



CLOSING
THE LOOP

CLOSING THE LOOP ON PLASTIC POLLUTION IN DA NANG CITY, VIETNAM

Baseline Report



Acknowledgement

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Abbreviation

| | |
|-----------------------|--|
| 3Rs | Reduce, Reuse, Recycle |
| BC | Black Carbon |
| ASEAN | The Association of Southeast Asian Nations |
| CBO | Community Based Organization |
| CO₂ | Carbon Dioxide |
| CTL | Closing the Loop |
| DEM | Digital Evaluation Model |
| DOC | Department of Construction |
| DONRE | Department of Natural Resources and Environment |
| ESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| GDP | Gross Domestic Product |
| IGES | Institute for Global Environmental Strategies |
| ISWA | International Solid Waste Association |
| IUCN | International Union for Conservation of Nature |
| MFA | Material Flow Analysis |
| MONRE | Ministry of Natural Resources and Environment |
| MSW | Municipal Solid Waste |
| Mt | Metric tonne |
| NGO | Non-Government Organization |
| PET | Polyethylene terephthalate (plastic drinking bottles are commonly made of) |
| PPE | Personal Protection Equipment |
| PPC | Plastic Pollution Calculator |
| SDG | Sustainable Development Goals |
| SWM | Solid Waste Management |
| UOL | University of Leeds |
| UNDP | United Nations Development Programme |
| URENCO | Urban Environment Company |
| VASI | Viet Nam Administration of Seas and Islands |
| VEA | Viet Nam Environmental Administration |
| VND | Vietnamese đồng |
| WCSC | Waste Collection Service Charge |
| WEPA | Waste Management and Environmental Promotion Agency |



SUMMARY

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

- P10 **City Statement**
- P12 **Key Findings on Plastic Waste in
Da Nang City**
- P14 **Plastic Management Recommendations**
- P16 **Policy Recommendations**

City Statement

Director of Department of Natural Resources and Environment (DONRE), Da Nang City



With a population of about 1.1 million people, Da Nang City is a dynamic coastal city, which is rapidly developing in the central region of Viet Nam. Along with economic growth, the amount of solid waste generated is constantly increasing. On average, the City generates about 1,100 tons per day, of which plastic waste accounts for a large proportion and is expected to increase in coming years. If not strictly controlled, plastic wastes will affect the quality of the environment, marine ecosystems and human health.

On 4 December 2019, the Government of Viet Nam issued the National Action Plan for Management of Marine Plastic Litter by 2030 (Decision No. 1746/QĐ-TTg). The National Action Plan aims to prevent and reduce ocean plastic waste from waste sources on land and activities at sea, to completely eliminate the use of single-use plastic products and plastic bags from resorts, tourist attractions, accommodations and other tourist service businesses along the coast to ensure no plastic wastes in marine protected areas.

Building on the Da Nang - An Environmental City Plan, in addition to a series of other development goals, the city's Department of Natural Resources and Environment (DONRE) with the People's Committee Danang City issued the following Action Plan to Manage Marine Plastic Litter in Da Nang City by 2025, With A Vision Towards 2030 (KH 122/KH-UBND) on June 24, 2021.








With technical support of many national and international organizations the Project *'Closing the Loop: Innovation and Scaling Up to Solve the Problem of Plastic Pollution in Marine Areas in ASEAN Cities'* by the United Nations Social Commission of Asia and the Pacific (ESCAP), supported by the Government of Japan. Together, with the Institute for Global Environmental Strategy (IGES), University of Leeds and International Union for Conservation of Nature (IUCN) Da Nang City has created baseline research to identify plastic waste and potential sources of plastic leakage to the environment, establishing highly feasible target actions.

Promoting these very important results, the Department of Natural Resources and Environment of Da Nang City will continue to make efforts and coordinate with national and international organizations to effectively mobilize the participation of all organizations and communities. The people of the city aim to minimize the amount of plastic waste, contributing to the construction of an Environmental City!

Dr. Architect. To Van Hung
Director of Department of Natural Resources and Environment
Da Nang City, Vietnam

Key Findings on Plastic Waste in Da Nang City

| Key results of the Plastic Pollution Calculator for the case study of Da Nang City, Vietnam | |
|---|--|
| <p>WASTE GENERATION</p>  | <ul style="list-style-type: none"> • 449,000 tonnes/year • 1.08 kg/capita/day (<i>national average = 0.33 kg/capita/day</i>)¹ • 393 kg/capita/year |
| <p>PLASTIC COMPOSITION</p>  | <ul style="list-style-type: none"> • 83,000 tonnes of plastic waste is generated each year • 18.5% of MSW is plastic (<i>national average = 12.15%</i>)¹ • Plastic bags make up 48% by mass of all plastic waste |
| <p>WASTE TO THE ENVIRONMENT</p>  | <ul style="list-style-type: none"> • 6,752 tonnes/year of plastic is emitted into the environment • Littering is the largest source of plastic pollution (47%) followed by uncollected waste (23%), fly tipping / illegal dumping (14%) and leakage whilst waiting for collection (11%). |
| <p>OPEN BURNING OF UNCOLLECTED WASTE</p>  | <ul style="list-style-type: none"> • 20 tonnes/year of plastic waste is openly burnt • Releasing an estimated 57 tonnes of CO₂ and 255 kg/year black carbon emissions • The high global warming potential of black carbon means there are 619 tonnes/year CO₂eq emissions |
| <p>PLASTIC TRANSPORTATION TO WATERWAYS</p>  | <ul style="list-style-type: none"> • 1,087 tonnes/year of plastic enters waterways • Whilst only 1.3% of MSW, this is equivalent to many millions of plastic items • 5,645 tonnes / year of plastic waste is retained uncontrolled on land or in drains |

- Plastic pollution is a major problem in Da Nang City and requires immediate strategies and policy actions to mitigate the impact on the environment and economy. The majority of plastic waste generated is composed of single-use plastic bags (48%), plastic films (18%) and plastic bottles (5.5%).
- Approximately 8.1% of the plastic waste from land-based sources enters the environment, primarily through littering, uncollected waste and fly-tipping. 1.3% of this becomes marine litter, which may seem small, but is equivalent to 1,087 tonnes per year and many millions of plastic products.
- Lightweight plastic waste (i.e. plastic bags and films) is a particular problem as it is low value, making it unappealing for recyclers and highly mobile in wind or waterways.
- Although Viet Nam's The National Action Plan for Management of Marine Litter by 2030 aims to reduce fishing gear littered in the ocean, Da Nang City does not have a clear strategy to combat this pollution.
- Da Nang City has established ambitious targets in their policies regarding waste separation at source and 3R activities. However, progress has been limited to pilot areas, partly due to a lack of public awareness, cooperation and monitoring capacity.
- The City needs to lead structural interventions to reduce single-use plastic products. These will include measures like advanced monitoring systems and better sorting mechanisms at the source of waste, including residential communities, public institutions, schools, retailers and agriculture and aquaculture businesses.

Plastic Management Recommendations



1. Reduce Use of Single-Use Plastics, including Plastic Bags and Plastic Bottles

Why?

Single-use plastics including plastic bags, plastic films, and PET bottles are the most common marine plastic litter in Da Nang City. The National Action Plan for Management of Marine Litter by 2030 mandates that 100% of single-use plastic in tourism areas be reduced, and 75% of the total marine plastic litter be reduced by 2030.

How?

Enhancement of waste separation activity at source; research and technology development on alternative material such as biodegradable plastic through building networks and developing skills; development of regulations such as bans, tax/levy for commercial sectors to limit the use of single-use plastics.



2. Reduce Littering and Open Dumping, and Increase Collection

Why?

Littering, inadequate waste collection and fly-tipping are the leading causes of plastic pollution, particularly in the tourist areas. 100% waste collection is mandated by the Da Nang City Plan for Solid Waste Treatment and until 2030 and Da Nang City Socio-Economic Development Master Plan to 2020, with a Vision to 2030.

How?

Strengthen controls on littering and ensure waste bins in tourism areas; enforce legislation for waste collection and treatment at source, including residential, institutional, commercial, and industrial areas.



3. Increase Source Separation

Why?

In Da Nang City, only 6.1% of plastic is currently recycled, compared to the national average of 10-15%. The goal of Plan for Solid Waste Treatment with a Vision towards 2045, the City is to achieve 100% of waste separation at source by 2030.

How?

Strengthen the implementation of sorting, collection, research and apply recycling technology and techniques through business investment and support from international cooperation



Policy Recommendations



1. Implementation of Policy

Why?

The National Action Plan for Management of Marine Litter by 2030 requires 100% of abandoned fishing gear to be collected, 100% of single-use plastic at tourism areas to be reduced, and 75% of marine plastic litter to be reduced by 2030.

How?

Update and complete the city waste segregation plan (Decision No. 1577/QĐ-UBND dated April 11, 2019); Develop and implement pilot projects to reduce plastic waste generation at all levels, including community groups, commercial sectors, schools, tourism facilities, agri- and aquaculture and healthcare facilities.



2. Move From Waste Management to Circular Economy Solutions

Why?

Establishing a circular economy policy with ambitious targets will create opportunities for innovation and experimentation with different circular economy solutions.

How?

Support implementation of pilot projects, including research and communications, to introduce new products and promote lifestyle changes to prevent plastic waste generation.



3. Strengthen the Capacity of Local Bodies

Why?

Da Nang City government is responsible for waste management. District- and ward-level institutions should build capacity for feasible and sustainable action.

How?

Provide continuous training and awareness-raising on plastic waste management for public officials and employees. Support inspection of plastic packaging activities in city markets by individuals and organisations.



4. Public and Private Sector Participation

Why?

Private sector involvement in plastic pollution mitigation could increase operational efficiency and outreach to reduce the consumption of single-use plastic items by citizens and businesses

How?

Continue to raise awareness of plastic pollution with information, education and communication materials and guidelines at all levels. In particular, targeting residential communities, public procurement officials, school children, tourism facilities and agri- and aquacultures. Promote and incentivise the development and use of reusable or easy-recyclable alternatives to single-use plastic products.



5. Resource Mobilisation

Why?

The current budget may limit the improvement of plastic waste management operations. Circular economy solutions can offset costs and help extract maximum value from products made of recycled plastic.

How?

Mobilise domestic and international resources for technical support and technology development to reduce plastic waste generation and leakage.



6. Use of Digital Tools, Data Management

Why?

Regularity of data updates and monitoring mechanism can help track progress and evaluate solutions.

How?

Integrate remote sensing with AI technology developed under Closing the Loop project into plastic waste monitoring plans to monitor and map plastic waste hotspots from land to sea.

CHAPTER 1

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

Introduction

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CHAPTER 1

Introduction

1.1 Background

Plastic pollution presents a tremendous environmental challenge and requires an urgent global response. Without action, the annual flow of plastic into the oceans will triple by 2040, reaching 29 million metric tonnes (Mt) per year¹. Out of approximately 6,300 Mt of plastic waste had been generated as of 2015, only 9% of global plastic waste is recycled, 12% is incinerated and the remaining 79% is piled in landfills or unmanaged in cities, rivers, oceans and forests². If current production, consumption and waste management trends continue, roughly 12,000 Mt of plastic waste will be ended up in landfills or the natural environment by 2050. Fast-growing cities with weak waste management systems in East Asia, South Asia and China are responsible for about 60% of plastic waste leakage³. Ocean plastics cost the tourism, fishing, and shipping industries in the Asia-Pacific region US \$10.8 billion per year⁴.

¹ PEW Charitable Trusts and SystemIQ. 2020. Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution. <https://www.pewtrusts.org/en/research-and-analysis/articles/2020/07/23/breaking-the-plastic-wave-top-findings>

² Geyer, R., Jambeck, J., Law, K. 2017. Production, use, and fate of all plastics ever made. *Sci. Adv.* 3. <https://advances.sciencemag.org/content/3/7/e1700782>

³ Jambeck, J., Geyer, R., Wilcox, C., Siegler, T., Perryman, M, Andrady, A., Narayan, R., Law, K. 2015. Plastic waste inputs from land into the ocean. *Science.* 347. 6223. <https://science.sciencemag.org/content/347/6223/768>

⁴ McIlgorm, A., Raubenheimer, K., McIlgorm, D. 2020. Update of 2009 APEC report on Economic Costs of Marine Debris to APEC Economies. A report to the APEC Ocean and Fisheries Working Group by the Australian National Centre for Ocean Resources and Security (ANCORS), University of Wollongong. <https://www.apec.org/Publications/2020/03/Update-of-2009-APEC-Report-on-Economic-Costs-of-Marine-Debris-to-APEC-Economies>



The lack of effective policies, technologies and capacities to manage plastic waste at the local level has regional and global implications. More actions are required to address plastic application and waste management in the ASEAN region, influence consumer behaviour and build a circular economy across the waste value chain. Tackling plastic waste protects the oceans and creates social and economic development opportunities. Within the framework of the 2030 Agenda, integrated approaches across Sustainable Development Goals (SDGs) 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production) and 14 (Life below Water) with specific targets on plastic waste and pollution are urgently needed.

1.2 Aims

Closing the Loop: Scaling up Innovation to Tackle Marine Plastic Pollution in Cities, a project by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) with support from the Government of Japan, aims to reduce the environmental impact of cities in the ASEAN region by addressing marine plastic pollution.

