

SECTION 1 – METHODOLOGY

1. OVERALL GEOGRAPHIC SCOPE

This study focuses on the research on and efforts developed to combat pollution from marine plastic debris (interchangeably designated as marine plastic litter or marine plastics) in Asia. In this context, the overall geographic scope has been determined so as to include the states, intergovernmental processes, initiatives and programmes involved with marine plastics in Southeast Asia (SEA) and East Asia. As shown in Diagram 1 below, the most inclusive and focused group is the Association of Southeast Asian Nations Plus Three (ASEAN+3), which consists of countries of the Coordinating Body on the Seas of East Asia (COBSEA) and of the ASEAN. They are three formally-established intergovernmental bodies in the region that have taken strong positions on combatting pollution from marine debris. COBSEA and the ASEAN have also adopted action plans and specific measures to combat pollution from marine plastics. They either focus on SEA or include a focus on SEA as one of their main geographic areas of interest. Southeast Asia is at the centre of this study due to the region being identified in a number of publications as a major source or hotspot of marine plastic debris globally.

ASEAN+3 includes Brunei Darussalam (Brunei or BRN), Cambodia (KHM), the People's Republic of China (China or CHN), Indonesia (IDN), Japan (JPN), the Republic of Korea (RO Korea, or ROK), Lao People's Democratic Republic (LAO), Malaysia (MYS), Myanmar (MMR), the Philippines (PHL), Singapore (SGP), Thailand (THA), and Viet Nam (Vietnam or VNM). In the research review, research in the ASEAN member states are reviewed prior to the additional three states. This allows for an easier analysis of ASEAN states as a group, an important unit in intergovernmental dynamics.

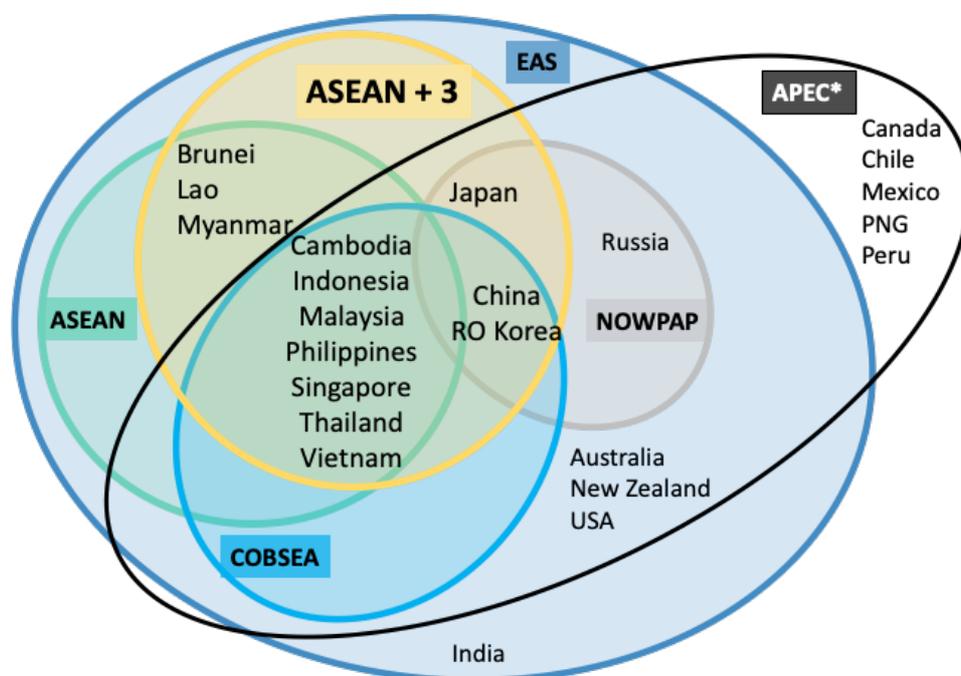


Diagram 1. Graphical representation of participation of states from ASEAN+3 in other intergovernmental organisations APEC, ASEAN, COBSEA, EAS and NOWPAP

* indicates that two economies are not mentioned in the diagram (not states recognised by the UN)

Other relevant intergovernmental bodies with a wider geographic focus are also included in Diagram 1 above. These are: the Asia-Pacific Economic Cooperation (APEC), the East Asia Summit (EAS) and the Northwest Pacific Action Plan (NOWPAP). Given that these intergovernmental processes also involve the ASEAN and COBSEA states, the research conducted by APEC, the EAS and NOWPAP is also covered in this report, especially their declarations and action plans on marine plastic debris. However, research conducted in states that compose these organisations and are not included in ASEAN and COBSEA are not covered in this study. The methodology adopted for the selection of these institutions and analysis of their work is detailed in section 3 below.

