology to enable the roll up of the data to a regional level and comparability.
- As many as 5 different geographic regions contribute to plastic pollution in the Caribbean, signalling the need for international support.
- Scientific research revealed plastic particles have infiltrated practically all aspects of the Caribbean ecosystem, however, not enough is known about the extent and ecological and health impacts.
- The region has been proactive in seeking solutions to manage plastic waste. There is however a need to assess the effectiveness of these solutions, consider the entire plastic lifecycle and align interventions to the direction of the global plastic treaty to best leverage financing and technical assistance.
- The science-policy bridge needs to be enhanced to create an entrenched interface platform which increases the effectiveness of exchange of information to drive relevant research and innovation to support national and regional policy development and implementation.

Annex 1 – Other Useful Information

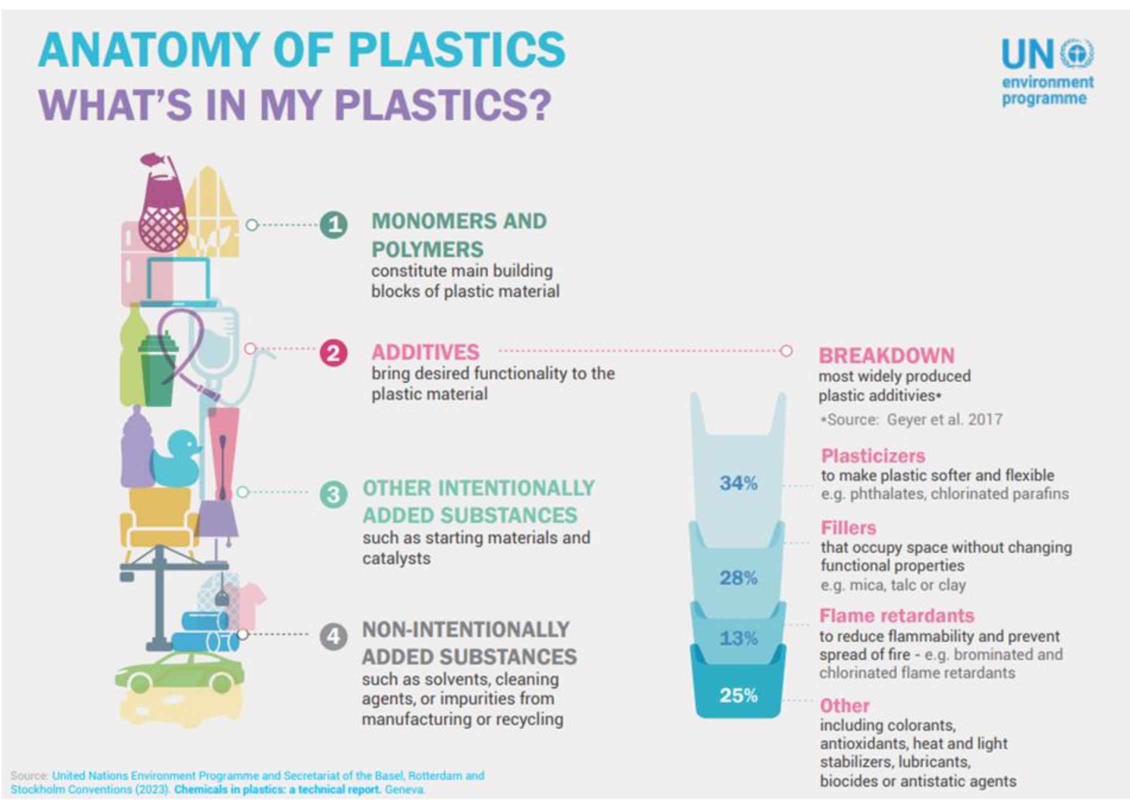
Glossary of terms used in the report and at the INC negotiations.