In line with the ASEAN Framework of Action on Marine Debris, the G20 Osaka Blue Vision and national policies and action plans, this project assists four cities: Da Nang, Viet Nam; Kuala Lumpur, Malaysia; Surabaya, Indonesia and Nakhon Si Thammarat, Thailand (Figure 1). These cities develop action plans to make plastic waste management more circular and reduce plastic waste entering the marine environment from land-based sources.



Figure 1

Closing the Loop Project Pilot Cities

As shown in **Figure 2**, the project also builds local capacity and technical expertise, supporting city governments and their partners to monitor and visualise plastic waste and identify hotspots to improve management. It raises awareness of marine litter and the solutions cities are taking to improve plastic value chain management, promote behavioural change among consumers and industry and create enabling environments for policy development.

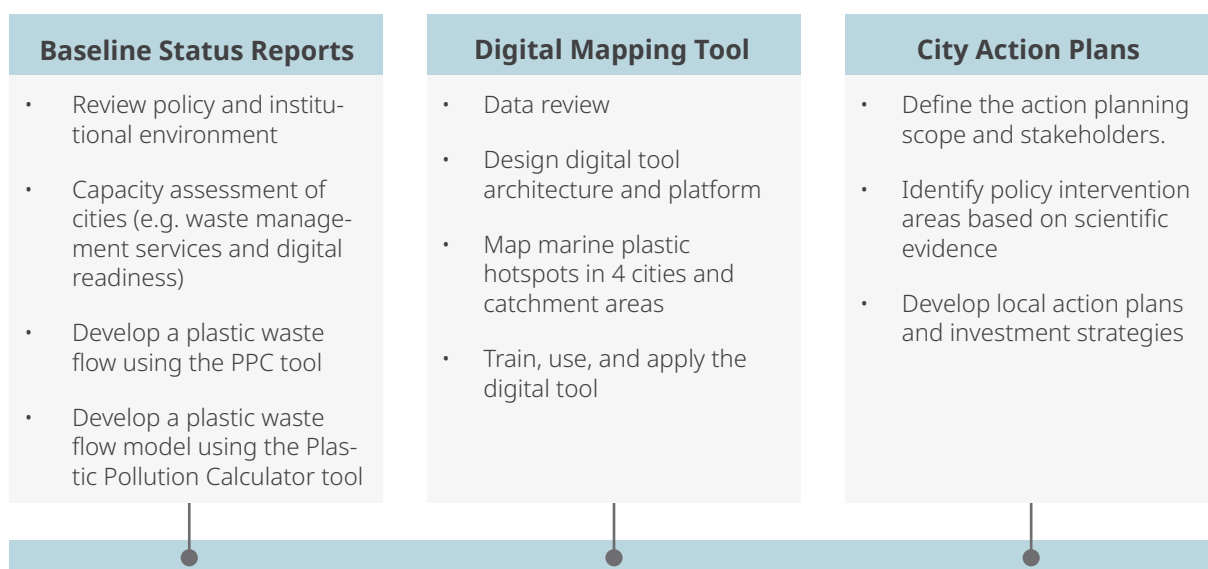


Figure 2

Three elements to Circular Plastic Waste Management

1.3 Methodology

This baseline report presents and analyses the current plastic waste management system in Da Nang City. Considering the importance of addressing both the physical (hardware) components and the governance (software) features⁵ for sustainable waste management, it covers data related to both aspects as shown in **Figure 3**. The structure of the report consists of five sections; (1) introduction, (2) city profile, (3) physical assessment (4) governance assessment, and (5) recommendations and conclusions.

| Physical Assessment | Governance Assessment |
|--|---|
| <ul style="list-style-type: none">• Assessing plastic waste generation, collection, recycling and treatment.• Using the Plastic Pollution Calculator (PPC) developed by the University of Leeds and ISWA the City quantifies plastic pollution. | <ul style="list-style-type: none">• Evaluation of city and national policies related to plastic waste management.• Assessment of stakeholder participation, financial sustainability and digital readiness for managing plastic waste in the city. |

Figure 3

Data collection

⁵Scheinberg, Anne, 2004, Integrated Sustainable Waste Management-the Concept, WASTE, the Netherlands



To analyse the components identified above, a local partner (IUCN) was first designated and a local research team has been established with members who are familiar with local situation. They functioned both as a leading researcher and as a coordinator who consult with and collect information from the city authorities and key stakeholders. The following data collection methods have been used.

Desk Research

A desk review includes collecting secondary information and data from existing resources. Here, relevant data and information were collected from open sources, the government published data and other reports from stakeholders.

Field Surveys and Observations

A field survey including observations was carried out to understand the current situation and challenges for MSW management and plastic waste management in the city. Due to the lack of secondary data on plastic waste generation, a field sampling survey was conducted from October to November 2021. The field survey collected primary data from different sources such as households (multi- and single-family dwellings), rural areas, public areas, commercial areas, institutional areas, formal waste transfer stations, recycling activities, and at disposals sites. **Table 1** summarises the number and category of sectors selected for the sample survey. First, solid waste was collected randomly in front of the houses before waste collection. Each sample was then labelled and transferred by cart to the gathering point. For other waste sources, waste was collected and transferred by cart or truck. Due to a large amount of waste from the markets, the coning and quartering method was used to reduce the sample size to about 200 kg for sorting. The coordinates of the samples are recorded for positioning on the map. The waste composition is illustrated in **Table 2**.

| | Waste sources | Sub-waste sources | Number of samples | Remarks |
|---|--------------------------|------------------------------|-------------------|--------------|
| 1 | Household | Small size | 30 | Single floor |
| | | Middle size | 30 | 2 floors |
| | | Big size | 30 | > 2 floors |
| 2 | Food (Restaurants) | | 3 | |
| | Drink | | 3 | |
| | Accommodation | | 3 | |
| 3 | Commercial sectors | Traditional market | 2 | |
| 4 | Institutional sectors | Schools | 3 | |
| | | People's Committee office | 3 | |
| 5 | Informal collected waste | Itinerant buyer ² | 3 | |
| | | Waste pickers | 3 | |

Table 1

The waste sources of sampling survey



| | Waste component | Description |
|---|---------------------|------------------------------------|
| 1 | Organic waste | Food waste, kitchen waste |
| 2 | Garden waste | Leaves, flowers |
| 3 | Paper and Cardboard | All kinds of paper and Cardboard |
| 4 | Metals | All kinds of metal |
| 5 | Glass | All kinds of glass |
| 6 | Plastics | The detail in Table 3 |
| 7 | Textiles | All kinds of textle |
| 8 | Covid-related | Mark, protect clothes |
| 9 | Other | Rubber, leather, wood, ceramic,... |

Table 2

The main composition of waste

After sorting the main components of waste, the composition of the types of plastic waste was identified and measured under 12 components based on the PPC as summarized in **Table 3**.

| | Waste component | Description |
|----|--|---|
| 1 | Plastic bags | Carrier bags, refuse bags, dog poo bags, dry cleaner bags |
| 2 | Sanitary products | Plastic cotton buds, wet wipes, nappies (diapers), feminine hygiene products, etc. |
| 3 | Other plastic films | Film packing, film lids, crisp packets, sweet wrappers, cling film, bubble wrap, shrink wrap, newspaper sleeves, cereal box liners, bread bags, plastic sheeting, sachets, pouch |
| 4 | PET bottles | Bottles made of PET: e.g. typically water bottles, soda bottles, clear, Soap bottles, clear spray bottles. Note this should include the bottle, Cap when attached. |
| 5 | Other non-PET bottles | Typically HDPE but maybe other polymers. Milk bottles, shampoo bottles, household cleaning bottles, multi-use drink bottles. Note this should include the bottle cap when attached. |
| 6 | Pots, tubs & trays | Dense plastic food packaging including meat trays, margarine tubs, yoghurt pots, salad trays, cookie trays, etc. |
| 7 | Expanded Polystyrene | EPS cups, plates, takeaway containers (clamshells), packaging insulation. |
| 8 | Single-use foodservice | Straw, disposable plastic cutlery, coffee stirrers, disposable cups, coffee lids. |
| 9 | Cigarette butts | Cigarette butts |
| 10 | Other small dense items (all dimensions ≤ 20 cm) | Small non-food packaging: toothpaste tubes, blister packaging etc. Small non-packaging items: stationery, lighters, combs, plastic spools, small toys, tape dispensers, etc. |
| 11 | Other large dense items (at least one dimension > 20 cm) | Buckets, pipes, plastic chairs, storage containers, crates, large plant pots etc. |
| 12 | Covid related PPE | Plastic face masks, plastic gloves, plastic gowns |

Table 3

Plastic composition

Interviews

An open-ended questionnaire was also used to gather information from the key stakeholders including managers of URENCO, the staffs of local environmental departments about the municipal waste management system and current waste management practice at sources. Both formal (03) and informal private sectors (03) dealing in plastic waste, and NGOs that conduct awareness raising activities and skill-up trainings to promote 3Rs of plastic waste were also included.

Mapping method

The distribution of residents along the water body and the coast by the distance was described in the cadastral map of Da Nang city.



1.3.1 Plastic Pollution Calculator (PPC) Tool

Material Flow Analysis Approach

The study applied the Plastic Pollution Calculator⁶, an international waste modelling methodology developed by the International Solid Waste Association (ISWA) and the University of Leeds, at a district level. It uses a comprehensive Material Flow Analysis (MFA) approach to quantify plastic pollution sources, sinks and pathways (**Figure 4**). This method integrates the many different factors controlling plastic pollution, including waste composition, topography, infrastructure quality, local socio-economic conditions, climate and waste management practices. A digital elevation model and flow routing algorithm are then applied to map the pathways that plastic waste enters the environment, including modelling surface runoff and entry points.

Calculation of Plastic Emissions into the Environment

As shown in **Figure 4**, all major components of the solid waste management system are modelled so that the plastic item flows are balanced across each process. Acknowledging the challenge in calculating plastic waste emissions to the environment due to variations in time and space/location, the PPC uses conceptual models to relate all factors important in estimating plastic emissions based on available data and expert opinion. The relationships are assigned a number to estimate the quantitative influence based on available data and expert opinion and are converted to mathematical algorithms. Input data on waste management infrastructure, practices and other influencing factors are then combined to estimate the likely amount of plastic waste emitted into the environment. The transfer coefficients, an ability to be moved by wind or surface runoff, probability of collection for recycling, and likelihood of becoming entangled in vegetation once released in the environment, are also calculated for each plastic item type within the MFA.

⁶ <https://plasticpollution.leeds.ac.uk/wp-content/uploads/sites/89/2020/07/Plastic-Pollution-Calculator-Summary.pdf>

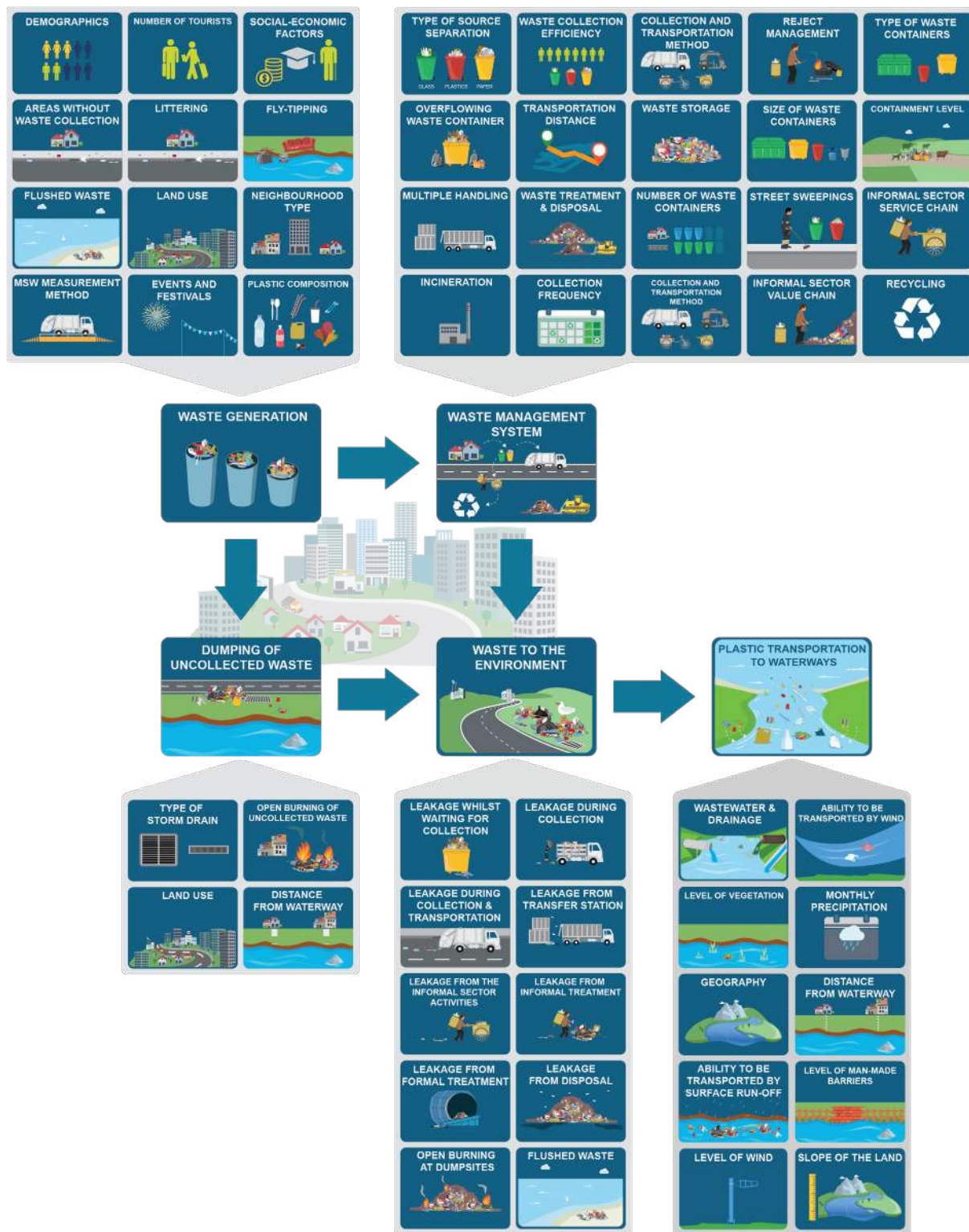


Figure 4
Material Flow Conceptual Framework of the Plastic Pollution Calculator (PPC)



Spatial Distribution of Plastic Emissions and Leakage

The PPC is applied at sub-city-district or neighborhood level assuming that lowest administrative areas have relatively homogeneous features for key plastic waste emission factors (e.g. waste management infrastructure, socio-economic and geographical characteristics). This allows a reasonably accurate picture of plastic flows across a whole city or region (also accounting for any transboundary flows). However, districts or neighborhoods are even not entirely homogenous, thus, the PPC estimates the spatial distribution of plastic emissions within a district by allocating each emission source to one of five grids, including Residential activity grid (e.g. population density), Non-residential activity grid (e.g. shops, tourist sites, parks), All activity grid (e.g. combined residential and non-residential activities), Roads grid and Waste infrastructure grid (e.g. dumpsites, transfer stations).