2. SCIENTIFIC RESEARCH

The following analytical framework has been employed to conduct the literature review of scientific research relating to pollution from marine plastics in ASEAN+3. The analysis of the status of research on marine plastic pollution in each country is divided into four parts:

- (i) context;
- (ii) research review;
- (iii) main players; and
- (iv) summary of understanding.

The methodology of (i) and (ii) is set out below.

2.1 Approach to background context

To provide useful background information to the issue of pollution from marine plastics in each country, this section is divided into the three sub-sections set out in the table below.

Table 1.1.2.1. Sub-sections included in the background context of each ASEAN+3 state.

Sub-section title		Aim
1	National approach to plastic waste and its management	Waste management strategy applicable to plastic waste and new trends in tackling the issue. This includes the treatment of municipal solid waste, sorting, recycling capacity, etc.
2	Plastics as a proportion of solid waste	Solid waste produced and proportion of plastics within
3	Illegal trade of plastic waste	Review of past and present state of trade of plastic scrap/waste in the country and of any reported illegal trading of plastic waste

Sub-section 3 on the illegal trade of plastic waste was added to this study as this topic has been raised in Southeast Asia, especially following China's 2018 'National Sword Policy' ban of plastic waste (HS 3195) imports. As a whole, ASEAN experienced a sharp 171% spike of plastic waste imports from 837,000 tonnes in 2016 to over 2 million tonnes in 2018 (Trademap, 2019 from Greenpeace, 2019). The majority of plastic waste exports originated from higher income countries such as the European Union (EU) and the United States of America (USA). Reports indicate that the lower income countries of Southeast Asia could be exploited as recipient countries because they lack transparent and

standardised trade procedures, such as a Prior Informed Consent (PIC) Procedure. Varying interpretations of plastic waste versus plastic scrap also allow for potential misdeclaration that can be exploited by criminal organisations (2018 World Bank report by Kaza et al., 2018).

2.2 Review of scientific research in each country

For each ASEAN+3 state, scientific publications (in English) on pollution from marine plastic research from the last decade have been reviewed and analysed prior to being included in the inventory available in [Appendix VI](#). This review focused on articles in marine plastics research and its related topics. Articles on plastic research which have no links to the marine environment were not focused on. These include research areas such as polymer design and development (i.e. material sciences), biodegradability of new plastics, plastic waste management, etc. Given their importance to the discussion of development of the circular economy, consideration may be given to the opportunity of including the more generic body of plastic research in a new version of the inventory established for this study.

Articles reviewed for the previous report are also included with updates since its publication in May 2019 until February 2020. Of special note, only English language publications were reviewed for China, and the review was limited to articles published from 2015 to 2019 due to the timeframe of this study and the large number of publications found in China. The decision to select 2015 as the start date for inclusion of studies in this report was based on the authors' observation that 90-95% of the articles were published from 2015 onwards. This timeframe is therefore expected to better reflect current trends in marine plastics research in China. Unfortunately, for the same reason of time constraints, publications from Taiwan were not included. However, the research inventory will be open for updates so that missing publications can be included from this and other included countries. This inventory has been designed as a living shared repository open to updates from research in ASEAN+3.

In order to analyse the scientific research publications, this study adopted a comprehensive set of 23 research foci within the overall research area of pollution from marine plastics, a comparative analytical framework, and a set of criteria and definitions for the database inventory.

2.2.1 Research foci and research clusters

The 23 research foci used for this study are listed as in Table 1.1.2.2 below. They were determined on the basis of existing areas of research, issues raised in scientific literature and those raised by intergovernmental bodies with a mandate on pollution from marine plastics. Of note, the research foci used in the NUS 2019 report on the status of research on marine plastics in the ASEAN were reviewed and extended to include additional areas of research that have become more prevalent in international discussions and/or are important research areas in China, Japan and RO Korea (such as contaminants associated with marine plastics).

Table 1.1.2.2. List and definition of the 23 research foci used for analysis in this study.

