

Marine Plastics Science in Countries of East Asian Seas

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Background on marine plastics in East Asian Seas

Marine plastics are defined as the synthetic or semi-synthetic polymers and associated additives that entered the ocean and the surrounding marine habitats. Given the various forms of plastics, they can be found across the depths of oceans: from the sea beds, water column, water surface, and along the coasts. The durability nature of plastics means that pollution brought about by marine plastics will persist in the environment leading to various challenges.

Seven of the 13 countries of the East Asian Seas are ranked in the top 20 among 192 coastal countries that mismanaged plastic waste in 2010 (Jambeck et al., 2010). Collectively, China, Indonesia, the Philippines, Thailand, and Viet Nam are considered to be responsible for more than half of the plastics entering the oceans (Ocean Conservancy, 2015).

The aim of the study is to provide an overview of marine plastics research in ASEAN +3. This includes a review of the current knowledge on pollution from marine plastics in the region, of the recent scientific outputs and of research interest in the topic by international and regional bodies and initiatives.

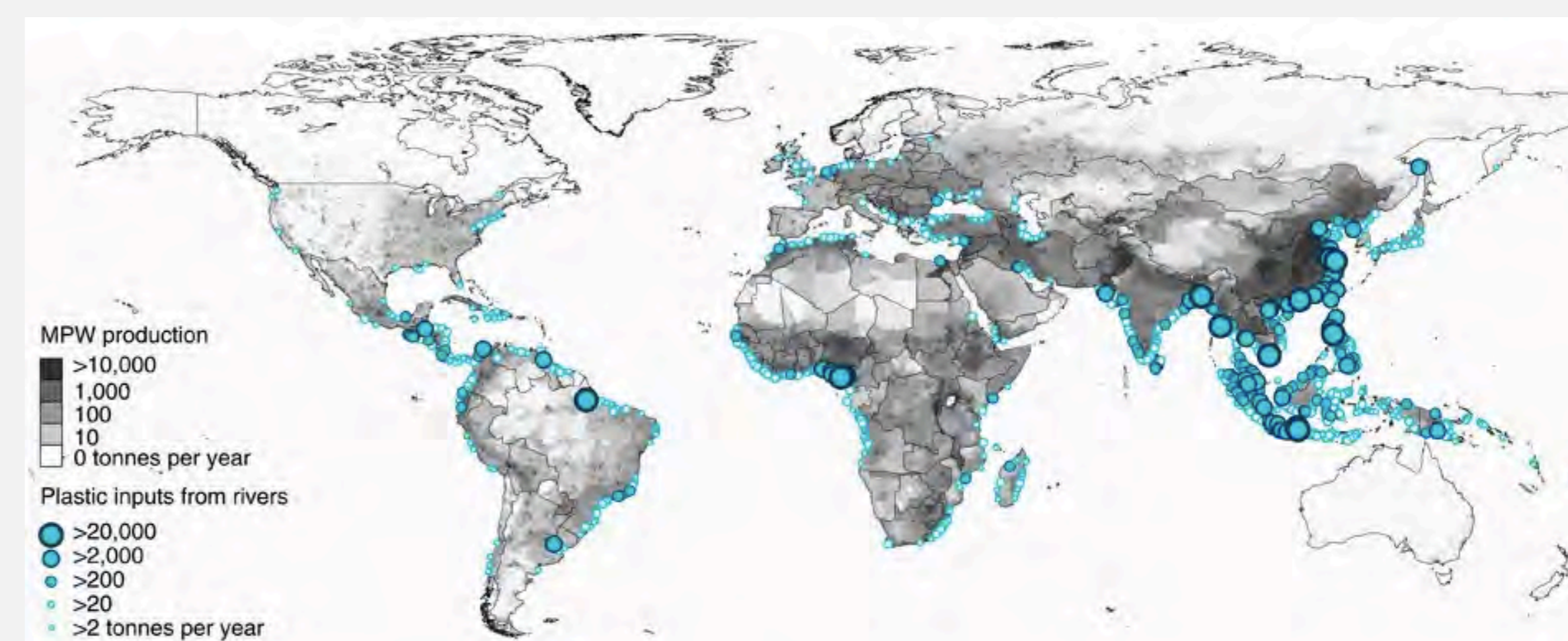


Figure 1. Marine plastic inputs from the riverine systems. MPW: mismanaged plastic waste. Source: Lebreton et al. (2017).

1: A Review of Research on Marine Plastics in Southeast Asia: Who does what?