Each of these five grids are ultimately overlaid to provide an overall spatial representation (hotspot map) of plastic emissions at the sub-district level. The PPC also identifies the important factors influencing the likelihood of a plastic item being transported in the environment (e.g. distance to waterways, meteorological conditions, and the geographical and built landscape). A conceptual model is created to estimate plastic emissions entering waterways by assigning a relative weighting to each factor depending on its perceived influence and relationship with other variables. The PPC uses a digital elevation model (DEM) and flow routing algorithms to map the routes that plastic waste emitted into the environment would travel due to surface runoff and the locations where plastic released into the environment may eventually reach waterways and the ocean.

Limitations of the PPC

The PPC functions by performing the MFA to map plastic waste flows across each district in the City, with emissions of plastic waste determined by analysing the waste management infrastructure, practices, and linking it to the PPC conceptual models. However, this approach relies on sufficient reliable data available to perform the MFA. For the case of Da Nang City, some input data was not directly available and as such had to either assumed using proxies or estimated using expert opinion from the local teams guided by University of Leeds. Examples of input data that proved particularly difficult to obtain included understanding the amounts of littering, dumping and open burning present.

Similarly, even when data was available, reliability was occasional lacking leading to potential irregularities in the results. For example, the waste generated by households was calculated to be significantly lower than the total waste arriving at the landfill. Whilst this is possible, it is thought that potential inconsistencies between the literature data used for household waste generation rates and the official data of waste arriving at landfill may lead to this difference being exaggerated. Whilst it would have been preferable not to use literature data for the household waste generation rates, and instead use the waste characterisation study performed here, this was not possible due to Covid-19 restrictions. These restrictions meant household surveys could not be undertaken to ascertain household size, and therefore per capita generation.

Other limitations of the study revolve around the assumption that the waste management within a district is homogeneous. This is required in order to simply describe the waste management system. Although efforts have been made to account for any differences in waste management by allowing this to be specified for each land use, some variance is still likely. For example, compactor trucks were reported as the main method used to collect waste from households, however, it is also known that in some hard to access areas, auto-rickshaws may be used instead. Within this study, only the dominant waste management practice is assigned. Similarly, behavioural practices such as dumping of waste in rivers is known to be highly spatially dependent. Within the PPC however, probabilities of direct dumping to water are assigned based on the average distance of the population within that district to waterways, and therefore does not account for the specific locations within the district which may lack waste collection services.

Lastly, whilst the provided interventions are linked to the plastic pollution source, items, pathways and sinks in Da Nang, we were unable to assign an estimated impact of these interventions due to sensitivity analysis being required in order to account for the complex relationship that upstream and downstream interventions may show, and which was out of scope for this project.



1.3.2 Review of Governance Aspects

One of the major reasons to the failure of solid waste management in the cities is poor governance due to lack of the following: 1) existing solid waste management policies and regulations; 2) financial capacity to introduce new SWM technology/ infrastructure; 3) appropriate institutions and capacities; 4) the development of private sector and recycling industries; 5) finance and cost recovery systems; 6) strategic planning/ directions, looking at waste management as an end-of-pipe issue; 7) political will; and 8) stakeholder participation and partnership⁷. This is not exceptional for plastic waste management in developing cities. In examining governance aspects, we focused on proactive policies and sound institutions, stakeholder participation and inclusivity, financial sustainability, and the digital readiness⁸.

⁷ Marshall and Farahbakhsh 2013; McDougall et al. 2001; Premakumara and Maeda 2014

⁸ Wilson et, al, 2015

Proactive Policies and Sound Institutions

Are there adequate national and local policies, legal frameworks, and enforcement mechanisms to tackle plastic pollution in Da Nang City?

Strong policies and sound institutions are key to a sustainable plastic waste management system. Without them, plastic waste management systems will not work well over the long term.

Stakeholder Participation and Inclusivity

How are local stakeholders involved in the plastic waste value chain in Da Nang City, and to what degree are they included in policy planning implementation and evaluation?

Even though the municipal governments are responsible for managing solid waste, they cannot provide effective service in isolation. Sustainable plastic waste management systems need to incorporate all key stakeholders in planning, implementing, and monitoring the changes, particularly three main groups of stakeholders: the service providers, including both formal and informal sectors; the users, who are the clients of the supplied service; and the external agents in the enabling environment, including national and local government, who organize the boundary conditions and make change possible.

Financial Sustainability

Are city waste management services adequately resourced, including ensuring cost recovery and long-term financial planning?

Securing financial sustainability in solid waste management is a major concern for cities. In developing cities, solid waste management in general represents a significant proportion of their total recurrent budget. In spite of relatively high costs, collection coverage is often low and disposal standards remain poor.

Digital Readiness

How is Da Nang City applying new digital technologies to enhance waste governance and citizen engagement?

Having an appropriate digital system in the cities opens new ways to prevent, reduce and even eliminate waste from specific sectors and streams, to advance resource recovery, to achieve high standards of treatment and disposal, to substantially reduce pollution and environmental impacts. At the same time, it provides new tools to stimulate stakeholders' interaction, awareness and citizens' participation, to apply the "polluter pays" and the "extended producer responsibility" principle towards smart cities.

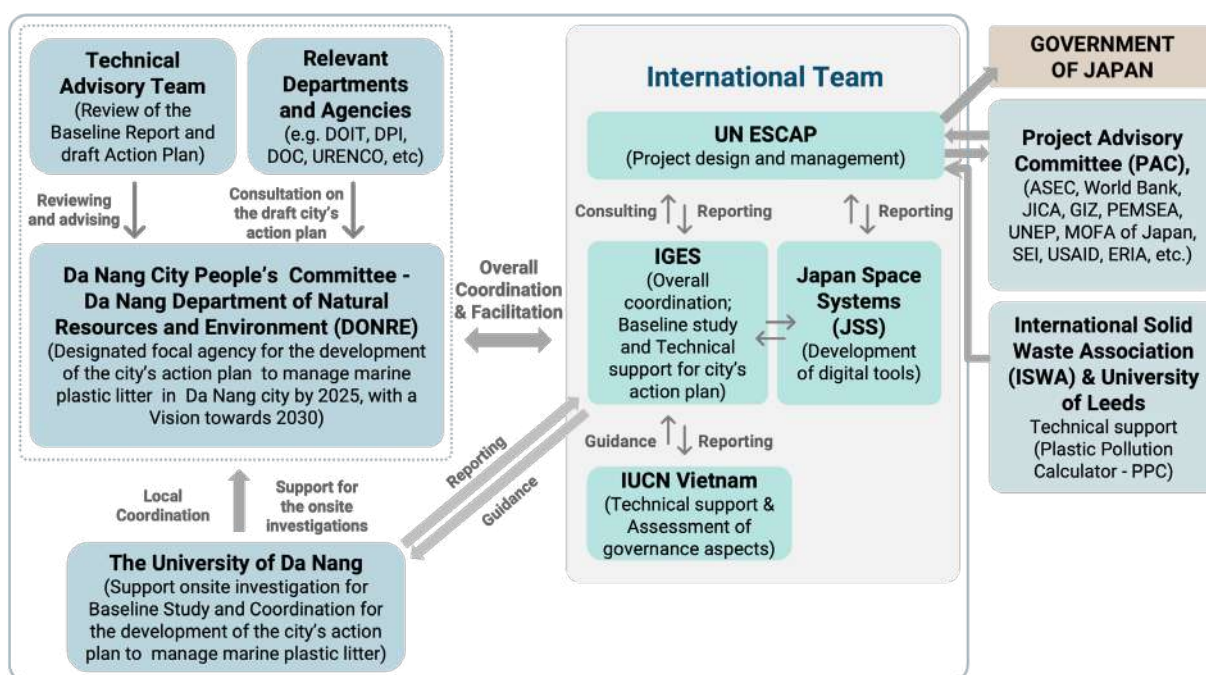


1.4 Study Area

Noting that plastic leakage into waterways is a transboundary issue it is necessary to understand leakage across administrative boundaries. For the purposes of determining plastic leakage from land-based sources within Da Nang City, this study determined to analyse the issue of plastic leakage within the following 7 districts of Da Nang City which make up the Study Area including: Hai Chau, Cam Le, Son Tra, Thanh Khe, Ngu Hanh Son, Lien Chieu and Hoa Vang. In this Baseline Report, the Study Area will also be referred to as “Da Nang City” or simply, “the City”.

1.5 Project Coordination Team

Organisational Structure for the Project Coordination



1.6 Data verification

The study also organised a stakeholder workshop on 1st March 2021 inviting experts representing officials, academic, and other civil society groups to discuss and verify the data and key findings of the baseline report.



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CHAPTER 2

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

City Profile

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CHAPTER 2

City Profile

2.1 Population

Da Nang City is the largest urban center and the economic hub in the central part of Viet Nam. It has a total land area of 1,285 sq.km⁹, located on the Coast of Eastern Sea at the mouth of the Han River. Da Nang City is a dynamic port with approximately 90km of coastline. The total population of Da Nang City was approximately 1.14 million people in 2019, increasing 2.4% since 2018. 87.2% of the population live in the urban districts and 12.8% in the rural district. The average population density in Da Nang City is 1,165 people/km², which is lower than Ho Chi Minh (4,363 people/km²) and Ha Noi (2,398 people/km²).

⁹ DONRE. 2019. Report of Environmental Situation of Da Nang in 2019 – Theme: “SWM”



2.2 Environment

Da Nang City consists of both a coastal plain and mountainous lands. The high and steep mountainous area concentrates in the West and Northwest part of the city with a height of about 700 - 1,500 m. The East and Southeast part of the city covers the low plains bordering to the East Sea, where most urban activities are concentrated.

In Da Nang City, all seven districts are contiguous with the riverbanks or the coastlines. Even though the natural area is limited, the river network is quite spread and join the downstream of Vu Gia – Thu Bon River. The river system is short and slightly steep, flowing from the Northwest to the sea with three main branches, namely Han, Tuy Loan and Cu De rivers. The local natural conditions have brought advantages for local socio-economic development. According to the Department of Natural Resource and Environment (DONRE), more than 30% of the population in each district has occupied within 500m from the waterways or the coast, in which Son Tra and Ngu Hanh Son account for the percentages of 60.8% and 48.1%, respectively. This indicates the advantages of nature to the lives and livelihoods of local communities, namely the development of tourism activities, economic trade in the vicinity. Undeniably, this also brings potential risks of water and ocean pollution from municipal solid waste.

2.3 Economy

Over the past decade, Da Nang City has recorded remarkable progress in achieving economic development with an average annual GDP growth rate of 10%. The City is expected to account for 2.8% of the national GDP and is estimated to reach a per capita GDP of US \$4,500 – 5,000 at the end of 2020¹⁰. Da Nang City's economy historically has been dominated by the industrial and construction sectors. However, this has now transitioned towards the trade and service sectors, accounting for 56.17% in 2018¹¹. The tourism sector reached a remarkable growth rate of 13.4% in 2019 though COVID-19 greatly impacted this in 2020¹². The tourism activities primarily concentrate on Son Tra, Ngu Hanh Son and Thanh Khe districts along the river and coastline. Hai Chau district is the administrative center, Lien Chieu and Cam Le districts focus more on developing industrial activities. Hoa Vang is the main agricultural area of the City.



Taking advantages of strategic location, economic incentives and growing workforce, Da Nang City has attracted substantial foreign investment projects in the past years. In 2020, the City granted 14 investment licenses to foreign investment projects with the total committed capital of more than US\$1.68 million, mainly in the fields of food, services, information technology and foreign language training¹³. The City is also expecting domestic and foreign investment in 57 key projects by 2025. These projects included education, healthcare, tourism-services-commerce, culture and sports, information technology-industrial infrastructure, high-tech industry, environmental improvement, transport-infrastructure-logistics and high-tech agriculture.