No.	Research foci	Definition
1	Laws, administrative measures	Research that discusses (current or prospective) marine plastic laws, non-regulatory measures and policies to manage pollution from marine plastics. This includes discussions on action plans.
2	Guidelines and standards	Research that discusses applicable or prospective guidelines or standards to manage production, use, re-use, recycling and disposal of plastic products as well as sampling and monitoring for marine plastic litter.
3	Research framework and coordination	Research that discusses or investigates governance regimes, efforts to coordinate research between different research fields and other coordination mechanisms involving other relevant stakeholders to respond to pollution from marine plastics.
4	Upstream research/waste management	Research on sources of marine plastics prior to leakages to the marine environment, typically focused on waste management. This may also include studies of raw plastic production, polymer-specific uses and applications.
5	Methodology for marine plastic clean-up	Research that discusses different approaches, techniques and protocols for the clean-up of marine plastic including with respect to technologies available, assessment protocols and units of measure.
6	Survey and monitoring/pollution status	Research on the types of surveys/monitoring programmes to determine the amount of marine plastics in any environ. These serve as a first step to assessing the status of marine plastic pollution. This category of research typically involves the quantification and identification of either macro-, meso- and microplastic types. The resolution of these research is varied, as it is dependent on the objective of and conditions for the assessment. For example, a high resolution of the information may be gathered from scientific sampling of microplastics on coastal sediment surface, while a lower resolution of the amount of marine plastic debris (e.g., number of items and type) may be collected through citizen science beach clean-up programmes which also support outreach and education. The latter research is also typically reported in grey literature.
7	Methodology for the monitoring and assessment of marine litter	Research that discusses methodologies and technologies employed for surveying and/or monitoring and assessing the state of marine litter in specific environs, or comparing different methodologies.
8	Accumulation zones and hotspots	Research that discusses, establishes protocols for and seeks to identify areas where marine plastic accumulates and may be considered as hotspots of marine plastics or priority areas for marine plastic clean-up and research. This research topic often involves data mining surveys and monitoring programmes of marine plastics, investigation of sources and the generation of a hotspot map through numerical modelling (including sources, transport, sinks and fate).
9	Movement of plastics in water bodies	Research that discusses monitoring, assessing, and/or measuring movement of plastic debris in rivers or oceans. This may involve field surveys, monitoring programmes of marine plastics, and predictive modelling of transport of marine plastic debris. The resulting information shows where marine plastic debris from land- or sea-locations may end up and involves the modelling of transport and behaviour of passive particles and/or active particles (i.e. with pre- defined behaviour which may be based on expected fragmentation rate).
10	Source differentiation	Research that discusses sources of marine plastics designed to provide tracing of their origin and potential mismanagement of plastic waste resulting in leakage into the marine environment. This may include sources of marine plastics from the riverine system, runoffs due to flooding, aquaculture, fisheries activities (ALDFGs), etc.
11	Contribution from rivers	Research that discusses leakages of marine plastics into riverine systems, transport through them, and pathways to the marine environment. This may involve discussions of potentially necessary river-basin management strategies, though this report focuses on downstream imports from rivers.
12	Discharge from offshore infrastructures and shipping	Research that discusses plastic waste that is, or may be, generated from shipping, offshore installations including mining installations and aquaculture farms.
13	Contribution from fisheries/abandoned, lost or otherwise	Research that discusses abandoned, lost or otherwise discarded fishing gear (ALDFG), including "ghost gear" or "derelict fishing gear", condition for abandonment, contribution to marine plastics, and response strategies. Research indicates that ALDFG would have