Methodology

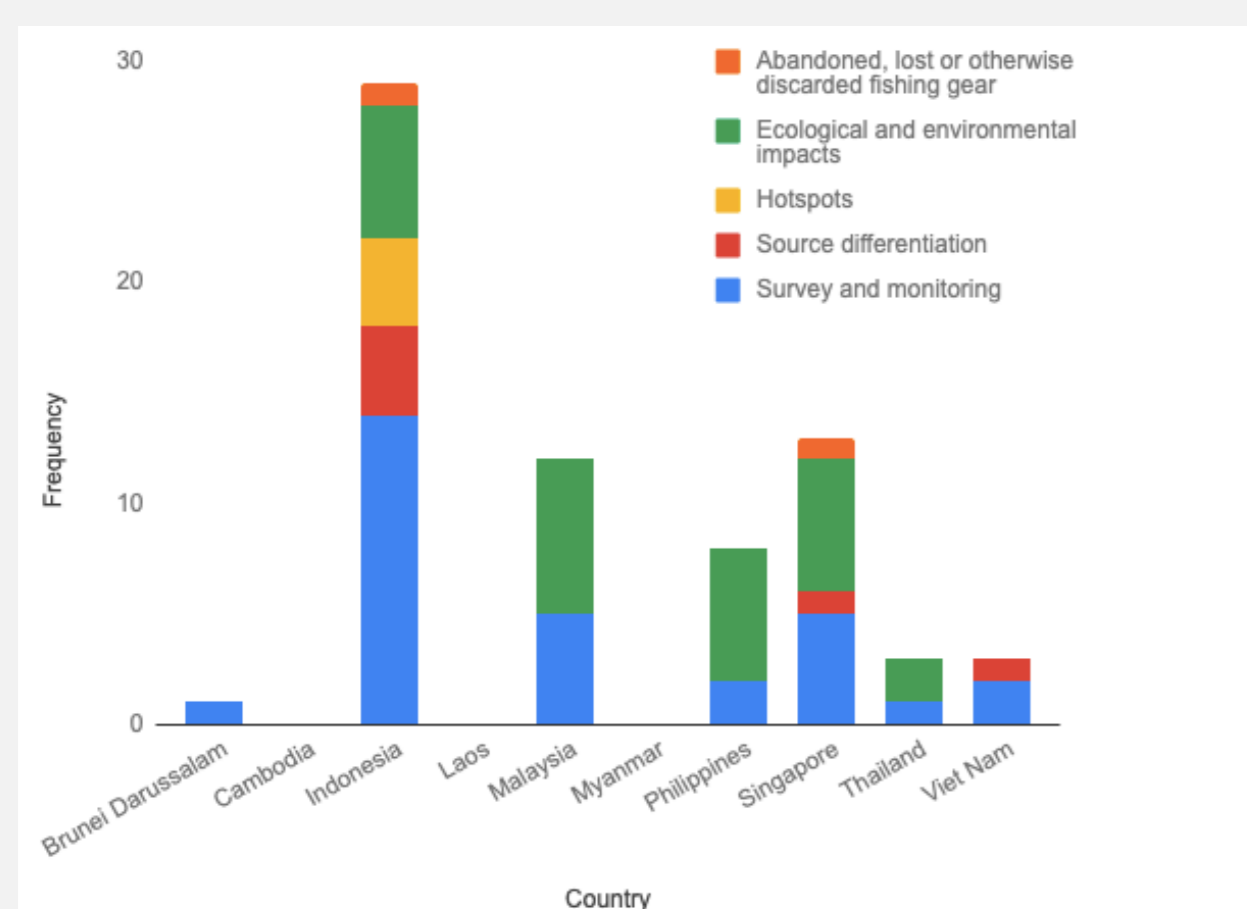
- Systematic literature search of current research in publications, proceedings, reports, worldwide web
- Science communicated through fora, symposia, conferences, and online surveys included in the review