According to the land-use, the industrial zones are concentrated along the North-West bay and the eastern bank of the Han River. The business districts and high-density residential zones can be found on the western bank. The increase of urbanization and the rapid development of the tourism industry have increased the risks of solid waste, including plastics, being released into the waterways. Therefore, it is essential to assess the pollution hotspots, the capacity of the local MSW management system and evaluates the risk of plastic leakage from source-to-sea in Da Nang. These assessments will provide inputs to identify practical actions for reducing the leakage of plastic waste into the sea and protect the marine environment.

¹⁰ Da Nang government. 2019. Statistical Year-Book of Da Nang city.

¹¹ DONRE. 2019. Report of Environmental Situation of Da Nang in 2019 – Theme: “SWM”

¹² VGP News - Online Newspaper of the Government, December 2019

<http://news.chinhphu.vn/Home/Da-Nang-strives-to-welcome-98-million-tourists-next-year/201912/38381.vgp>
VGP News - Online Newspaper of the Government, February 2020

¹³ <http://news.chinhphu.vn/Home/Da-Nang-licenses-14-foreigninvested-projects-in-January/20202/38688.vgp>



CHAPTER 3

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

Status of Plastic Waste Management, Leakage and Hotspots

- P48 MSW Generation**
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CHAPTER 3

Status of Plastic Waste Management, Leakage and Hotspots

3.1 Municipal Solid Waste Generation

Municipal waste generation in Da Nang City has been steadily increasing alongside strong economic development. The average municipal solid waste (MSW) generation rate increased by 15-16% from 2016 to 2020¹⁴. As of 2019, MSW generation in the City was approximately 1,177 tonnes per day, yet dropped 8% to 1,078 tonnes per day in 2020 due to the impacts of COVID-19. Based on a regular development forecast, the City will generate 1,794 tonnes per day by 2030 and 2,450 tonnes per day by 2045. While waste management collection, transport and treatment services have improved to cover an average of 95% of waste generated in Da Nang City in the last five years, it is still not enough to solve their plastic pollution problem.

¹⁴ Da Nang Department of Natural Resources and Environment (DONRE), 2021. The current state of environment in Da Nang city in the period 2016 - 2020.

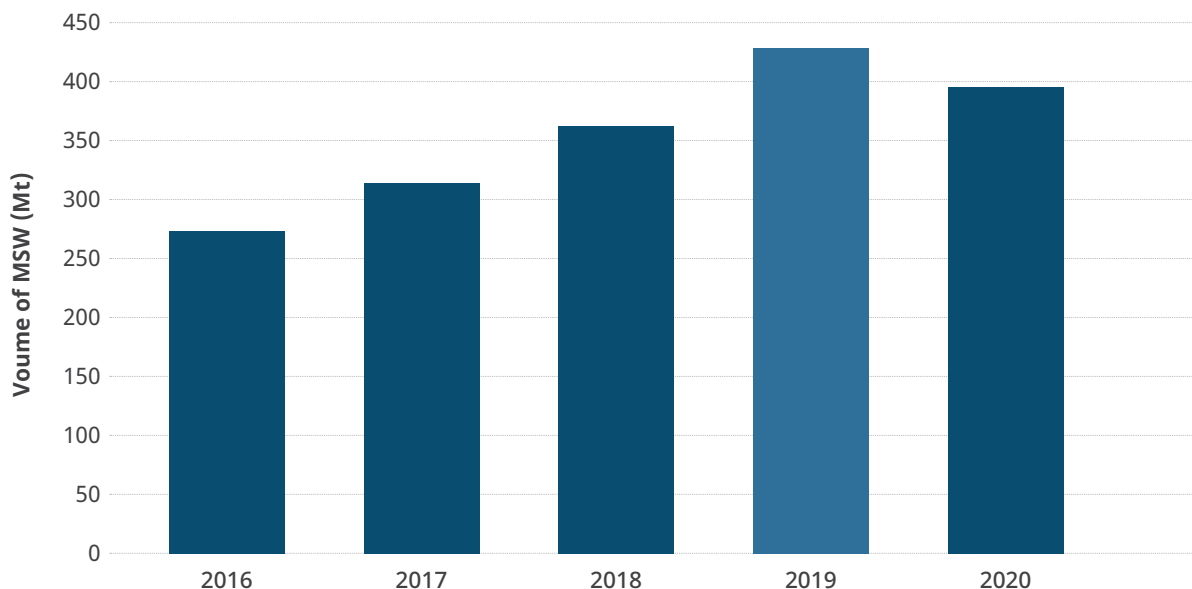


Figure 5

Volume of Municipal Solid Waste generated per year in Da Nang City

In total 449,000 tonnes of municipal solid waste (MSW) is generated in Da Nang each year. Only by accounting for all this waste can we accurately map the waste flows. With a residential population of just over one million people, this equates to an average waste generation rate of 1.08 kg per person per day. These waste generation rates are calculated to account for all sources of waste, including those which are typically not measured (e.g. litter that goes uncollected). This figure is substantially higher than values for the country as a whole, with the World Bank What a Waste 2.0 report suggesting a 2016 waste generation rate of 0.33 kg/capita/day¹⁵. However, large urban cities are known to have higher waste generation rates, with comparable waste generation rates found in Ho Chi Minh and Hanoi^{16,17}.

¹⁵ KAZA, S., L. YAO, P. BHADA-TATA and F.V. WOERDEN. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development Series, Washington, DC: World Bank, 2018

¹⁶ VERMA, R.L., G. BORONGAN and M. MEMON. Municipal Solid Waste Management in Ho Chi Minh City, Viet Nam, Current Practices and Future Recommendation. *Procedia Environmental Sciences*, 2016, 35, pp.127-139.

¹⁷ TSAI, F.M., T.-D. BUI, M.-L. TSENG and K.-J. WU. A causal municipal solid waste management model for sustainable cities in Vietnam under uncertainty: A comparison. *Resources, Conservation and Recycling*, 2020, 154, p.104599.

3.1.1 MSW Generation by District

MSW generation across the districts within the study area of Da Nang is spatially diverse, with the more urban district generating higher quantities of MSW than the larger Hòa Vang rural district. Of the urban districts, Hải Châu, Thanh Khê, Sơn Trà and Liên Chiểu generate the most amount of MSW. This outcome results from having larger populations combined with higher waste generation rates as seen in **Figure 6**.

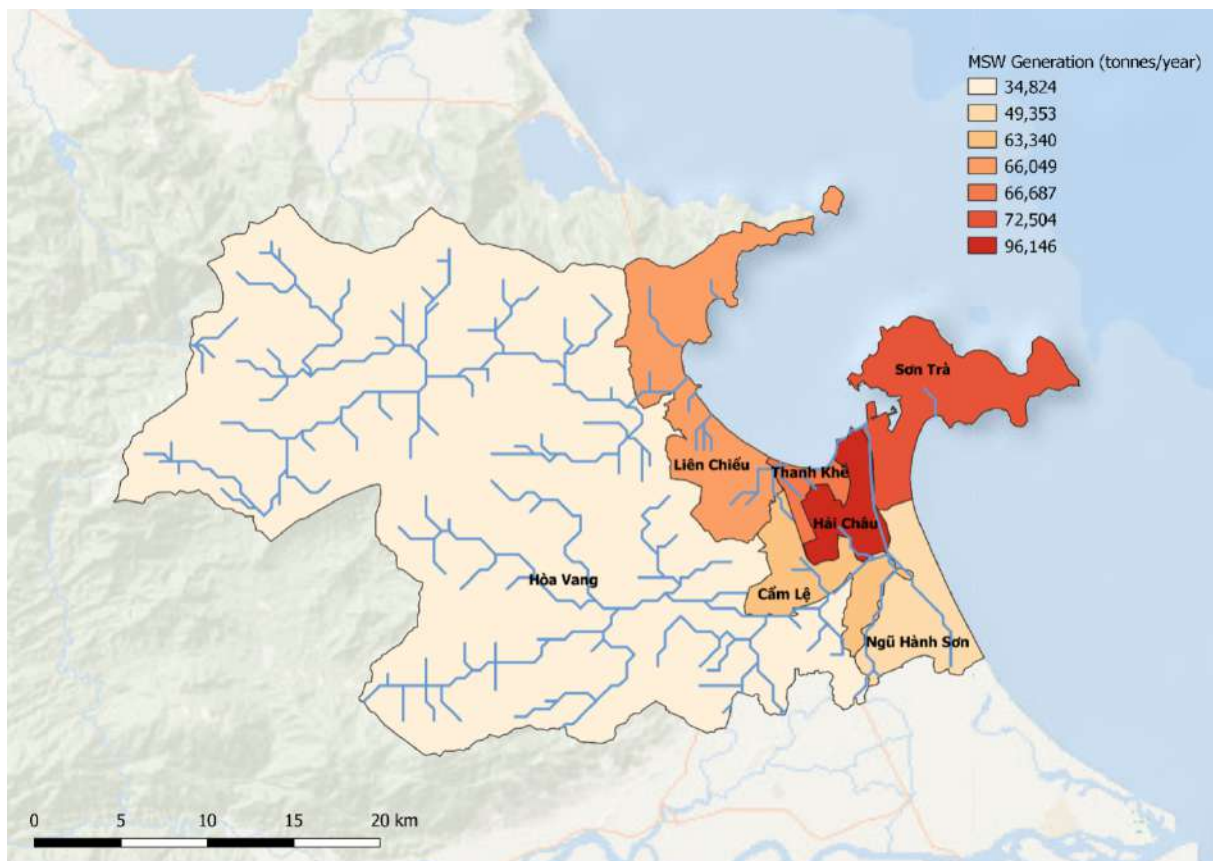


Figure 6

MSW generation within the study area

3.1.2 MSW Generation by Source Activity

The MSW generating activities that produce this waste can be thought of broadly as residential waste, commercial waste, institutional waste (e.g. schools, healthcare and public administration) and other waste (e.g. street sweepings, litter that remains uncollected, flushing of sanitary waste, recyclables sold directly to the informal sector etc.). **Figure 7** shows that residential waste accounts for 46% of MSW generation, with a further 39% of MSW being generated by commercial activities. Institutional establishments produce about 5% of waste, whilst the remaining 10% of waste originates from other activities. For comparison, we also reviews the result of the solid waste management project in Thanh Khe district (an urban district of Da Nang city) funded by WWF¹⁸. According to this sample study, the MSW generation by source is as shown in **Figure 8**: households (50%), business sectors (20%), markets (12%), institutions (12%) and, others (6%). It has been found out that the waste generation from residential sector is relatively low in the PPC result. There may involve counting issue between residential and commercial waste as most common form of housing in Da Nang City is combination of shops at the ground floor and houses at the upper floors¹⁹.

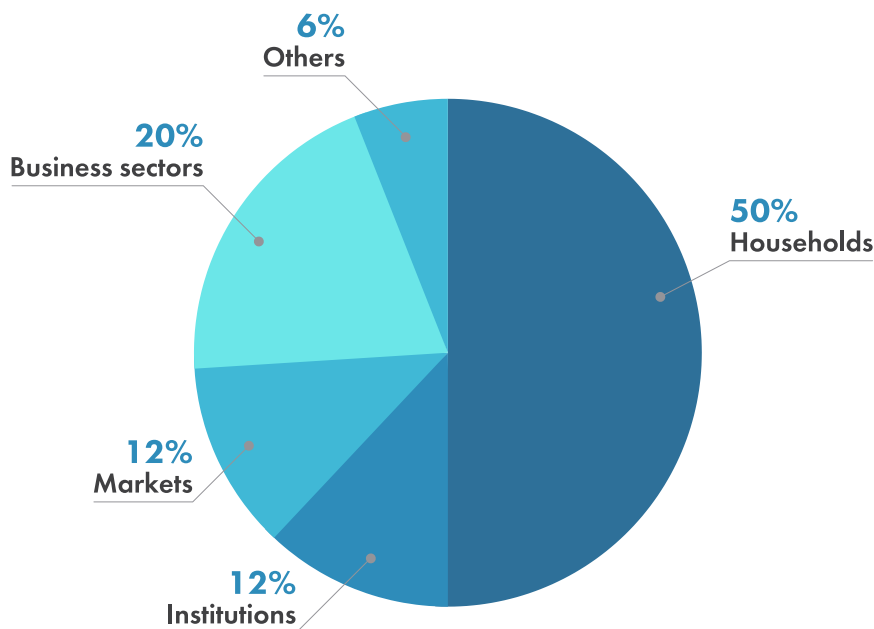


Figure 7

MSW generated by sectors in Thanh Khe district

¹⁸ The City of Da Nang, Vietnam joined WWF's Plastic Smart Cities (<https://plasticsmartcities.org/blogs/media/vietnam-now-counts-three-plastic-smart-cities-commitments>)

¹⁹ VETTER-GINDELE, J., A. BRAUN, G. WARTH, T.T.Q. BUI, F. BACHOFER and L.J.R. ELTROP. Assessment of Household Solid Waste Generation and Composition by Building Type in Da Nang, Vietnam. 2019, 8(4), p.171.