No.	Research foci	Definition
	discarded fishing gear (ALDFG)	accounted for close to half of the surface plastic waste of the Global Pacific Garbage Patch in 2015 (Lebreton et al., 2018) and up to 70% of the floating microplastic globally.
14	Fragmentation and degradation	Research that discusses the breakdown of marine plastics into smaller pieces (i.e. macroplastic to mesoplastic to microplastic). This includes studies examining the fragmentation and degradation of marine plastics (including polymer-specific) that may be driven by biochemical, physical, physicochemical, etc. processes.
15	Ecological and environmental impact	Research that elaborates on the impacts of marine plastics on marine organisms, their habitats, and the ecosystems they belong to. This Includes laboratory experiments as well as field work. Some studies can be opportunistic, due to events such as the beaching of large mammals or marine organisms, and subsequent examination of their gut contents. This category is divided further into the six sub-categories below (also in green).
(i)	Ingestion of plastic in the wild	Research that discusses the oral ingestion of plastic in the wild, through the digestive system of marine biota. Examination of this may be at any point along the digestive tract, including the gastrointestinal tract on a whole or specifically to the intestines and/or stomach.
(ii)	Branchial uptake of plastic in the wild	Research that discusses the branchial uptake of plastic in the wild, usually in reference to fish and its respiratory system of the gill organs and involve examination of particulate of plastic trapped in the gills.
(iii)	Entanglement by plastics in the wild	Research that discusses the physical strangulation or entanglement of marine organisms by plastic debris.
(iv)	Changes in microbial assemblages	Research that discusses microbial presence on microplastics, in different environs and associated with different polymers and possible linkages to fragmentation.
(v)	Experimental studies of physicochemical impacts	Research that is performed under laboratory setting to examine impacts of plastics in marine biota with various physicochemical pathways. This includes research on the toxicity of certain polymers or associated contaminants on the survivability, growth, development or other life functions of a particular marine biota taken at different life stages.
(vi)	Trophic transfer of plastics	Research that discusses the possible transfer of plastics from one trophic level to the next, resulting in a possible bio-accumulation of marine plastic and/or its associated contaminants.
16	Socio-economic impact	Research that discusses the impacts of marine plastics on human society of a societal or economic nature. This category is divided further into the two following sub-categories.
(i)	Human health/ food safety	Research that discusses impacts of marine debris on human health. This includes the sampling of plastics in marine-derived products like seafood and salt, or potential toxic chemicals in food packaging that are also found discarded in the marine environment.
(ii)	Economic loss	Research that seeks to quantitatively assess economic losses due to plastic pollution, for instance loss of tourism, costs to maritime operations through entanglement in propellers and costs of marine plastic clean-up.
17	Social perceptions	Research that investigate perceptions by the public of marine plastic pollution and the management of plastic waste. This includes studies on public awareness, perceived effectiveness of marine debris policies, behavioural studies, or willingness-to-pay studies.
18	Public outreach/beach clean-up	Research that discusses efforts of public outreach and/or beach clean-up, which refers to the engagement of public citizens in the collection of data on marine debris (plastic).
19	Contaminants associated with marine plastics	Research that examines marine plastics as a pathway for contamination by external contaminants other than polymers themselves. Associated contaminants may either be (i) additives that are added in the manufacturing of the plastic or (ii) sorbed contaminants which attach-detach to the surface of the plastic. For the purpose of this report and the research inventory, this category is further divided into the three following sub-categories.
(i)	Organic and inorganic pollutants from marine plastic debris	Research that discusses the presence/absence of plastic contaminants in marine plastic debris, either organic (i.e. plastic polymers or plastic additives) or inorganic contaminants (i.e. heavy metals).
(ii)	Adsorption-Desorption of chemicals/pollutants	Research that discusses the adsorption and/or desorption of contaminants, either organic (i.e. plastic polymers or plastic additives) or inorganic contaminants (i.e. heavy metals), on marine plastics. This includes studies conducted both in the field and laboratory experiments to understand how plastics interact with external chemicals and/or pollutants.

No.	Research foci	Definition
(iii)	Plastics as transport vector/medium	Research that discusses the way in which floating particles of plastics (of any size) can be carriers of organisms and/or contaminants that get transported over long distances and new habitats or organisms. This includes the possibility of marine plastic acting as a potential vector for introducing invasive species into a new environment.
20	Port reception facilities	Research that investigates the need, adequacy and characteristics of infrastructure available to receive waste generated from inbound vessels at ports.
21	Fibreglass-reinforced plastic vessels	Research that investigates current and prospective contributions of abandoned plastic-reinforced fibreglass vessels to marine plastic pollution
22	Hull scraping and marine coating	Research that investigates the contribution of hull scraping and marine coating to marine plastic pollution
23	Language and cultural barriers/data accessibility	Research that focuses on social and cultural behaviours, and barriers to accessibility of education and outreach on marine plastic pollution and response strategies

2.2.2 Structure of each countries' scientific research review

The review of scientific research undertaken for each country follows the same enquiry and structure which is set out in Table 1.1.2.3 below.

