

1. BRUNEI DARUSSALAM

Summary of research topics: Two published peer-reviewed papers relevant to marine plastics could be found for Brunei Darussalam, but they refer to the same study with a more detailed discussion in the most recent article. The research topic of the study was focused on surveying and monitoring abundance and types of micro- and macro-plastics in selected riverine and coastal beaches of Brunei Darussalam.

Summary of understanding at national level: There has been limited number academic research conducted to understand marine plastic pollution issues in Brunei Darussalam, but the Department of Environment, Parks and Recreation (JASTRe) has national-level initiatives to tackle plastic waste issues. The studies indicate that most of the marine debris are macroplastics with size >20 mm (61.86%), followed by mega plastics with size >100 mm (22.29%), and hypothesise that they might be from land-based sources with higher flow in wet weather.

Keywords/research fields: National approach; solid waste; trade of plastic waste; research foci; marine environs; surveys and monitoring, source differentiation, contribution from rivers; main players

1.1 Context

1.1.1 National approach to plastic waste and its management

Efforts to address plastic waste issues are underway in Brunei Darussalam, such as with the Brunei Vision 2035 (Wawasan Brunei, 2035) which aims to cultivate a green-oriented and long-term sustainable economy. This includes the adoption of the 3Rs practices to tackle plastic waste issues, and zero waste strategies that look into the upstream problems of marine plastics (Shams et al., 2014). Some specific examples include 'No Plastic Bag Everyday' initiative implemented to limit the use of PET bags by participating stores and shops daily, 'Plastic Bottle Free Initiative' by the Ministry of Development, reducing the use of polystyrene containers and phasing out the use of plastic bags in major supermarkets by 2019 (ASEAN Secretariat News, 2018: available <https://asean.org/asean-joins-movement-beat-plastic-pollution/>).

However, sorting of waste and treatment of separated plastic waste seems limited. The country has a waste collection system in place, therefore all the waste is often disposed of indiscriminately at common landfill sites, or discharged or leaked into water bodies. There appears to be a single waste recycling facility in Brunei Darussalam that targets used lubricants and oils derived mainly from Shell Petroleum company, but the recycling of other waste has yet to be established – an area that is acknowledged as requiring action by the government (Presentation by Yunos et al., 2010).

1.1.2 Plastics as a proportion of solid waste

Based on the figures reported by the Department of Environment, Parks and Recreation (JASTRe) (under the Ministry of Development), the Municipal Solid Waste (MSW) was at 189,000 tonnes in 2015.

In the following year, the MSW was estimated at 216,000 tonnes, equivalent to 1.4 kg per capita per day, and with a projection of reaching 263,000 tonnes in 2030 and 308,000 tonnes in 2050 (Kaza et al., 2018). In general, the bulk of the solid waste ends up in the six landfills in Brunei. For instance, the landfill at Sungei Paku in the Tutong District collects 400-500 tonnes of waste daily (JASTRe, 2015).

Of the solid waste generated in Brunei Darussalam, plastics rank third at 16% of total solid waste (Energy and Industry Department, 2017). Most of the plastic waste is derived from Brunei Muara District, the smallest of the four districts in Brunei, but the most populous with over half of the country's population (United Nations Framework Convention on Climate Change, 2017).

1.1.3 Illegal trade of plastic waste

Based on the recent Greenpeace Southeast Asia's ASEAN Policy Brief 2019 and import data from Trademap, there was a clear six-fold increase in plastic waste volume imported into Brunei Darussalam, from 30 tonnes in 2016 to 185 tonnes in 2018, following China's import ban in 2018. This said, the exact amount of plastic waste imported is not publicly verifiable. Brunei Darussalam is also party to the Basel Convention (see [Part 1, Section 3.7](#)).

1.2 Research review of pollution from marine plastic

1.2.1 Research overview

Academic research on marine plastics in Brunei Darussalam is limited, with only two published peer-reviewed papers identified here for assessment. The awareness of marine plastics among the scientific community is unknown but does not appear to be a main research thrust of research in Brunei.

Interestingly, though the papers are published in different contexts (Table 1.2.1.1), they both report the same study conducted in 2016, which geographically covers four coastal beach areas. They were focused on surveys and monitoring to understand pollution status. As both studies essentially report the same work, their research focus is the same and will only be captured once in this assessment. However, the following will discuss both studies in parallel.

Table 1.2.1.1. List of published work identified and examined in this study for Brunei Darussalam.

Published Peer-Reviewed Work/Research Team	Aim of Research	Period of Study
Qaisrani et al. (2019) Uni Teknologi Brunei (UTB); Balochistan Uni of Information Technology, Engineering and Management Sciences (BUITEMS, Pakistan); Prince of Songkla Uni (Thailand)	Understand the abundance and classification of marine debris accumulated along the beaches of Brunei Darussalam	May 2016
Qaisrani et al. (2018) - Conference paper BUITEMS (Pakistan); Uni Teknologi Brunei (UTB); Uni Brunei Darussalam (UBD)	Understand the abundance and classification of marine debris accumulated along the beaches of Brunei Darussalam	May 2016

1.2.2 Types of research conducted

Both Qaisrani et al. (2018) and Qaisrani et al. (2019) reported the following aspects of research: surveys and monitoring to understand pollution status, source differentiation, and the contribution of plastics (i.e. rivers). The surveys investigated the marine debris comprising microplastic and macroplastic found on their coastal beaches (i.e. shoreline environment).

