10. VIETNAM

Summary of research topics: *Publications on pollution from marine plastics in Vietnam show that the country is at an early stage of research on this topic. The four articles found were published since 2016 and all involved foreign research partners together with local institutions. Despite the relatively small number of publications, these publications cover a large number of research topics, ranging from laws and other national measures to POPs transported and released by marine plastics.*

Summary of understanding at national level: *Two of the studies focused on the Saigon River and suggested that it would contribute four times more plastic debris to the marine environment than had been estimated in 2017. Resin pellets were also identified as a pathway for POPs. A review also suggested that vessels and fishing gear would be a substantial source of marine debris. However, there is no clear evidence of this. Furthermore, there is no analysis of polymers that compose marine plastic debris, nor of the presence or impact of marine plastics on marine biota, or on the seabed and in seabed sediments.*

Keywords/research fields: *National approach; solid waste; trade of plastic waste; research foci; marine environs; surveys and monitoring; methodology for the monitoring and assessment of marine litter; source differentiation; contribution from rivers; accumulation zones; hotspots; fragmentation and degradation; ecological and environmental impact; socio-economic impact; movement of plastics; adsorption-desorption of contaminants; organic contaminants; inorganic contaminants; plastic as transport vector; main players*

10.1 Context

10.1.1 National approach to plastic waste and its management

Based on Jambeck et al. (2015) estimates, Vietnam would have been the fourth country with the most mismanaged waste in 2010. Of the plastic flows through Vietnam, 0.7-1.0 million tonnes are recycled back into production, and another 1.3 million tonnes are sent for waste treatment and disposal facilities. While there is no specific policy on plastic waste management, Vietnam's Law on Environmental Protection 1993 regulates the general provisions on environmental protection and waste management. However, the 3Rs policy does not appear to have been emphasised. Most waste would also be disposed of in an insufficient number of often inadequate landfills that are thus subject to significant leakages.

On 4 November 2019, Vietnam officially took over ASEAN's rotating Chairmanship for 2020 from Thailand. Under ASEAN's socio-cultural agenda, the ASEAN Leaders adopted the Bangkok Declaration on Combating Marine Debris in ASEAN Region at the 34th ASEAN summit in June 2019. Whilst Vietnam considers the handling of plastics and ocean plastic waste a priority to be implemented, it is unclear how Vietnam plans to encourage the ASEAN Leaders to cooperate further to combat pollution from marine plastics (S. Rajaratnam School of International Studies, NTU: available https://www.rsis.edu.sg/rsis-publication/cms/next-asean-summit-how-will-vietnam-

lead/#.XjQFExMzb_Q). There has been mentions of Japan's support for ASEAN in dealing with plastic waste and ocean plastic by working closely with Vietnam during its Chairmanship (Nhân Dân: available https://en.nhandan.org.vn/politics/item/8003202-japan-backs-environment-priorities-during-vietnam%E2%80%99s-assumption-of-asean-chair.html).

10.1.2 Plastics as a proportion of solid waste

In 2016, municipal solid waste (MSW) for Vietnam was estimated at 11.6 million tonnes with a projection of 15.9 million tonnes in 2030 and 22 million tonnes in 2050 (Kaza et al., 2018). In Ho Chi Minh City alone, about 8,175 tonnes of solid waste may have been generated per day in 2014, with 1.02 kg/capita/day generation of waste (Verma et al., 2016).

Of the MSW, plastic waste ranked second after food waste (Verma et al., 2016). The composition of plastics in solid waste was estimated at 16% for Vietnam (Hoornweg and Perinaz, 2012).

10.1.3 Illegal trade of plastic waste

Vietnam became one of the top importers of global illegal plastic waste after China's ban on plastic waste import in 2018. Plastic waste imports increased from 348,000 tonnes in early 2016 to 492,000 tonnes in end-2018. The bulk of the waste came from Japan and Thailand (Greenpeace, 2019). Vietnam has since stopped issuing new permits to import plastic waste, increased customs inspections of illegal shipments, and adopted a target to ban plastic scrap imports by 2025 (Waste Management Review: available https://wastemanagementreview.com.au/battling-sovereign-risk/). Moving forward, Vietnam plans to look into the 21,600 containers of plastic scrap that would have remained stuck in ports since February 2019. See Greenpeace, 2019 and Unearthed Greenpeace, 2018: available https://unearthed.greenpeace.org/2018/10/05/plastic-waste-china-ban-united-states-america/.

10.2 Research review of pollution from marine plastic

10.2.1 Research overview

Publications of on pollution from marine plastics in Vietnam show that the country is at an early stage of research on this topic. No local scientific research institution has yet to publish articles in English on this topic without the support of external partners.