Table 1.1.2.3. Sub-sections included in the research review of pollution from marine plastics in each of the ASEAN+3.

Sub-section		Aim
1	Research review of pollution from marine plastics	<ul style="list-style-type: none"> • Total number of scientific publications reviewed • Any temporal trends in publications • Geographic coverage of these studies • Total number of research foci examined and its distribution
	<i>Research overview</i>	<ul style="list-style-type: none"> • Total number of research conducted for each plastic type (i.e. micro-/macro-/both micro- and macro- plastics) • Emphasis (if any) on any plastic type • General type of studies conducted for each plastic type • Examination into plastic contaminants (if any)
	<i>Types of research conducted</i>	<p>Coverage of marine environs</p> <ul style="list-style-type: none"> • Total number of research conducted for each marine environ (i.e. shoreline/seafloor/marine biota/sea surface) • Emphasis (if any) on any marine environ
	<i>Survey and monitoring</i>	<ul style="list-style-type: none"> • Type of micro-/macro- plastics studies in different marine environ and its relevant scientific publications • Mentions of interesting scientific publications (if any) • Examination into the possible level of maturity and advancement of the country's micro-/macro-plastics research: <ul style="list-style-type: none"> <u>Microplastics</u> <ul style="list-style-type: none"> ○ If microplastics studied are of a consensus definition (i.e. less than 5mm) ○ If microplastics were examined for their polymer types, if so, reports: <ol style="list-style-type: none"> (i) Total number of studies that conducted polymer-level examination (ii) Polymer types found in the natural environment and the common ones ○ If microplastics were examined into finer structures of films and fibres <u>Macroplastics</u> <ul style="list-style-type: none"> ○ If macroplastics were examined into functional types (i.e. packaging/building and construction/textiles/consumer products/transportation/electrical/fishing gears/others) • Examination into the consistency of methodology practiced

		<ul style="list-style-type: none"> ○ If methodologies of sampling were consistent ○ If measurement of quantifications were consistent or comparable
	Source differentiation and pathways	<ul style="list-style-type: none"> ● Examination on the source/differentiation/leakage of marine plastics ● Examination on marine plastics as a potential pathway/medium/vector in transporting contaminants in the natural environment, such as the examination of (a) plastic polymers itself as a contaminant (b) plastic additives in plastic (added in the manufacturing of the plastic) (c) plastic-sorbed contaminants on the surface of the plastic, and if so, reports: <ul style="list-style-type: none"> ○ The specific polymer type(s) examined – identity of polymer and if the specific polymer type examined is one of the common polymer types found across the relevant studies in the country ○ The specific plastic-associated contaminant(s) examined
	Movement of plastics, accumulation and hotspots	<ul style="list-style-type: none"> ● Examination into the movement of plastic in the natural environment, either through modelling or simulation experiments, if so, reports: <ul style="list-style-type: none"> ○ The specific polymer type(s) examined – including whether it is one of the common polymer types in use or found in surveys ● Examination into the possible accumulation zones and hotspots of marine plastic, possibly as a result of the use of models and simulation experiments
	Ecological and environmental impacts	<ul style="list-style-type: none"> ● Examination into the impacts of marine plastic on the marine biota/ecosystem/ecology, if so, reports: <ul style="list-style-type: none"> ○ Type of impact posed by marine plastic (i.e. ingestion of plastic in the wild/branchial uptake of plastic in the wild/entanglement by plastic in the wild/changes in microbial assemblages/experimental studies of physicochemical impacts/trophic transfer of plastic) ○ Type of marine biota examined (i.e. wild or cultured species or those of commercial importance and value)
	Abandoned, lost or otherwise discarded fishing gear	<ul style="list-style-type: none"> ● Examination into ALDFG, if so reports: <ul style="list-style-type: none"> ○ Type of ALDFG study examined (i.e. quantifying/identifying presence-absence of ALDFG/ALDFG and related fishing management practices/ALDFG and its impacts)
	Social perceptions and socio-economic impact	<ul style="list-style-type: none"> ● Examination into the social perceptions of people, usually the locals living in the vicinity of the research study area, if so reports: <ul style="list-style-type: none"> ○ Type of social perception study examined (i.e. on the public awareness of people on the issue of marine plastic pollution/willingness to partake in mitigating marine plastic pollution/viewpoint on individual responsibility on marine plastic pollution) ● Examination into the socio-economic impact posed by marine plastics, if so reports: <ul style="list-style-type: none"> ○ Type of impact examined (i.e. human health and food safety/economic loss)
2	Main players	<ul style="list-style-type: none"> ● Composition of research efforts seen in the marine plastics research scene, either from local efforts or non-local efforts ● Identify and highlight prominent players in the marine plastics research field of the country and their institutions ● Where information is available, include current experts with relevant plastic research expertise
3	Summary of understanding	<ul style="list-style-type: none"> ● Breadth and depth of research foci, marine environs) ● What research area(s) has(ve) been conducted – is that sufficient? ● How advanced research is – smaller forms of plastics, polymer types, contaminants tests ● Study on impacts – what is present and what is missing ● Geographic coverage ● Sources (land-based or sea-based) - Leakage into the natural environment ● Modelling ● ALDFG