Structure



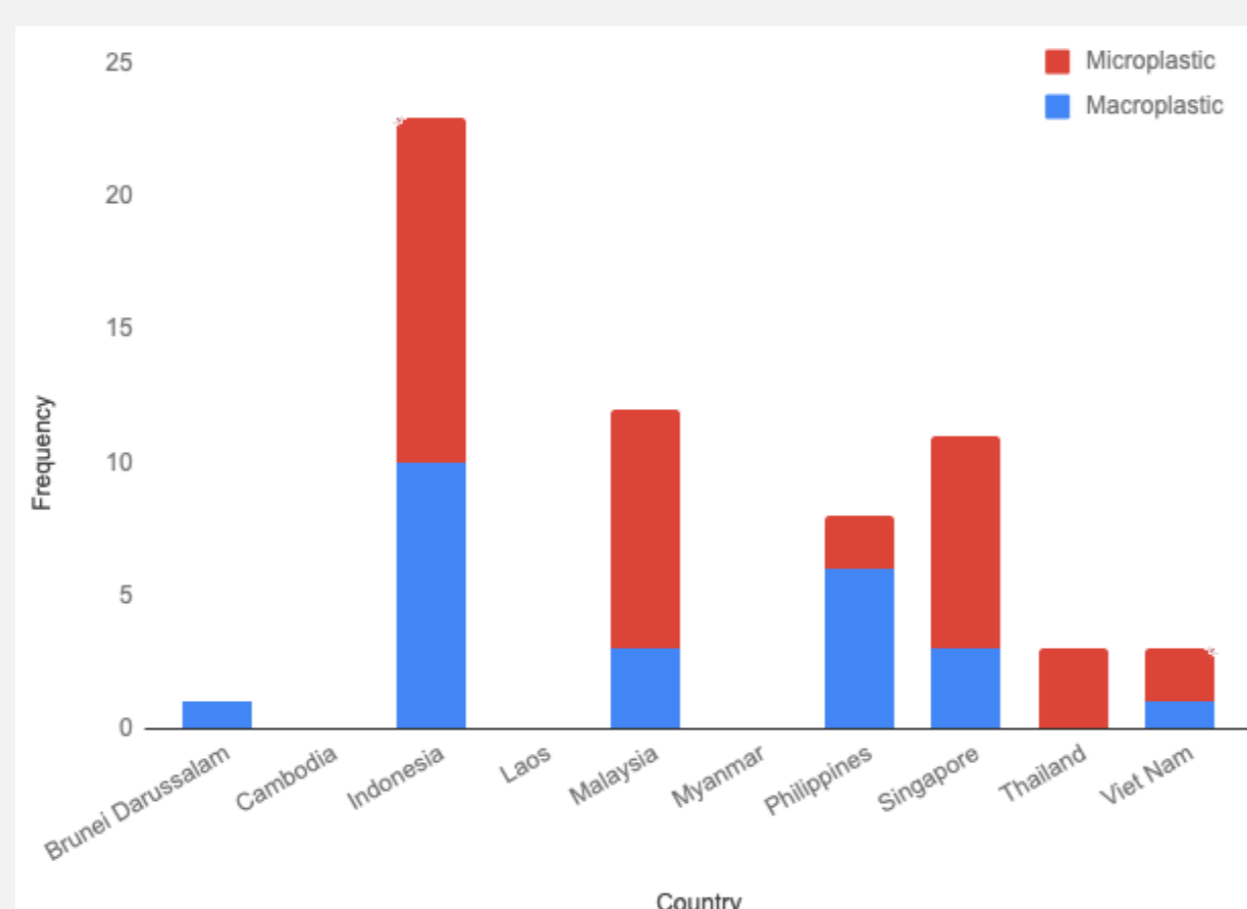
Report's Findings

A Comparison of Research Focus



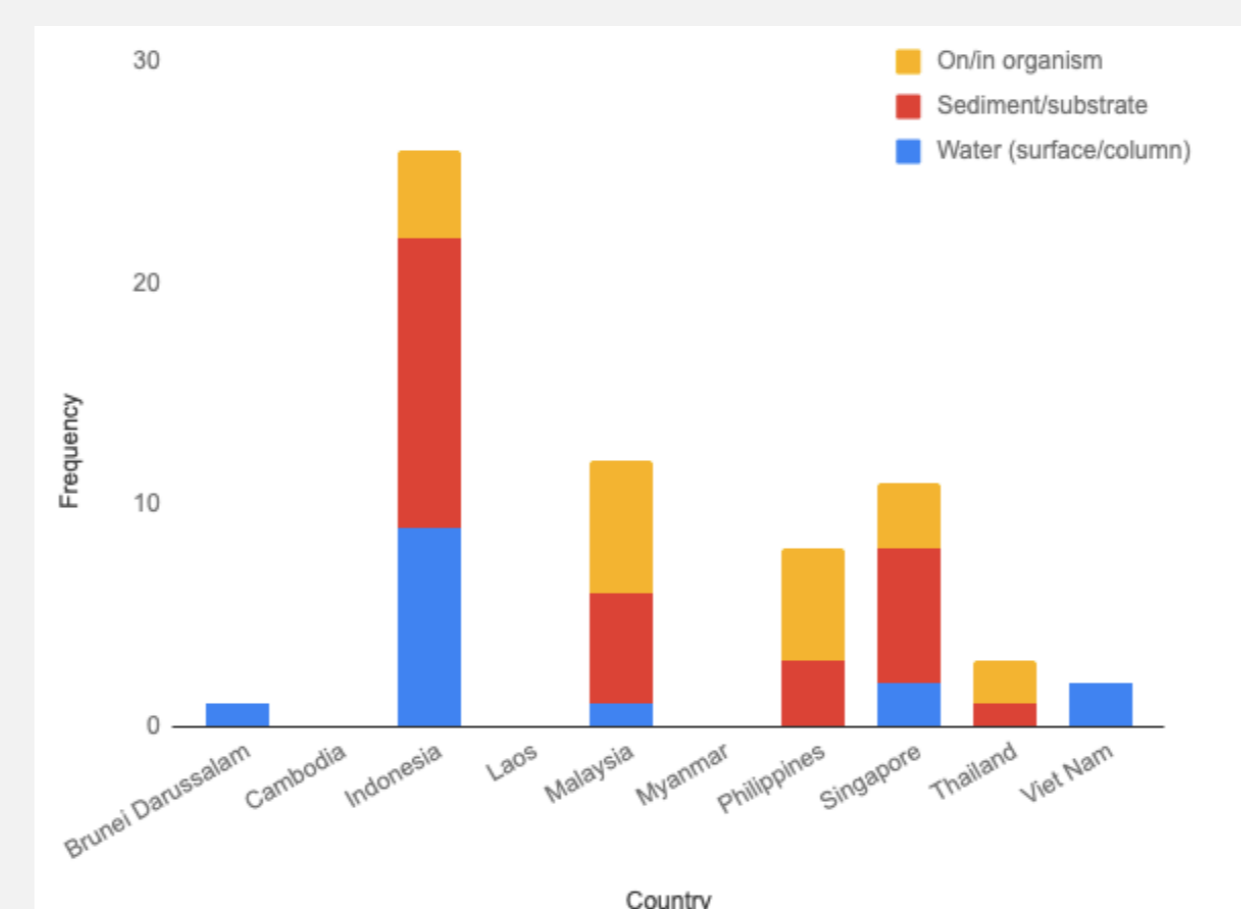
- Indonesia displayed attempts to understand more aspects of marine plastics problem than all other SEA countries, and the only one with effort in identifying hotspots and accumulation zones.
- Surveying and monitoring of marine plastics in the coastline or in waters, followed by ecological and environmental impacts, are most common research focus.

B Comparison of Macro- and Microplastic Research



- There appears to be more microplastic research in peer-reviewed research publications.
- Contrary, most macroplastic research are more readily reported in grey literature, and less in research papers.
- Nevertheless, there is comparable representation of both works in the report.

C Comparison of Marine Environs containing plastics



- Among the marine environs, sampling of sediment or substrate is most frequent in studies.
- Investigation of plastics on water surface or in water column is less prominent.
- Quantifying the amount of plastics in or on marine organisms may be opportunistic, depending on beached carcasses.

D Comparison of Methodologies used in Marine Plastics Research

	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM
Review (literature/ social media)	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Sampling	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Monitoring	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Quantification	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Identification	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Laboratory experimental work	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red
Simulation model	Red	Red	Green	Red	Red	Red	Green	Red	Red	Red

- Again, Indonesia incorporated the greatest diversity of methods when investigating the state of marine plastics in their waters.
- Sampling and quantifying what is present are the common first steps to get a sense of the status of plastic pollution, which explains why they are the most common methods across all SEA countries.
- Identification and monitoring of plastic follows as the next common method.

2: Expansion of Marine Plastic Science Inventory – ASEAN +3 (China, Japan, South Korea)

As an extension to the previous study that focused on SEA countries, this section expands the geographic scope for marine plastics research to China, Japan, and South Korea. A similar methodology and structure are adopted when examining the research scope for marine plastics in these countries, with some preliminary findings reported below.

Preliminary Findings

- The amount of marine plastics research conducted in China, Japan, and South Korea is at least 2-3 times higher compared to SEA countries.
- Apart from the common research foci identified in earlier studies, there is relatively more experimental research investigating the potential impacts of marine plastics on both marine organisms and humans.
- A handful of studies have examined the fragmentation and degradation rates of marine plastics in the natural environment, as well as waste management to tackle the growing amount of marine plastics.
- Table 1 shows how the data is captured for input into an inventory.