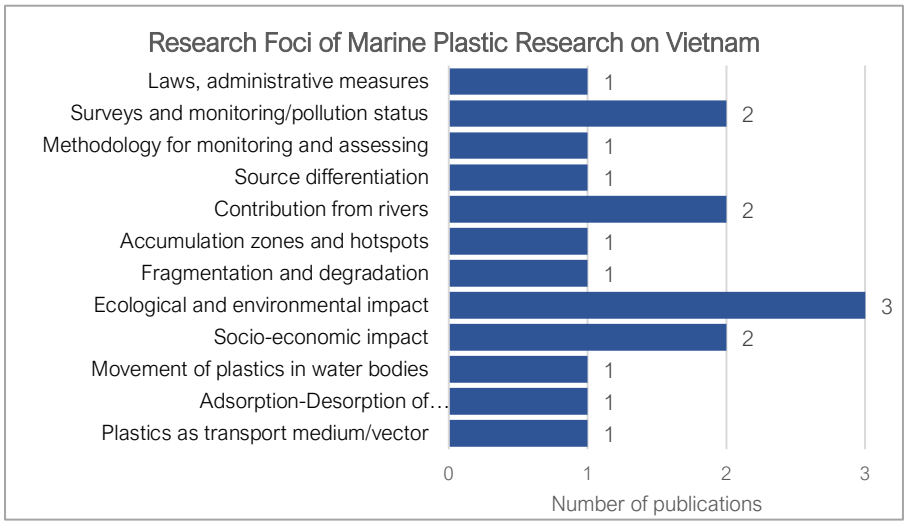
Notably, in 2017, country representatives from Vietnam attended the inaugural 'Workshop on Distribution, Source, Fate and Impacts of Marine Microplastics in Asia and the Pacific' in Phuket, Thailand, which was supported by IOC-WESTPAC. The Workshop's Report mentioned the country's limited understanding of marine plastics, as well as the lack of priorities for related research, monitoring, and management.

The four studies that were examined for this report were conducted within the last five years (2016–2019) within a limited geographic coverage of the country (i.e. Saigon River, Minh Chau Island, Ba Lat estuary). However, they cover a large number of research topics, ranging from laws and other national measures to POPs associated with marine plastics. This shows a general understanding of the issues

and determination to assess them all. It also suggests that more specific and detailed research projects should be expected.

Most of the studies focused on ecology and environmental impact (n=3), followed by survey and monitoring to understand pollution status (n=2), contribution from rivers (n=2), and socio-economic impact (n=2).

Figure 1.2.10.1. Research foci of marine plastic research conducted in Vietnam.



10.2.2 Types of research conducted

Types of plastics research foci

The four studies examined suggest an equivalent interest in micro- and macro-plastics. The studies that examined microplastics were varied: one assessed the presence of persistent organic pollutants (POPs) on resin pellets (Le et al., 2016), one assessed presence/absence of microplastics (and macroplastics) in the Saigon River (Lahens et al., 2018), and the last one is a review providing the status of marine plastics status in Vietnam that included a microplastics discussion (Van Truong and Chu, 2019). The macroplastics study looked at assessing the spatiotemporal variation of plastic debris through hydrodynamic modelling on Saigon River (Van Emmerik et al., 2018).

No published study on plastic additives was found. However, of note is the article by Le et al. (2016) which identifies three POPs (DDTs, PCBS and HCHs) carried by resin plastic pellets as collected from Vietnamese coastal waters. This study was carried out as part of the programme, International Pellet Watch, for monitoring the global POPs distribution on contaminated resin pellets in the marine environ.

Table 1.2.10.2. List of published work identified and examined in this study for Vietnam.

Published Peer-Reviewed Work/Research Team	Aim of Research	Period of Study
Van Truong and Chu (2019) Dalian Maritime Uni (China)	Provide a general review of marine plastics, and a brief account of marine plastic waste on coastal Vietnam; Review International Conventions and Vietnam's regulations related to the prevention and control of plastic waste from ships; Categorise sources of plastic waste in the marine environment; Quantify amount of plastic waste in the marine environment of Vietnam's coastal area	N.A.
Lahens et al. (2018) Uni Paris-Est (France); Uni Grenoble Alpes (France); Ho Chi Minh City Uni of Technology; Ifremer (France)	Assess macroplastic and microplastic contamination levels in a tropical river estuary system, Saigon River	Dec 2015; Apr 2016
van Emmerik et al. (2018) The Ocean Cleanup (The Netherlands); Ho Chi Minh City Uni of Technology; Uni of Grenoble Alpes (France); Uni Paris-Est (France); The Modelling House Limited (New Zealand)	Assess spatiotemporal variation in river plastic quantities and composition using new sampling methods and hydrodynamic modelling on Saigon River	Feb 28-Mar 13, 2018
Le et al. (2016) Uni Malaysia Terengganu (Malaysia); Tokyo Uni of Agriculture and Technology (Japan); Vietnam National Uni HCM; Vietnamese Academy of Sci. and Tech.	Assess the presence of DDTs, PCBs and HCHs on plastic resin pellets collected in Vietnam; Study carried out as part of the International Pellet Watch Programme for monitoring the global distribution of POPs	2007-2014

Coverage of marine environs

The four studies examined focused primarily on the presence/absence of marine plastics at water surface and in the water column (specifically in the Saigon River, in Lahens et al., 2018; Van Emmerik et al., 2018). Only one examined the beaches of Minh Chau Island and Ba Lat estuary to collect resin plastic pellets (Le et al., 2016).