The major difference between Qaisrani et al. (2018) and Qaisrani et al. (2019) is the types of measures used to quantify abundance, in terms of density and weight (see [Part 1, Section 2.1.2.3](#)). In addition, the latter study conducted more extensive analyses and charting of the results obtained from the surveys compared to the former study, providing better insights into the current state of marine plastic pollution.

Efforts in public outreach and beach clean-ups are conducted through the Eco-Clubs (i.e. 16 secondary schools) that are registered under the Department of Environment, Parks and Recreation (JASTRe) in the Ministry of Development throughout Brunei Darussalam. The JASTRe organises environmental awareness activities such as beach cleaning campaigns to reduce the amount of litter along the beaches, especially plastics, in an effort to keep the beaches clean.

There is no published peer-reviewed study on plastic-associated (organic or inorganic) contaminants.

1.2.3 Survey and monitoring

Both Qaisrani et al. (2018) and Qaisrani et al. (2019) reported on the examination of the abundance and distribution of marine debris collected from four different coastal beaches along Brunei Darussalam in a May 2016 study. The study had categorised the debris found as plastic, metal, glass, rubber, cloth/fibre, lumber, and miscellaneous. They found that most of the marine debris were macroplastics with size between 20-100 mm (61.86%), followed by mega plastics with size of >100 mm (22.29%). The common types of plastic found and identified were from food 'stuff', plastic fragments and PET bottles. These items were made of either PET, PE, or PVC plastics.

Qaisrani et al. (2018) had quantified abundance of plastics based on counts (i.e. number of items) and weight of debris (i.e. kg per day), but Qaisrani et al. (2019) added further measures to quantify abundance of plastics. For instance, the latter study also quantified abundance based on area covered (i.e. number of items per unit area) and weight of debris (i.e. kg per unit area per week).

Studies of microplastics adhered to the definition of size <5 mm, but the shapes of microplastics were not reported. While the types of plastic polymers were not identified for microplastics observed, the studies broadly identified PET, PE and PVC from their macro- and mega-debris.

1.2.4 Source differentiation and pathways

Qaisrani et al. (2018) and Qaisrani et al. (2019) proposed that plastics could have originated from local land-based sources as a result of high tourism activities.

Whilst Qaisrani et al. (2016) is not included in the inventory of research prepared for this study because it focuses solely on a river system (flow into the Kedayan River), it provides interesting insights on debris flow in Brunei plastic debris flow and movement into this river. The study showed seasonal variations in the flow of plastic waste. A larger proportion of plastic debris was found in the river during wet weather compared to dry weather. This implies a correlation between movement of debris and intensity of rainfall resulting in runoff.

1.2.5 Movement of plastics, accumulation and hotspots

There is no published peer-reviewed study on the movement of marine plastic debris, except from rivers (Qaisrani et al., 2016), nor accumulation and hotspots of marine plastics.

1.2.6 Ecological and environmental impacts

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

1.2.7 ALDFG

There is no published peer-reviewed study on abandoned, lost or otherwise discarded fishing gear.

Given that marine capture fisheries have contributed significantly to the country's supply of fish for >20 years (SEAFDEC: available http://map.seafdec.org/Monograph/Monograph_brunei/marine.php), ALDFGs are expected to be a significant component of marine plastic debris in Brunei, as they are in the rest of the region.

1.2.8 Social perceptions and socio-economic impacts

There is no published peer-reviewed study on the social perceptions and socio-economic impacts of marine plastics.

1.3 Main players in marine plastic research

This study found Qaisrani Z.N. of Universiti Teknologi Brunei (currently based in BUIITEMS, Pakistan) to be the lead author of the research mentioned above. Additional information on Brunei's plastic waste situation was obtained from a policy brief produced by Greenpeace Southeast Asia (Greenpeace, 2019).

The government department, JASTRe, has played an active role in providing plastic pollution statistics (as reported in online news outlets). It has also launched initiatives to encourage Bruneians to use less single-use plastics.

1.4 Summary of understanding

The current understanding of marine plastic pollution status in Brunei Darussalam is limited to a single relevant peer-reviewed report. This 2016 study focused primarily on debris flow from selected riverine and coastal areas entering the beach environment. While some statistics are available from the government and research-driven studies in marine plastics, they are mostly presented in informal reports such as online news outlets with few details of methodology and results.

The 2016 study indicated that most of the marine debris were macroplastics with size >20mm (61.86%), followed by mega plastics with size >100 mm (22.29%), and hypothesised that they might have been from land-based sources with higher flow in wet weather.

Given the missing research foci and the prevalence of marine debris, improving the research capacity for Brunei Darussalam to understand source differentiation and pathways of marine plastic debris as well as the ecological and environmental impacts of ALDFGs, would be useful to guide the country's plastic waste management approaches.