2.2.3 Database inventory: criteria and definitions

The 371 scientific articles which have been reviewed in this study are included in the inventory database which is available online. The extraction and tabulation of information from each of the scientific publications is done according to Table 1.1.2.4 below.

Table 1.1.2.4. List of criteria and definitions used to categorise research papers and reports on marine plastics.

Criteria	Sub-criteria	Defined for this study as
Year Published		This reflects the year that the article was published or produced.
Country		This describes the main institution carrying out the research, based on corresponding author (peer-reviewed papers) / if unavailable, lead author (non-peer-reviewed papers).
Research Group(s)		This describes all of the institutional affiliations of researchers.
Source of Funding		This reflects the source(s) of funding supporting the research.
Aim of Research		To briefly define purpose of study.
Period of Study		This usually reflects the time of sampling (i.e. dates, months, or years).
Methodologies Used		A set of keywords have been selected to describe the methodologies used by studies.
	Review (literature/ social media)	-
	Monitoring	Visual survey
	Quantification	-
	Identification	-
	Sampling	Transect sampling; Quadrat sampling; Sediment sampling; Sediment grab sampling; Auger core sampling; Net tow sampling; Ekman trawl sampling; Bongo trawl sampling; Manta trawl sampling; Bottom trawl sampling; Neuston net sampling; Mesh plankton net sampling; Net fish sampling; Gillnet fish sampling; Local fisherman sampling; Local fishery market sampling; Coral fragment sampling; Plankton pump sampling; <i>In situ</i> filtration; Microplastics purchase
	Simulation model	Hydrodynamic modelling; Particle tracking modelling
	Laboratory experimental work (Sorption of pollutants/chemicals)	Sorption experiment; Batch equilibrium method; Sorption amount calculation; Sorption modelling; Pollutant chemical analysis; Brunner-Emmet-Teller surface area analysis; Chromatography; Liquid chromatography; Gas chromatography; Dynamic light scattering analysis
	Laboratory experimental work (Toxicity of plastic on development in marine biota life stages)	Leaching experiments; Clam spawning induction; Toxicity exposure experiments; Larvae physiological assessment (rates of hatching, developmental, malformation, metamorphosis, ...)
	Laboratory experimental work (Heavy metal analysis)	Atomic fluorescence spectroscopy; Inductively coupled plasma mass spectrometry; Biota-sediment accumulation factor calculation
	Plastics extraction/preparation	Sonication extraction; Solvent extraction; Chemical digestion; Flotation extraction; Modified flotation method; Filtration; Dissection and analysis (gut/stomach/etc); Density separation; Soxhlet extraction; Microplastics irradiation aging
	Plastics characterisation, identification, quantification	Sieve-shaking sediment size analysis; NOAA analysis; Visual characterisation; Stereomicroscopy characterisation; fluorescence microscopy characterisation; SEM characterisation; X-ray diffractometre surface area analysis; Barrett-Joyner-Halenda (BJH) pore size analysis; Dissecting microscopy characterisation; Transmission electron microscopy analysis; Laser scanning microscopy analysis; FTIR spectroscopy polymer analysis; ATR-FTIR spectroscopy polymer analysis; μ -FTIR spectroscopy polymer analysis; GC-MS polymer analysis; Energy-dispersive spectroscopy polymer analysis; ATR-Lumos (Bruker) microscopy polymer analysis;