No published peer-reviewed study was found on marine plastics in marine biota or the seafloor (surface and sediments).

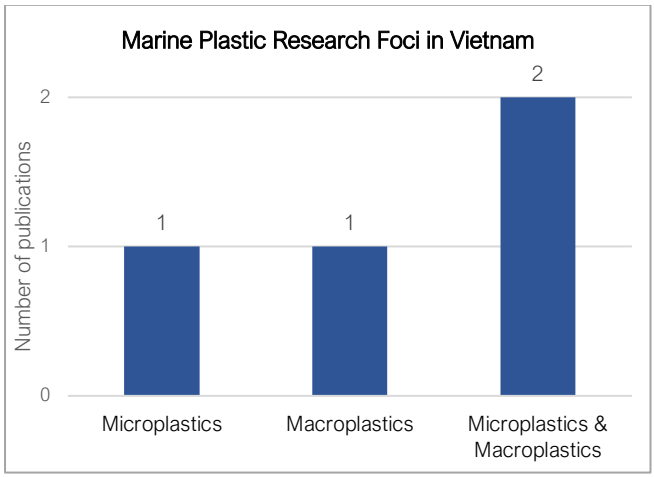


Figure 1.2.10.3. Distribution of marine micro-/macro-plastics researched in Vietnam

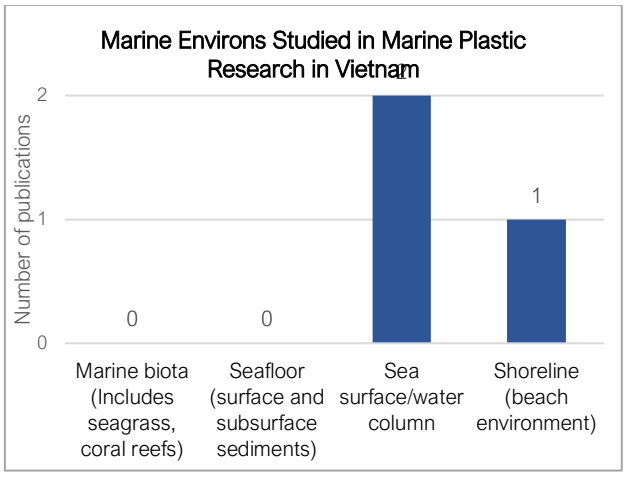


Figure 1.2.10.4. Distribution of marine environs researched in Vietnam

10.2.3 Survey and monitoring

Le et al. (2016)'s article is focused on assessing the presence of POPs on plastic resin pellets collected from the Vietnamese coastal waters. The pellets were analysed for three POPs: dichloro-diphenyl-trichloroethanes (DDTs), polychlorinated biphenyls (PCBs) and hexachlorocyclohexanes (HCHs). Presence and concentration of POPs on plastic pellets provide an indication that may be useful to trace where the plastics could come from in the region. The authors indicated that higher levels of DDTs compared to PCBs suggest agricultural inputs rather than industrial discharges. Plastic pellets, serving as a transport vehicle for POPs, could therefore be used to track temporal and spatial patterns of POP levels in the marine environment.

Van Emmerik et al. (2018) briefly examined the amount of plastics found on the water surface of the Saigon River, though they did not identify the type of macroplastics found. Microplastics were defined in the article as <5 mm; their shape was also described (e.g. fibre, fragment). Abundance was quantified as number of fibres per size class, wet weight in percentage, and fibre concentration per m^3. The types of plastic polymer in this study were identified as PE, PP, Polyester, PET, rayon, PP-vistalon, viscose, acrylic. Van Emmerik et al. (2018) collected this data to test a new methodology on characterising riverine macroplastics leakages into the oceans.

10.2.4 Source differentiation and pathways

There is no published peer-reviewed study on source differentiation and pathways on marine plastics.

Whilst the article by Van Emmerik et al. (2018) identifies the Saigon River as an important source of marine plastic, no quantitative contribution was offered. In their review, Van Truong and Chu (2019) mentioned that the GreenHub organisation indicated that 62% of waste is discharged from major rivers in Vietnam, such as the Red River Delta, the Mekong Delta, the East, the Southern and Central coast, and that 71% of these marine debris are plastics.