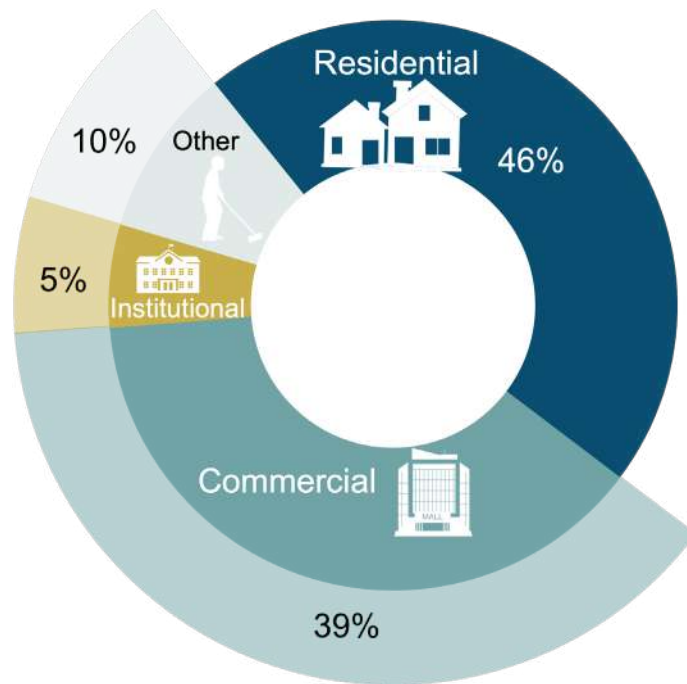


Figure 8

MSW generation by broad sectors

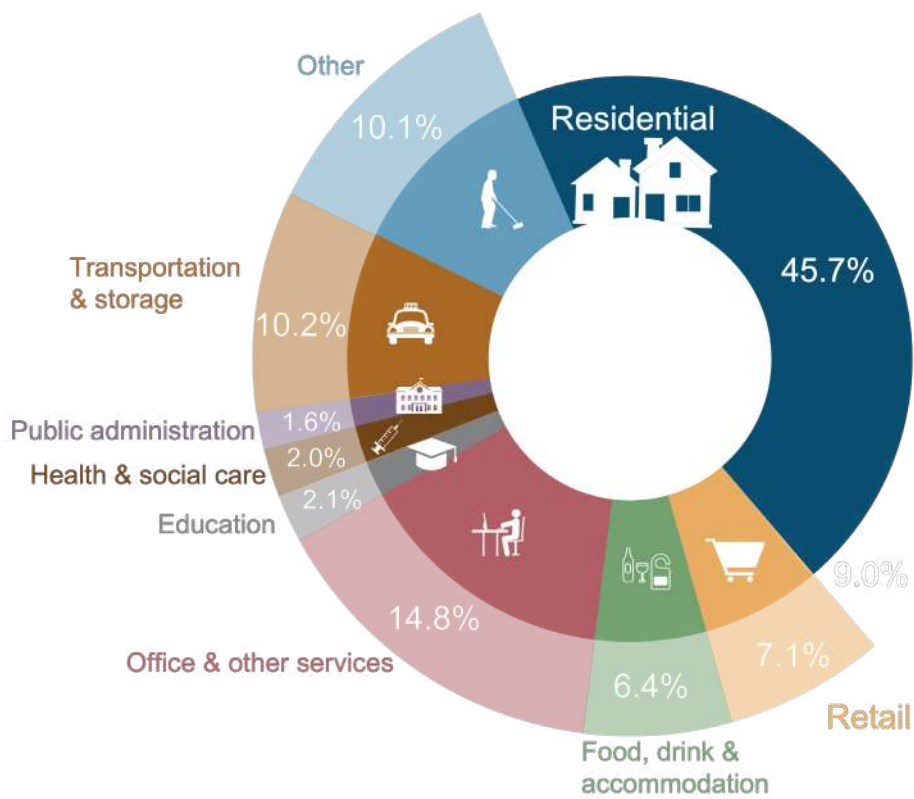


Figure 9

MSW generation by detailed activity

This non-household generated MSW can be further divided by the detailed sectors according to the International Standard Industrial Classifications of All Economic Activities (ISIC), Rev. 4²⁰, as shown in **Figure 8** and **Figure 9**. It can be seen the major contributions to the commercial sector come from office and other services, transportation and storage, food drink and accommodation, and retail and wholesale. The institutional waste generation on the other hand is relatively equal between public administration, health and social care and education.

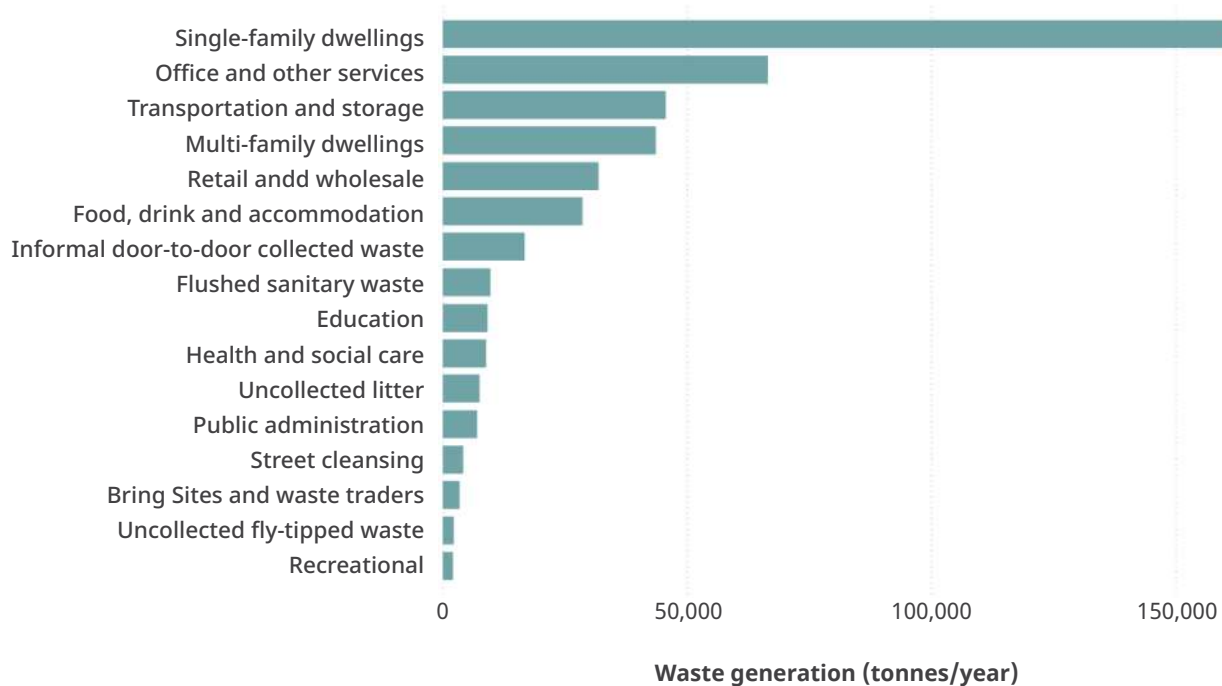


Figure 10

MSW generation per year by detailed activity

²⁰ UNITED NATIONS. *International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4*. Statistical Papers, New York: United Nations, 2008.

3.2 Plastic Waste Generation and Composition

Each of the detailed MSW generating activities has its own unique waste composition, with the amount and composition of plastic waste generated varying for each (**Figure 10**). Applying these compositions to the waste generation quantities shown in the section 4.1 calculates 83,000 tonnes of plastic waste is generated per year in Da Nang City. The distribution of this plastic waste is largely consistent with the overall MSW quantities for each detailed activity. The highest quantities of plastic waste are generated by single-family dwellings followed by office and other services, transportation and storage, and food, drink and accommodation sectors.

The overall composition of the plastic waste generated is shown in **Figure 11**. Plastic bags dominate the plastic waste generation, accounting for 48.1%. In addition to plastic bags, other plastic films are also relatively high at 18%. Therefore, most of Da Nang City's plastic waste is lightweight plastic products that commonly have low value and are susceptible to leakage.

Higher value plastic items, which are commonly targeted for recycling such as plastic bottles, only represent 7.5% of plastic waste generation, thereby inherently limiting the potential for recycling.

It should be noted here that as this waste characterisation survey was performed in November 2020 during the Covid-19 pandemic, waste generating patterns may have altered due to behavioural changes or sanitary practices. However, by mass it was found this category consisting of personal protection equipment (PPE) only accounted for 0.16% of MSW sampled, or 0.86% of plastic waste sampled. This Covid-related waste was included here within the sanitary products category so as to accurately reflect waste generation in 2020. As this is deemed negligible in size the composition is not expected to vary considerably to that from non-Covid years and therefore these results are potentially applicable to other years.

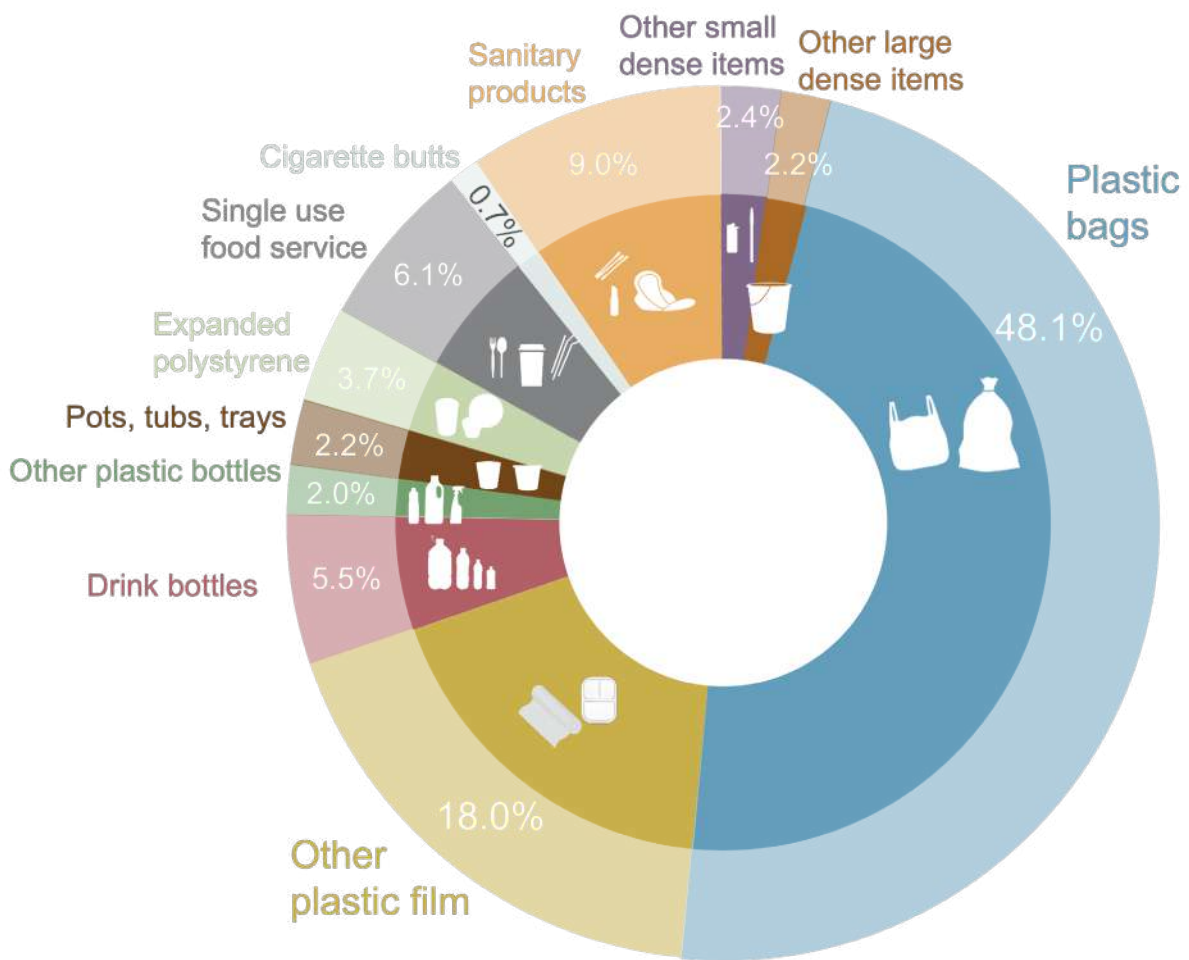


Figure 11
Plastic waste item composition at source per year

Figure 12 shows a more comprehensive breakdown by each detailed activity. It is important to consider not only the overall plastic composition, but also the plastic composition per land use because plastic composition can vary largely depending on the specific activities, with some land uses potentially generating larger amounts of ‘troublesome’ items such as carrier bags or single-use plastic items, thereby becoming key land uses for intervention. In Da Nang City, residential activities produce a diverse range of plastic waste products. For most activities plastic bags account for almost half of all plastic emissions and as such represent an item that should be targeted throughout the city. Commercial waste in particular has large amounts of its plastic waste stream comprised of plastic bags, other plastic film and single-use food service plastics.