	Mass spectroscopy; Raman spectroscopy polymer analysis; Fluorescence labelling; Isotope labelling; Abundance calculation
<i>Social perceptions</i>	Questionnaire; Interview
<i>Type of Plastics Examined</i>	This describes the types and classifications of plastics examined. Keywords used are microplastics only, macroplastics only, microplastics and macroplastics. The types of plastic polymers also listed here, if information is available.
<i>Geographic Location of Work</i>	This describes where the research was carried out, if <i>in situ</i> . For <i>ex situ</i> studies, indicate as 'Laboratory' for those doing experimental studies.
<i>Marine Environs</i>	This describes the types of environment where plastics were found and/or studied. These include biological environs (i.e. marine biota), and non-biological environs (i.e. shoreline, seafloor, sediments).
<i>Key findings</i>	This describes key findings of the study.
<i>Source of Plastics</i>	This describes the potential sources of plastics, which include land-based, sea-based, rivers, and specific locations.
<i>Peer-reviewed Output</i>	To cite the full reference.
<i>Link to source</i>	Insert weblink to peer-reviewed output.
<i>Non peer-reviewed Output</i>	To cite the full reference.
<i>Link to source</i>	Insert weblink to non peer-reviewed output.
<i>Categories of Research Topics</i>	This describes the research topics covered by article. See lines 37-69 below
	Laws, administrative measures
	Guidelines and standards
	Public outreach/ Beach clean-up
	Language and cultural barriers/ data accessibility
	Upstream research/ Waste management
	Research framework, coordination
	Surveys and monitoring/pollution status
	Methodology for the monitoring and assessment of marine litter
	Source differentiation
	Port reception facilities
	Fibreglass- reinforced plastic vessels
	Hull scraping and marine coating
	Discharge from offshore infrastructures (incl. aquaculture)
	Contribution from fisheries/ ALDFG
	Contribution from rivers
	Accumulation zones and hotspots
	Fragmentation and degradation
	Ecological and environmental impact
	>> <i>Ingestion of plastic in the wild</i>
	>> <i>Branchial uptake of plastic in the wild</i>
	>> <i>Entanglement by plastic in the wild</i>
	>> <i>Changes in microbial assemblages</i>
	>> <i>Experimental studies of physicochemical impacts</i>

	>> <i>Trophic transfer of plastics</i>
	Socio-economic impact
	>> <i>Human health/food safety</i>
	>> <i>Economic loss</i>
	Methodology for marine plastic clean-up
	Movement of plastics in water bodies
	Social perceptions
	Adsorption-Desorption of chemicals/pollutants
	Plastics as transport medium/vector
	Plastic additives (produced either by chemical, physical, leaching, etc... methods)
Checklist for Survey and Monitoring Protocols	These parameters were selected based on GESAMP (2019), so as to identify key areas for improvement to survey and monitoring protocols. See from Lines 71-77.
Types of macroplastics, according to uses	To list down all the macroplastics for common applications, for example, fishing gears, utensils, textiles, bottles, etc... It is useful to provide a description of items to identify types and sources of litter.
Types of plastic polymer	To list down all the mentioned polymers identified in the study, using their common abbreviations.
Size of microplastics defined as <5 mm	To indicate '0' or '1' if the study adheres to the definition of microplastics <5 mm. If not, to state otherwise.
Shape of plastics	To list down all mentioned shapes of microplastics/plastics identified in the study. The identification of these morphologies can provide some indication of potential sources, such as textiles or ropes for fibres, as well as their behaviour within an environmental compartment (e.g. beached versus sank).
Measure of abundance (number of pieces/density)	To list down the units of measure for abundance, in terms of counts or density.
Measure of abundance (weight/volume)	To list down the units of measure for abundance, in terms of weight or volume.
Status of degradation?	To indicate '0' or '1' if the study had examined the state of plastics collected.

3. RESEARCH IN INTERNATIONAL LAW, INTERGOVERNMENTAL ORGANISATIONS AND GOVERNANCE OF POLLUTION FROM MARINE PLASTIC

3.1 Structure

3.1.1 Identification of bodies, institutions, legal instruments, programmes and initiatives

This study provides an inventory of regionally-significant work streams undertaken to respond to pollution from marine plastics in the ASEAN+3 from four categories:

- (i) Global intergovernmental and/or institutional policy frameworks, guidelines and initiatives relevant to SEA;
- (ii) Regional intergovernmental and/or track 1.5 institutional mechanisms, programmes and projects;
- (iii) Funding organisations to ASEAN states; and
- (iv) Notable partnerships, non-institutional research programmes and public-private initiatives in the region.