Table 1. A summary of variables identified when reviewing the literature on marine plastics science. Two examples provided to visualize how most of the data is captured for this inventory.

Variables	Descriptions of variable	Example 1: Mato et al. (2001)	Example 2: Ke et al. (2019)
Country	Location of the main research institution	Japan	China
Research Group(s)	Institution affiliations of all researchers
Source of Funding	Source(s) of funding supporting the research
Aim of Research	Briefly define the purpose of study	Quantify the presence of toxic chemicals on plastic resin pellets obtained from the coasts of Japan	Impacts of leachates from single-use polyethylene bags on egg fertilization, egg hatching, and larvae mortality in <i>Meretrix meretrix</i> clam
Methodologies Used	Systematic use of key terms, instead of full descriptions of methods	Survey; Chemical analysis; Field absorption experiments	Experimental biology
Period of Study	Dates/Years of sampling	1997, 1998	Not Applicable
Scope of Work	Subject matter linked to plastics research	Resin pellets	Single-use polyethylene bags
Geographic Location of Work	Indicate where the research was conducted	Four coastal sites in Japan	China (Laboratory)
Scale of Work	Biological/Ecological (e.g. habitat type); Non-biological environment; Socioeconomic linked to plastics research	Collection of resin pellets from beaches in Japan	Exposure of polyethylene leachates to <i>Meretrix meretrix</i> in filtered seawater
Pollution Impact	Specific to the subject of study – physical, ecological, physiological, biochemical, etc...	Resin pellets serve as both a transport medium and a potential source of toxic chemicals in marine environment	Early life history of marine organisms
Plastic Source	Indicate the point of entry into environment	Sea	Not Applicable
Research Focus Categories	See Table 2 below	Survey and monitoring / Ecological and environmental impact	Ecological and environmental impact