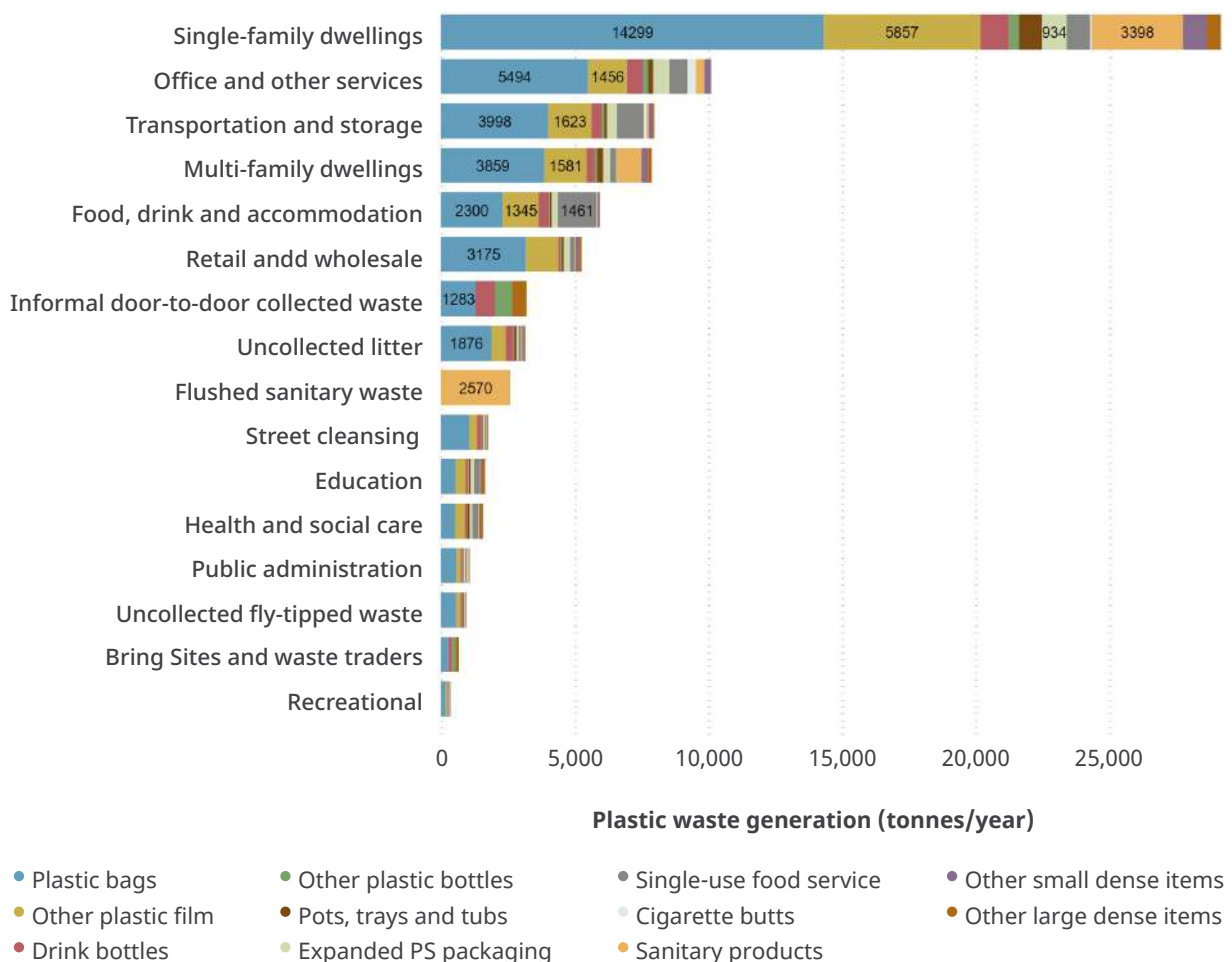


Figure 12

Plastic waste composition by detailed activity in the study area

3.3 Plastic Emissions to the Environment

Plastic emissions to the environment (i.e. plastic leakage) are here defined as the plastic waste, which escapes the MSW management system to become uncontrolled in the environment. Although formally managed dumpsites often lack sound practices, the very nature of collecting and dumping the waste in a defined location is counted here as control and therefore is not included in our definition of plastic emissions. However, any plastic which blows off these disposal sites, or which is emitted at another stage of MSW management, including that which remains uncollected, is included.



3.3.1 Key Sources of Plastic Pollution

The plastic emission sources to the environment for Da Nang are shown in **Figure 13**. Littering is the most prominent emission pathway for plastic entering the environment, releasing 3,156 tonnes of plastic waste a year. On a per capita basis and accounting for the number and visit length of tourists, this is equivalent to approximately 7 grams of plastic littered per person per day or about one plastic bottle a day per person. Efforts are needed to address both individual habits and infrastructure around littering. In addition to littering, leakage from uncollected waste accounts for the second-largest emission pathway in Da Nang City, releasing 1,568 tonnes of plastic waste a year. Despite Da Nang City achieving relatively complete collection coverage, > 95% in Thanh Khê, Hải Châu and Sơn Trà; 95% in Liên Chiểu, Cẩm Lệ and Ngũ Hành Sơn and 90% in Hòa Vang rural district. This shows that even small gaps in collection coverage can lead to large plastic emissions into the environment.

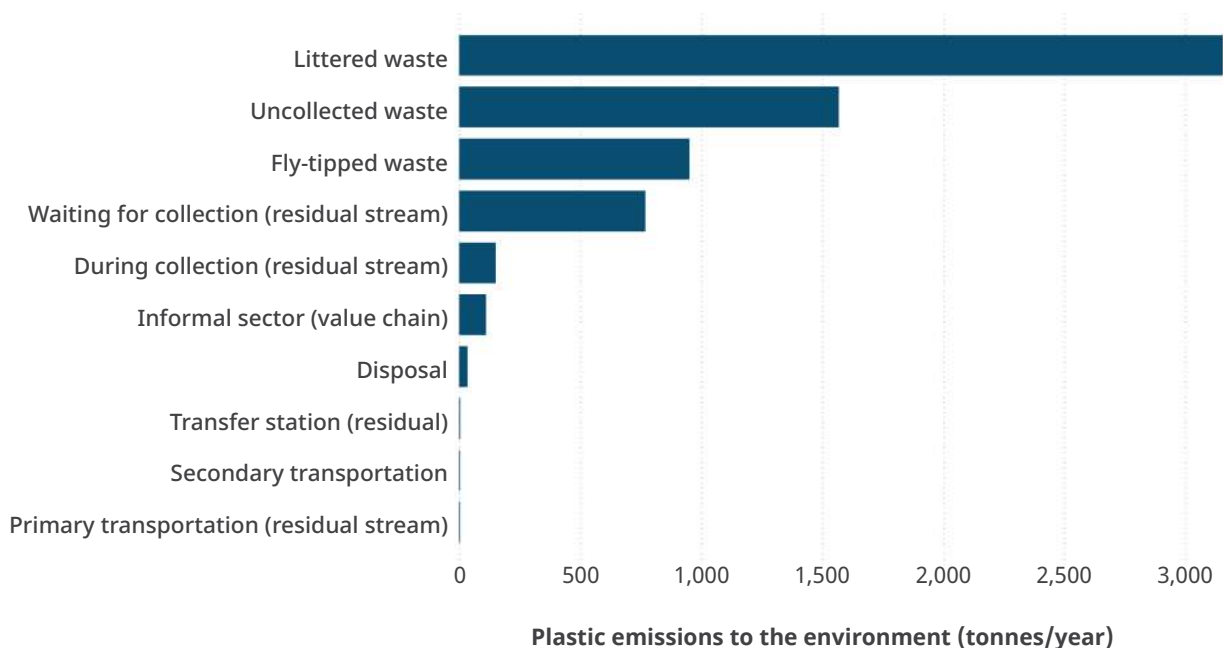


Figure 13

Key source of plastic pollution in the study area



Following uncollected waste, both 'fly-tipping' and 'whilst waiting for collection (residual stream)' are the next largest sources of plastic pollution, with similar quantities around 951 and 769 tonnes per year, respectively. The damaged, dilapidated and overflowing collection containers in some districts are among the causes of this leakage.

Fly-tipped waste: illegally dumped waste on a large scale (multiple items) by residents or businesses at a place where collection service is available, often as a means to avoid paying disposal fees.

Littered waste: disposed waste on a small scale (single item) at non-waste collection point such as streets, rivers, and open areas.

Uncollected waste: dumped waste at a place which lack any form of waste collection service



Figure 14

Damaged and overflowing waste containers leading to plastic emissions A) outside apartment buildings, and B) within a market.

3.3.2 Composition of Plastic Emissions to the Environment

The composition of plastic emitted to the environment varies compared to that generated. This is due to increased likelihood of certain item types leaking based on the waste management practices of their source activity and due to their inherent material form making some more susceptible to movement. However, unsurprisingly the emissions to the environment are still primarily dominated by plastic bags, accounting for 56.9% of all plastic released, followed by plastic film (18%) (Figure 15). These lightweight and cheap plastic products dominate plastic pollution in the environment.

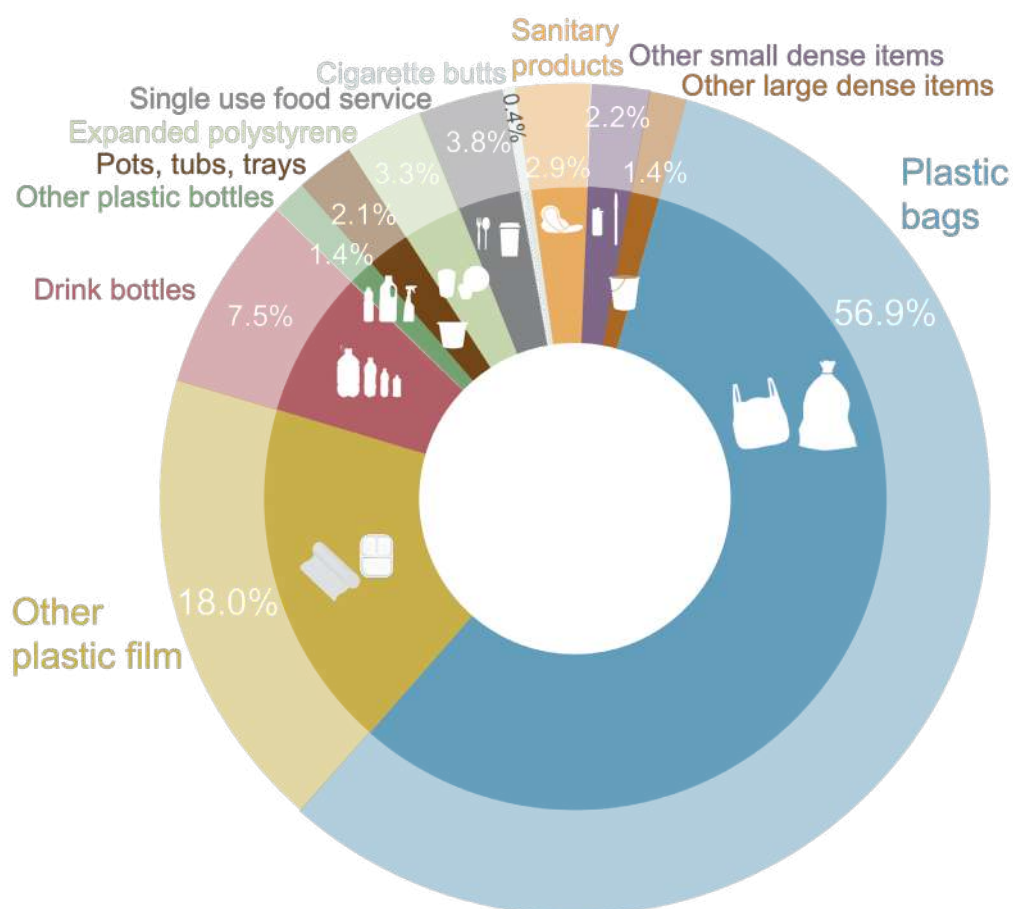


Figure 15

Item composition of plastic emissions to the environment in the study area

3.3.3 Plastic Emissions with Time

The emissions of plastic waste can often vary across the different months of the year. This is particularly the case when emission sources are as a result of wind or surface runoff which itself can show seasonal patterns. This time dependence for emissions can be seen in the results for Da Nang City, with peak emissions occurring during the rainy season from September to December (**Figure 16**). This increase in emissions during this period is mainly a result of the 'waiting for collection' source with any waste placed in or around waste bins having higher likelihood of movement due to increased rainfall. On the other hand, the other prominent emission sources of uncollected waste and littering do not display a temporal dependence and therefore occur throughout the year in large amounts. Breaking the result down by item type, plastic bags and other plastic film in particular show the most seasonal fluctuation due to their high occurrence in the waste stream and their strong affinity to be moved by wind and surface runoff. Whilst other items also show small fluctuations with time, this is not as significant as that seen for the aforementioned items.