The first two categories seek to provide a comprehensive and exhaustive account of the intergovernmental processes that are engaged in combatting pollution from marine plastics at global and regional levels. However, the content of the work is based on documents that are publicly-available. Of note, track 1.5 processes have also been included as they are a key process through which governments engage with influential stakeholders. They are also particularly utilised in SEA due to important reliance on external donors to support research in most ASEAN states. Examples of track 1.5 processes are the Partnership for the Environmental Management of the Seas of Southeast Asia (PEMSEA) and the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF).

By contrast, the third and fourth categories are comprehensive but not exhaustive as not all of the initiatives they include are publicly available. These categories therefore focus on the most visible and largest programmes and initiatives of regional significance; a number of extremely valuable initiatives could not be mentioned, and the selection provided may not be fully representative of the diversity of those that exist. It is hoped by the authors that this study can provide the basis for the development of a shared and more exhaustive regional inventory hosted in the region.

3.1.2 Substantive work reviewed

For each instrument, body, institution, programme or initiative the following components were analysed and reported in this report:

- Overview of establishment, mandates and members or participants;
- Relevant provisions, projects, initiatives or mechanisms to combatting pollution from marine plastics;
- Status of work.

The work conducted by these bodies and programmes has been reviewed and analysed on the basis of the authors' professional knowledge of these networks as invited experts, speakers or observers, complemented by further web-research on the most recent work completed by relevant organisations and institutions. This web-research includes political, legal, and grey literature, as well as websites. It is important to note that all reviewed materials were written in the English language. Additional review of the literature published in the language of each ASEAN+3 state would be necessary to gain a full picture of the research carried out nationally and regionally from their national perspective.

3.2 Comparative analysis

The 23 initial research foci used to categorise scientific research have also been used for to analyse the work of each body, programme or initiative. However, for the purpose of the analysis of their work, the grouping in 10 clusters which is appropriate to the analysis of scientific research did not provide sufficient granularity for analysis of the work of these bodies, programmes and initiatives.

Instead, the work of these bodies, programmes and initiatives has been grouped into the following 16 categories that are better adapted to policy and legal interventions:

1. Policy, laws, administrative measures, action plans and guidelines;
2. Upstream research, circular economy, waste management;
3. Methodology for monitoring of marine litter, surveys and monitoring, pollution status;
4. Accumulation zones and hotspots;
5. Contribution from rivers;
6. Source differentiation;
7. Discharge from offshore infrastructures;
8. Contribution from fisheries/lost and abandoned fishing gear (ALDFG);
9. Fragmentation and degradation;
10. Ecological and environmental impact;
11. Socio-economic impact;
12. Public outreach/bleach clean-up, social perception;
13. Organic/inorganic contaminants associated with marine plastics;
14. Port reception facilities;
15. Fibreglass-reinforced plastic vessels; and,
16. Hull scraping and marine coating.

This analytical framework is used to assess the breadth and depth of the work of the bodies on different aspects of pollution from marine plastics.

4. GAP ANALYSIS

The gap analysis seeks to examine the adequacy of research findings and ongoing research to meet the needs of policy bodies, as well as the adequacy of policies, mechanisms, programmes and initiatives at the regional level to respond to the findings from scientific research.

The gap analysis is divided into four parts. First, the gap analysis compares the regional framework of actions from the perspective of their (i) goals and objectives, (ii) actions and activities; and (iii) cooperation processes that are envisaged. To this effect, the provisions of COBSEA RAP MALI and that of ASEAN FAMAD are systematically compared. Second, it investigates the extent to which these two action plans seek to implement international law through express or implied reference to relevant provisions of international law. Third, the gap analysis examines the scientific research inventory and their findings in the context of the provisions of the two action plans. This is to determine whether they provide sufficient scientific data to support a science-based decision-making process for policy-making purposes to respond to pollution from marine plastics in ASEAN+3. The fourth part of the gap analysis examines domestic and regulatory approaches and obstacles on the basis of four UN reports on this topic. It draws lessons from these reports to inform the previous analysis. Overall findings from the research review and the gap analysis are discussed in [Part 2, Section 6](#).