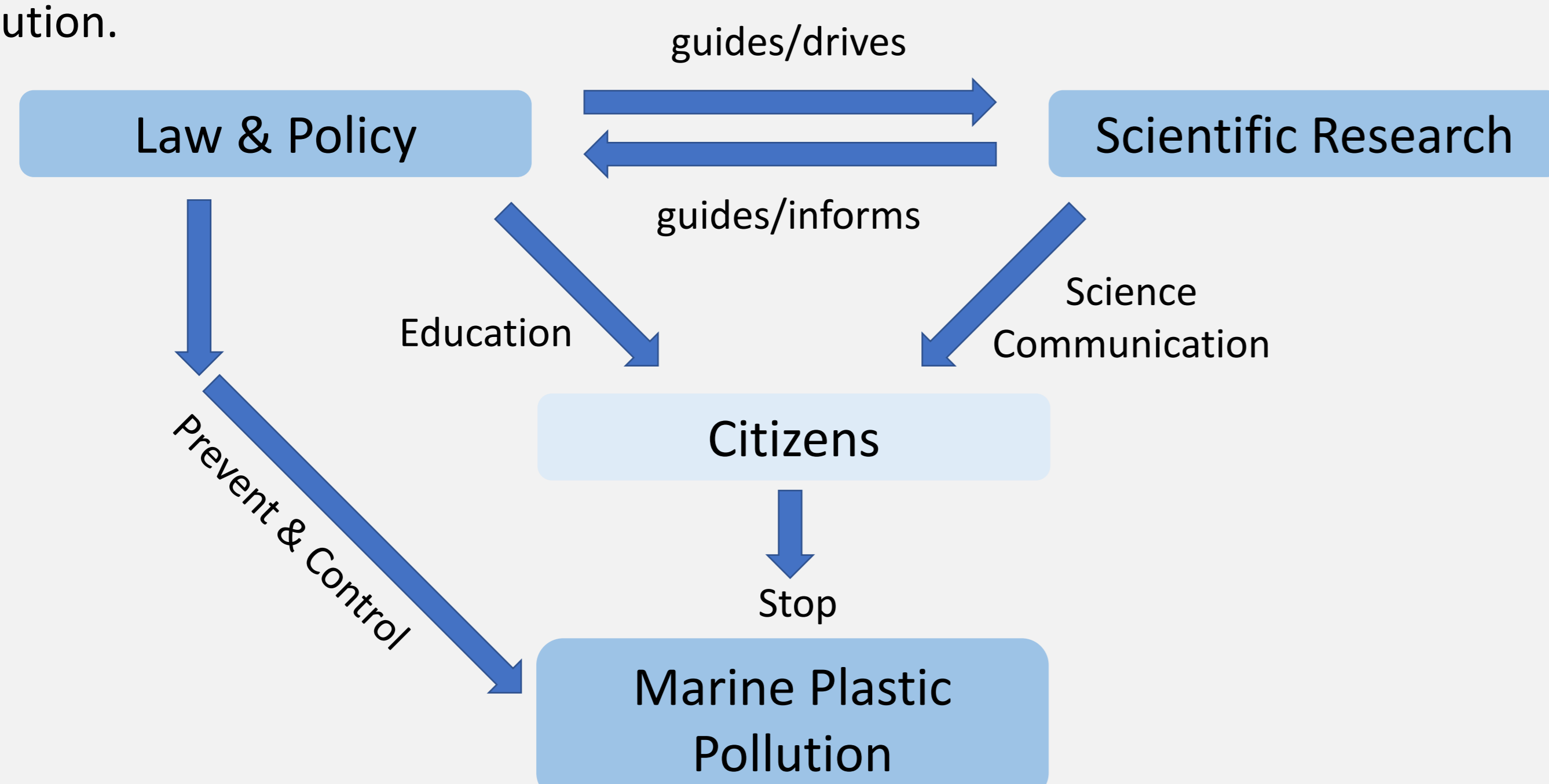
Conclusions

The concern with pollution by marine plastics is obvious based on the increasing amount of research conducted to understanding the issues. While research activity is recent and at its infancy for ASEAN countries, China, Japan, and South Korea are moderately ahead in the research aspects. The topic of highest shared interest overall is upstream research and waste management, including development of circular economy. Surprisingly, the interest of natural scientists in microplastics exceeds that of international and regional bodies and initiatives.

Table 2. An overview of the priorities and gaps in various areas of marine plastics research for Southeast Asian countries. Research focus is considered a “Research Priority” if both research community and international and regional bodies and initiatives shared “Medium” or “High” interest, a “Gap in Research” if international and regional bodies and initiatives are “Medium” or “High” interest, but research community is “Low” interest, a “More research needed” if both research community and international and regional bodies and initiatives shared “Low” interest.

Communication between policy and science

As science pushes forward to understand marine plastics, it needs to be framed so that it can guide law, policy and governance as a whole. Here, an ideal scenario is proposed (below), where a communicative model between policy and science elevates the literacy of the wider community to make informed choices, thus reducing marine plastics pollution.



Evolution of research focus among countries in light of the interest from policy-making bodies

The first science research study identified five main research areas: survey and monitoring, ecological and environmental impacts, source differentiation, lost or abandoned fishing gear and hotspots. Parallel work streams of intergovernmental bodies engaged in combatting pollution from marine plastics (each within their own mandate) have been taken into account and relied on to shape the research focus of the new science study. The research focus now also includes methodology for assessment, fragmentation, contribution from rivers, fiber-reinforced vessels, discharge from offshore infrastructure, etc. (Table 2)

Research Focus	Level of interest by bodies & initiatives	Natural Science Research	Recommended
Surveys and monitoring / pollution status	High	High	Priority
Ecological and environmental impact	High	High	Priority
Accumulation zones & Hotspots	High	Medium	Priority
Macroplastics	High	Medium	Priority
Source differentiation	Medium	Medium	Priority
Contribution of fisheries/Lost and abandoned fishing gear	Medium	Medium	Priority
Microplastics	Medium	High	In Progress
Methodology for the monitoring and assessment of marine litter	Medium	Low	Gap
Fragmentation and degradation	Medium	Low	Gap
Contribution from rivers/river basin management	Low	Low	Gap
Fiber reinforced plastic vessels	Low	Low	More research needed
Hull scraping and marine coating	Low	Low	More research needed
Discharge from offshore infrastructures (including aquaculture)	Low	Low	More research needed
Upstream research / Waste management	High	NA	Potential Gaps
Policy, laws, administrative measures	Medium	NA	Potential Gaps
Action Plan, guidelines and standards	Medium	NA	Potential Gaps
Public outreach / Beach clean-up	Medium	NA	Potential Gaps
Research framework, coordination	Medium	NA	Potential Gaps
Socio-economic impact	Medium	NA	Potential Gaps
Port reception facilities	Low	NA	Potential Gaps
Language and cultural barriers/data accessibility	Low	NA	Potential Gaps