10.2.5 Movement of plastics, accumulation and hotspots

The study by Van Emmerik et al. (2018) included the testing of a new method in characterising riverine macroplastic flux dynamics, i.e. the transport of macroplastic in rivers. This new methodology can be simplified in four steps: (i) determine the cross-sectional profiles of plastic flux; (ii) obtain plastic debris statistics; (iii) combine plastic flux to hydrology; and (iv) extrapolate observations. Using real-time data collected from the Saigon River, the study found that macroplastics transported by the river into the marine environment would be four times higher than previously estimated by Lebreton et al. (2017).

10.2.6 Ecological and environmental impacts

There is no published peer-reviewed study on the ecological and environmental impacts of marine plastics.

Several studies (Le et al., 2016; Lahens et al., 2018; Van Truong and Chu, 2019) strongly imply ecological and environmental impacts, but they are not discussed in the articles in the context of

Vietnam. For example, Le et al. (2016) suggest that DDT could have an impact on marine life such as sea birds, but do not discuss it further.

10.2.7 ALDFG

There is no published peer-reviewed study on ALDFG.

10.2.8 Social perceptions and socio-economic impacts

There is no published peer-reviewed study on social perceptions and socio-economic impacts of pollution from marine plastics in Vietnam.

10.3 Main players in marine plastic research

All four studies examined have been conducted by a diverse group of researchers, coming in majority from foreign research institutions (including Universiti Malaysia Terengganu-Malaysia, French universities, The Ocean Cleanup – The Netherlands, Tokyo University of Agriculture and Technology, and Dalian Maritime University – China). However, they also involved local partners, primarily Ho Chi Minh City University of Technology. No government agency or department could be identified.

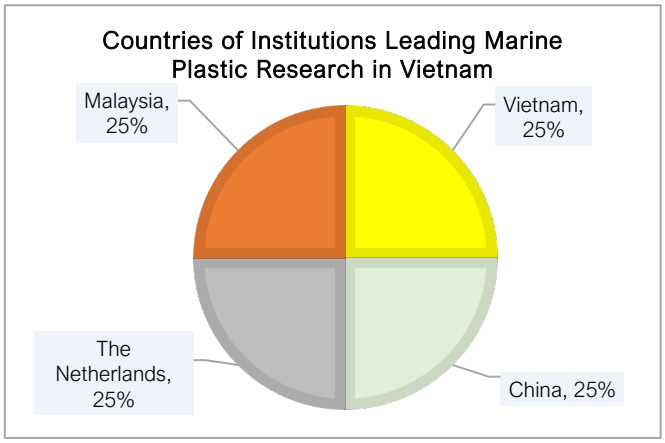


Figure 1.2.10.5. Composition of research efforts seen in Vietnam.

10.4 Summary of understanding

Despite their small number, the articles published in English cover a wide range of research aspects of marine plastic pollution in Vietnam, including the common ecological and environmental impacts, survey and monitoring, as well as movement of plastic debris in water bodies and adsorption-desorption of chemicals/pollutants. Two out of four environs were investigated.

Three out of four published articles seek to quantify the presence and abundance of marine plastic debris. Across the studies, varied methodologies (i.e. counting plastic debris versus simulation modelling) were used in monitoring marine litter in the marine environment, thus making it difficult to do direct comparisons. They nevertheless provide a more comprehensive picture of baselines on which further research can be based.
The two articles on microplastics categorised samples into various forms including those of fibres, fragments, pellets. They also identified plastic polymer types. Notably, one article investigated the

presence of POPs on plastic resin pellets located in the coastal environment of Vietnam and demonstrated that marine plastics are a pathway for pollution by POPs, specifically DDTs, PCBs, and HCHs. However, none of the studies focused on the degradation of any type of polymer in the marine environment.

Whilst most articles are concerned with ecological and environmental impacts, no studies could be found on marine biota, including ingestion or physical impacts of marine plastics on organisms of either socio-economic importance or endangered migratory species. There seems to have also been no investigation on plastic transfer through the food chain so far.

In their review of marine plastic pollution in coastal Vietnam, Van Truong and Chu (2019) suggested that merchant ships and fishing vessels would be one of the major sources of marine plastics pollution into the ocean. The review also analysed Vietnam's international and local regulations and measures on the management of marine plastics, and found that current local provisions are not sufficient to prevent pollution of the marine environment by plastic waste.

Further research on quantification and monitoring of marine plastics, as well as hotspots, would be useful. In addition, further improvement of understanding on sources and pathways, as well as the ecological, environmental, and socio-economic impacts within the country, could support decision-making in the adoption of adequate management measures. Whilst all four of the articles examined involved foreign researchers, involvement of local partners is expected to have contributed to building some of the research capacity needed for this purpose.