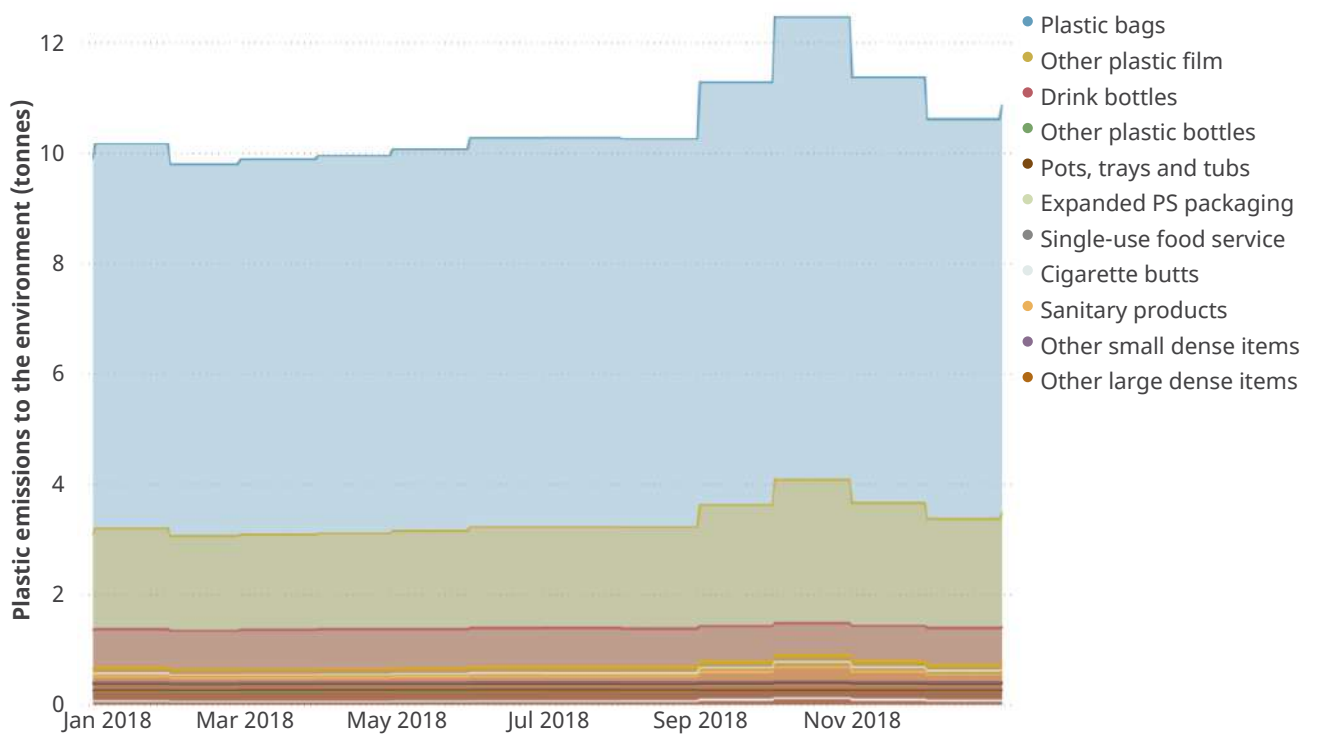


Figure 16

Plastic emissions into the environment by item type with time

3.3.4 Spatial Distribution of Plastic Pollution Emissions

Whilst the results so far have shown the plastic emission for Da Nang City as a whole, here we examine the plastic emissions to the environment by spatial location, made possible by running the Plastic Pollution Calculator across each district. **Figure 17** shows the total plastic emissions to the environment in tonnes per year for each district. Hai Chau, Cam Le and Liên Chiểu are considered the highest plastic emissions, producing an estimated 1,152, 1,122 and 1,113 tonnes per year, respectively. Hải Châu is a prominent district for plastic pollution largely due to its high population and because it is a focal point for commercial activities such as markets, therefore likely leading to increased littering. Alternatively, Liên Chiểu and Cẩm Lệ are predicted to have high levels of plastic pollution due to them having a high population combined with a collection coverage less than 100% and relatively poor waste management infrastructure. In addition, Sơn Trà, Thanh Khê and Hòa Vang were calculated as having the lowest plastic emissions. For Sơn Trà and Thanh Khê, their low plastic emissions are mainly because it has a relatively well functioning waste management system. On the other hand, Hòa Vang has low emissions due to it having a small residential population, despite much of the fly-tipped waste being dumped there.

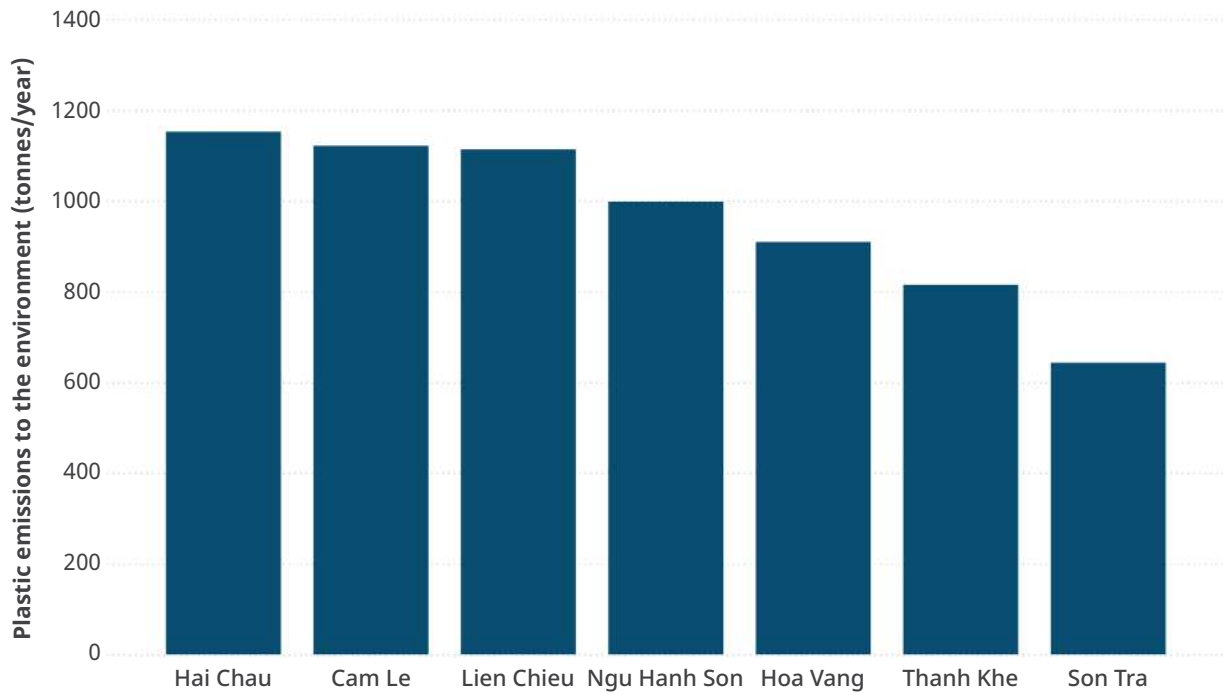


Figure 17

Plastic emissions to the environment in tonnes per year by district



For completeness, it is also important to consider the plastic emissions on a per capita basis so as to compare districts fairly. This is shown in **Figure 18** whereby the tourist numbers are either included or excluded in the per capita basis. When excluded, the per capita emissions is simply the total emissions per district divided by the residential population, however, when included, the total emissions per district are divided by the residential population plus the annual tourist arrivals multiplied by their average visit length in days over 365.

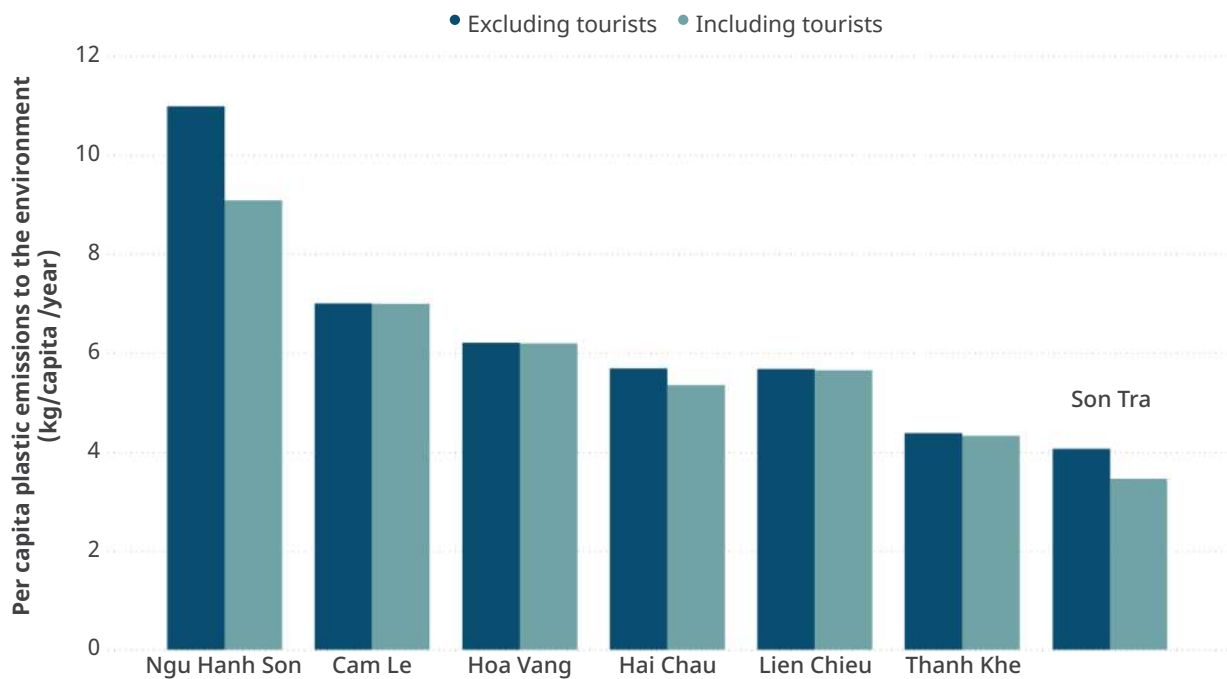


Figure 18

Per capita plastic emissions to the environment by district including (light blue) and excluding (dark blue) tourists in the per capita calculation.

It can be seen that Ngũ Hành Sơn has the highest per capita emissions at 11 kg/resident/year when excluding tourists in the per capita number. However, when including the presence of tourists in the per capita value, this drops to 9 kg/capita/year. Therefore, whilst Ngũ Hành Sơn was found to have the lowest overall plastic emissions, it also had the highest per capita emissions, likely as a result of the low residential population in the district. This has potentially important implications when deciding the districts to prioritise interventions. Hòa Vang has the lowest per capita plastic emissions, again due to a relatively small residential population but high overall emissions. Alternatively, Sơn Trà has the lowest per capita emissions when including tourists at 3.5 kg/capita/year. This is instead a result of improved waste management within the district, such as relatively well functioning and maintained waste containers.

Lastly, the plastic emissions by location of emittance are shown in **Figure 19**, mapped for each pixel (450 X 450m) in kg/year. This spatial representation of plastic emissions is achieved by mapping the waste management infrastructure and allocating the associated emissions from each district to each. For the case of Da Nang, only the location of the disposal site was available and therefore all other emissions were allocated according to the population distribution as reported by World Pop²¹. It can be seen that both Thanh Khê and Hải Châu appear to have a higher concentration of plastic emissions due to their increased population densities. Additionally, whilst the disposal site in Liên Chiểu is a point source for emissions, the controlled nature of the site means these emissions are negligible in comparison to other areas. Key hotspots for plastic emissions include those in Cam Le, downtown Hai Chau, as well as in the touristic areas of Ngũ Hành Sơn.

²¹ UNDP and EVERGREEN LABS. *Mapping Informal Waste Sector in Da Nang*. 2020.

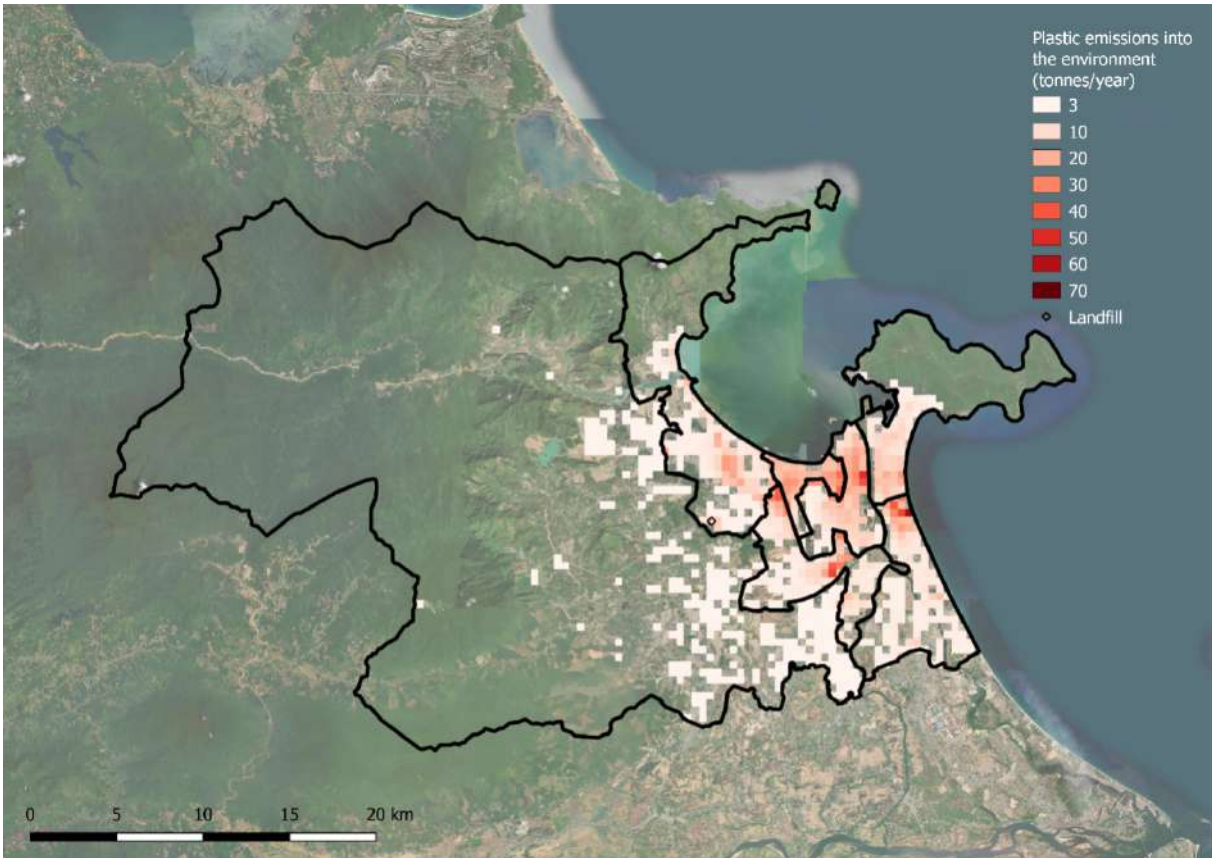


Figure 19
Spatial distributions of plastic emissions in kg per year in the study area. This visualised per 450 m X 450 m pixel

3.4 River and Marine Plastic Pathways

As plastic entering waterbodies has the potential to cause harm to aquatic life, the Plastic Pollution Calculator assumes a broad definition for its aquatic plastic debris which encompasses all MSW derived macroplastic waste (over 5mm in size) entering aquatic environments (i.e. permanent rivers and waterbodies). Depending on the location and in-river characteristics not all this plastic waste may enter oceans, however, this broad definition is deemed preferable to account for all potential harm. However, plastics pollution encompasses all damaging aspects of plastic emissions into the environment, therefore accounting not only for marine plastic litter, but also plastic retained on land, retained in drains or openly burnt.