Additive	Chemical compounds added during plastic compounding (the process of mixing or blending polymers and additives in a molten state) to fulfil specific desired functional properties in the production process or in the final plastic product.
Downstream Activities	Involve end-of-life management – including segregation, collection, sorting, recycling and disposal
Fisheries sector	Consists of domestic and international fishing vessels
Household and Commercial Sector	Consists of households and commercial businesses including supermarkets, stores, administration/office, food and retail outlets.
Leakage	Materials that do not follow an intended pathway and 'escape' or are otherwise lost to the system
Microplastics	Refers to plastic particles <5 mm in diameter.
Midstream Activities	Involve the design, manufacture, packaging, distribution, use (and reuse) and maintenance of plastic products and services
Mismanaged	The combined quantities of inadequate (waste that is not managed in a controlled setting, cannot be accounted for and is usually part of other (often informal) methods such as open dumping, burning, or burying) and littered fractions of waste.
Monomer	Molecules that can undergo polymerization, thereby contributing constitutional units to the essential structure of a macromolecule
Nanoplastics	Refers to plastic particles <1 µm in diameter
Plastic Alternatives	Can include bioplastics (bio-based polymers materials) or biodegradable (the end of life of plastics, indicating that they biodegrade in the natural environment, or that they can be composted) plastics
Plastic Substitutes	Natural materials from mineral, plant, animal, marine or forestry origin that have similar properties to plastics. They do not include fossil fuel-based or synthetic polymers, bioplastics, and biodegradable plastics
Polymer	Natural or synthetic long-chain substances consisting of sequences of one or more types of monomers. They form the backbone of a plastic material
Recyclable	If its main packaging components, together representing more than 95 per cent of the entire packaging weight meets the requirements that post-consumer collection, sorting and recycling is proven to work in practice and at scale
Secondary plastics	Small particle pieces that have resulted from the fragmentation and weathering of larger plastic items
Thermoplast	Can be softened repeatedly by heating and then hardened by cooling, thus allowing reshaping
Thermoset	Plastics that change their chemical nature once heated and cannot subsequently be remelted or reshaped
Tourism sector	Consists of land-based tourism activities (accommodation including hotels, resorts, bed, and breakfast), air-based tourism (airlines and airports) and water-based tourism (cruise ships and yachts).
Upstream Activities	Include obtaining the raw materials from crude oil, natural gas or recycled and renewable feedstock (e.g. biomass) and polymerization

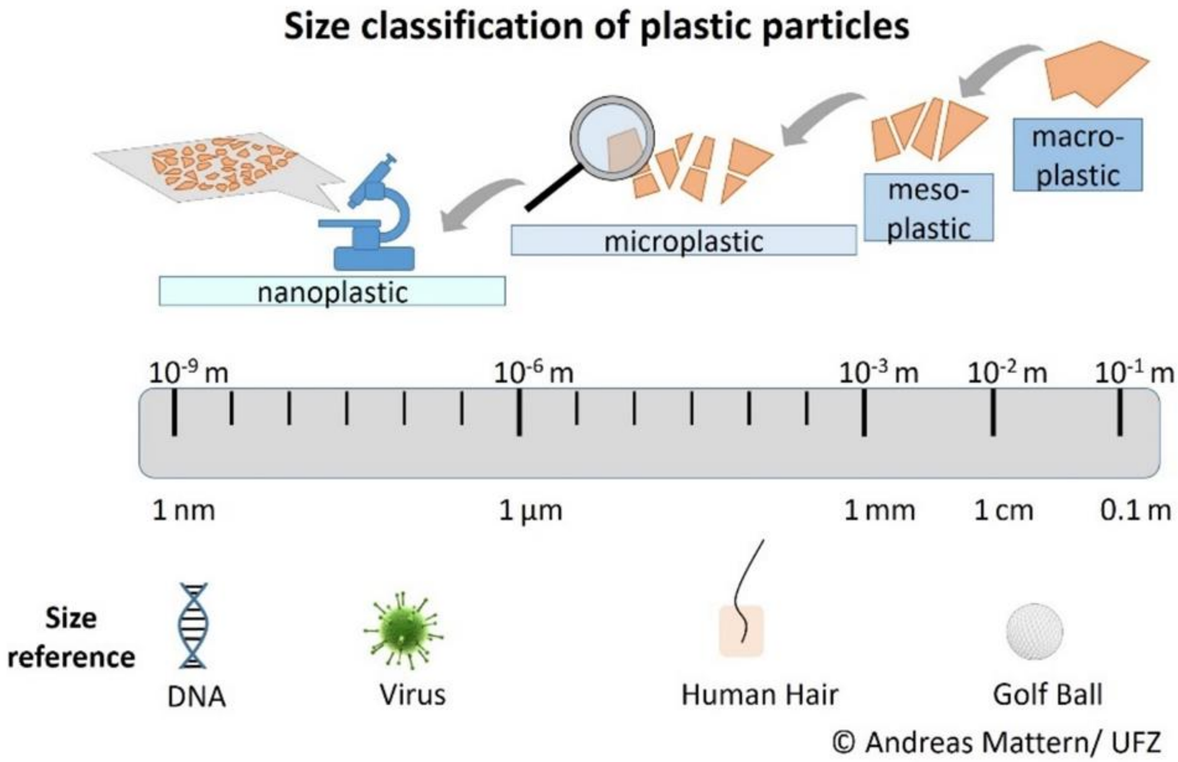
Illustrations of some key concepts related to the management of plastic pollution

Polymer name	Polyethylene terephthalate	High-density polyethylene	Polyvinyl chloride	Low-density polyethylene, Linear low-density polyethylene	Polypropylene	Polystyrene	Other, such as acrylic, nylon, polycarbonate, and polylactic acid and multilayer combinations of different plastics
Resin Identification Code	1	2	3	4	5	6	7
Abbreviation	PETE or PET	HDPE or PE-HD	PVC or V	LDPE or PE-LD	PP	PS	O
General recyclability	Commonly recycled	Commonly recycled	Sometimes recycled	Sometimes recycled	Sometimes recycled	Sometimes recycled	Rarely recycled
Use examples	Water and soft drink bottles, plastic lumber applications, headlight lenses, and safety shields	Detergent bottles, grocery bags, milk jugs, recycling bins, agricultural pipe	Pipe, window profile, siding, fencing, flooring, shower curtains, lawn chairs, nonfood bottles, children's toys, wrapping	Plastic bags, various containers, dispensing bottles, tubing, wrapping	Yogurt containers, sachets, auto parts, industrial fibers, furniture, luggage	Cafeteria trays, plastic utensils, coffee cup lids, toys, videocassettes and cases, expanded polystyrene foam products (e.g., Styrofoam™)	Baby bottles, plastic lumber applications, headlight lenses, and safety shields/glasses

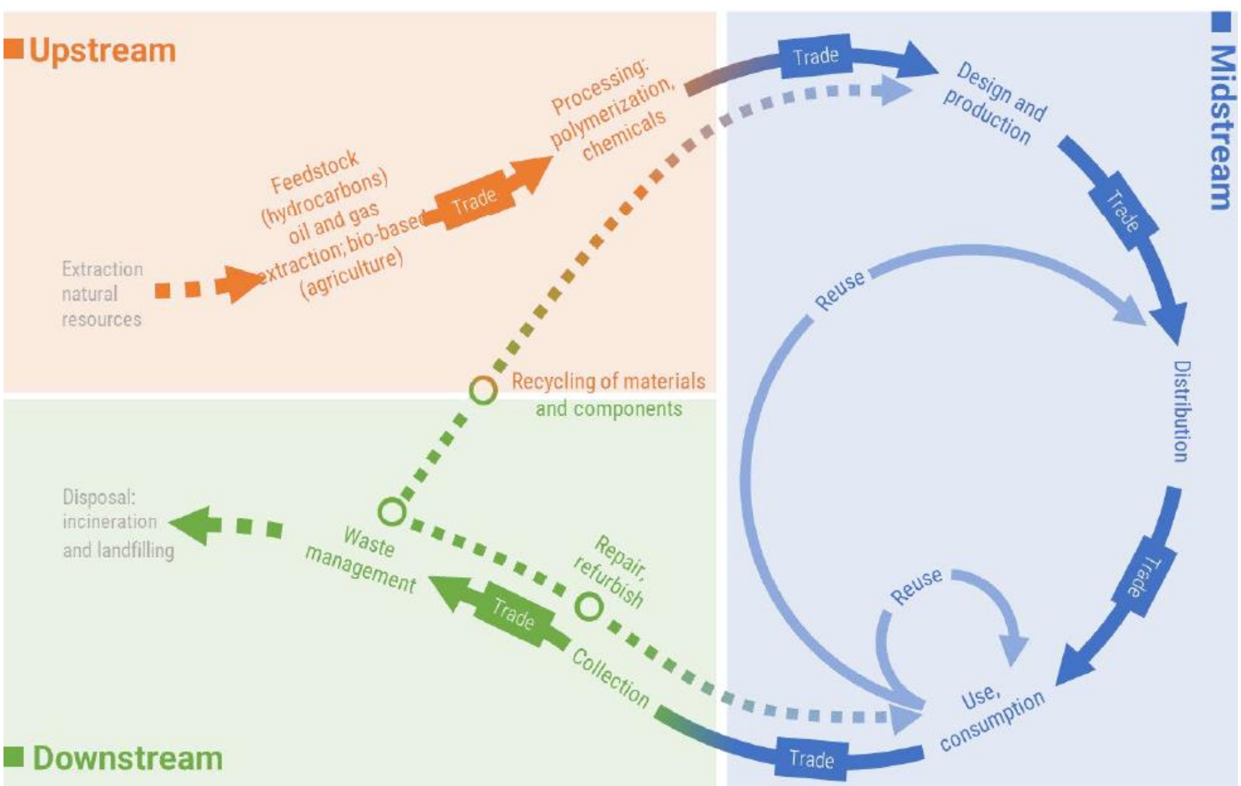
Source: Visualstan



Source: UNEP 2023. Chemicals in Plastics



Source: [Andreas Mattern/UFZ]



Source: [UNEP 2023. Plastic Science]