3.4.1 Key Pathways of River and Marine Plastic

The pathways that plastic waste emitted in the environment takes to reach waterways is shown in **Figure 20**. It can be seen that 49% of aquatic plastic debris enters waterways directly via dumping. This can be a result of both uncollected waste being dumped directly into waterways or due to littering and fly-tipping alongside the coast and rivers. A further 40% of aquatic plastic debris enters waterways by moving overland, for instance, by being blown by wind or moved by surface runoff. The remaining 11% of aquatic plastic debris enters waterways via storm drains. This is commonly a major transportation pathway for aquatic plastic debris, however, within Da Nang the storm drains are enclosed which significantly reduces the ability for plastic waste to enter them and transfer to waterways. Likewise, the presence of a wastewater treatment plant in Da Nang ensures that plastic waste flushed down toilets is removed and therefore this is not included as a pathway.

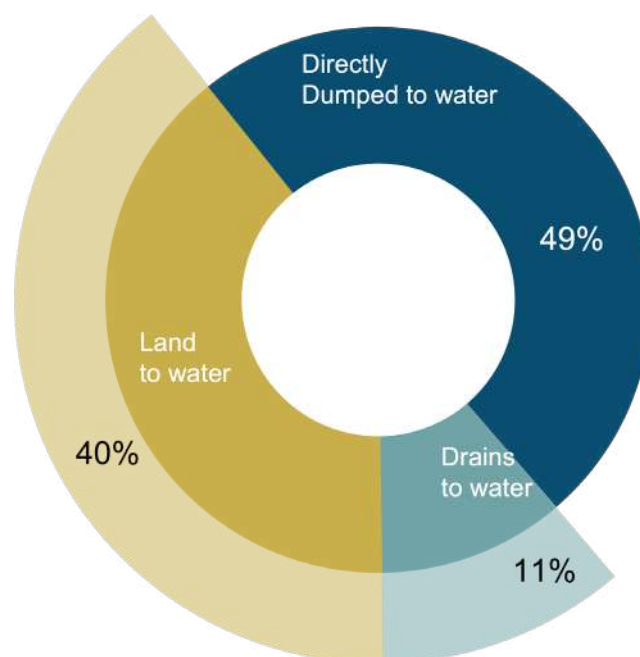


Figure 20

Key aquatic plastic debris pathways in the study area

3.4.2 Pathways of River and Marine Plastic with Time

The strong dependence of plastic transportation with meteorological conditions can be seen in **Figure 21**. Here the plastic emissions to water with time show a peak during the months of September to November, matching that of the rainy season. As previously described, the rainy season not only results in more plastic being released into the environment, but as shown here, also improves the likelihood of plastic being transported into rivers and the ocean by overland or within drains. The direct dumping of plastic to water does not significantly vary by month as would be expected.

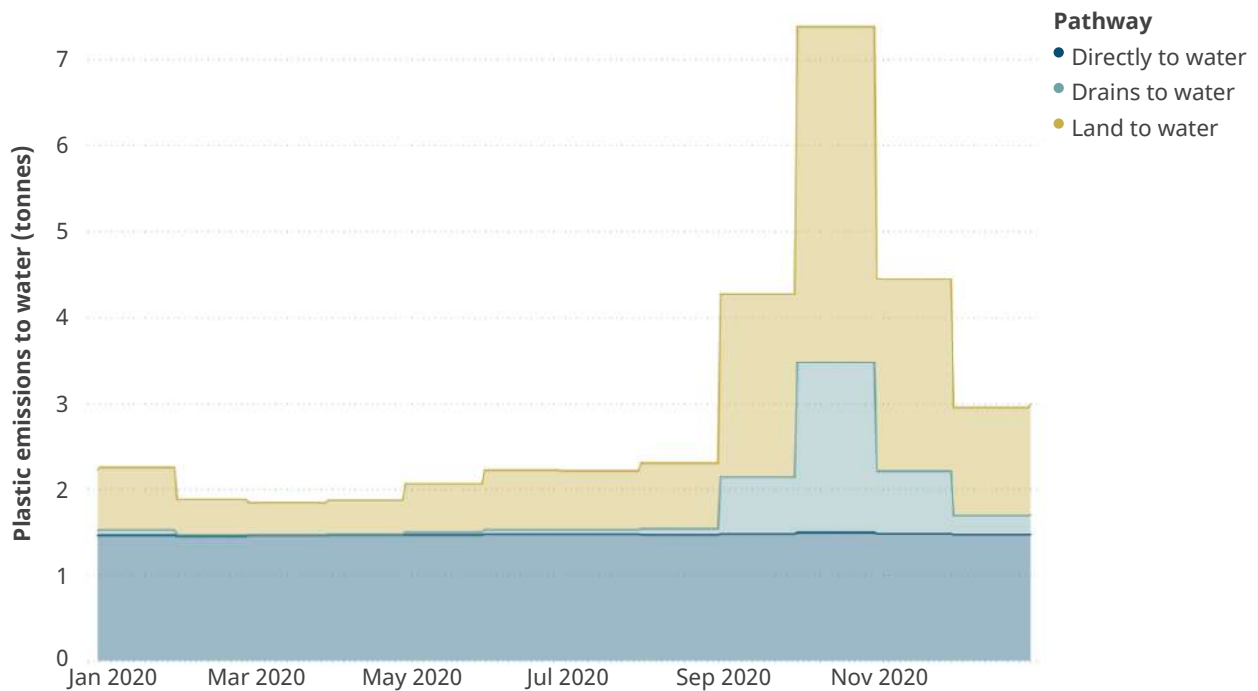


Figure 21

Plastic emissions to water with time

3.5 Fate of Plastic Waste

An overview of the fate of plastic waste within Da Nang City is summarised in **Figure 22**. Overall, 85.8% of plastic waste ends up at the disposal site where it is retained, whilst only 6.1% of the plastic is sorted for recycling and about 8% of the plastic waste is unmanaged. This unmanaged plastic waste stream has high potential to damage the local environment and ecosystems and accounts for an estimated 6,752 tonnes of plastic waste per year. Of this, 5,645 tonnes, equivalent to 6.8% are retained on land, while 1,087 tonnes enter the aquatic and marine environment. This aquatic unmanaged plastic waste is equivalent to 1.3% of overall waste and many millions of plastic waste items. Over time and without clean-up activities, this plastic will degrade, breaking down into innumerable micro-plastics which are extremely difficult to recover. Another 20 tonnes is openly burnt, contributing to urban air pollution.

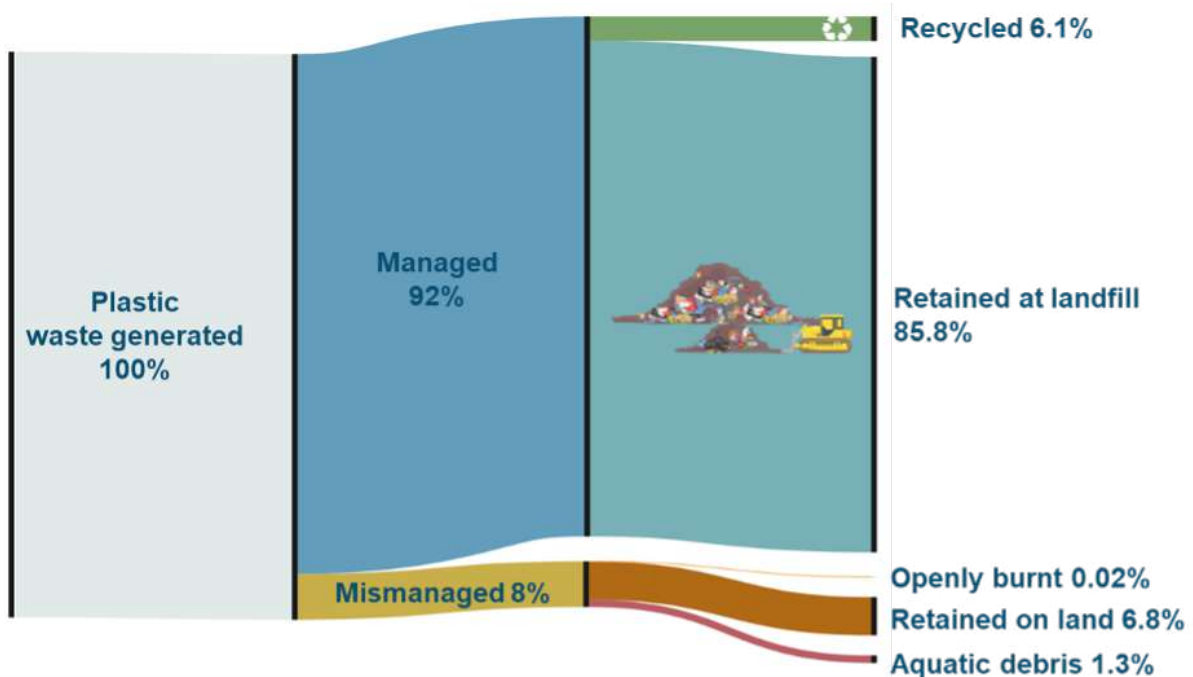


Figure 22

The fate of plastic waste in Da Nang City

3.5.1 Plastic Recycling

There is no formal system in place for the collection of plastic for recycling in Da Nang. This is evidenced by a lack of source separation by all generator types, meaning dry recyclables are mixed with all other waste fractions therefore contaminating potentially recyclable materials and making extraction of recyclables from this mixed waste more difficult. Instead, Da Nang operates in a largely linear fashion whereby the majority of waste is simply disposed of without recovering any of the inherent material value.

The 6.1% of plastic waste found to be recycled in Da Nang is largely due to the efforts of the informal recycling sector (waste pickers) of which there are an estimated 1,000 – 1,800 working²². These operate both door-to-door, collecting valuable recyclables from homes and businesses, and also at the disposal site, extracting any valuable materials from the waste being deposited there. This plastic waste is subsequently sold to waste traders, where the material is aggregated, sorted, and sold on to re-processors. Although these waste traders often operate across many types of recyclables, **Figure 23** clearly shows plastic waste, and in particular PET drink bottles, are targeted. However, the waste characterisation analysis performed for this study also found some plastic bags were also targeted for collection by the waste pickers, in agreement with that found in the recent UNDP and Evergreen Labs study on the informal waste sector in Da Nang City.

²² UNDP and EVERGREEN LABS. *Mapping Informal Waste Sector in Da Nang*. 2020.



Figure 23

Waste traders in Da Nang showing A) PET bottles collected for recycling and stored internally, B) other plastic bottles collected for recycling and stored externally but in bags, and C) plastic crates collected for recycling and stored loose and externally

3.5.2 Retained at Disposal Site

The vast majority of plastic waste generated in Da Nang ends up at the disposal site in Liên Chiểu. Whilst originally a sanitary landfill, the site now runs over capacity, operating more as a controlled dumpsite. However, the disposal site is not the primary reason for plastic emissions to the environment, with aspects such as uncollected waste, littering and emissions whilst waiting for collection more important. This is due to the disposal site still employing some controlled practices such as applying coverage to inactive areas of the site, as seen in **Figure 24**.



Figure 24

Disposal site of Da Nang (application of controlled plastics by covering)
Contrast between active areas and inactive areas

3.5.3 Openly Burnt

Approximately 20 tonnes per year of plastic waste is burnt in Da Nang City. This is reported to occur in the rural district of Hòa Vang, whereby an estimated 5% of uncollected waste is believed to be openly burnt as a means of waste disposal for residents. However, open burning of waste is notoriously difficult to monitor, measure and enforce; therefore this amount should be considered conservative. More research should be undertaken to understand the true extent of open burning both in Da Nang and the surrounding areas.

Considering 20 tonnes of plastic waste is burnt annually, an estimated 57 tonnes of CO₂ emissions are released each year. This is calculated by converting the items to polymers and multiplying the carbon content of each polymer burnt by 3.67 to account for the carbon reacting with oxygen. Incomplete combustion is assumed at 2% as reported by Hamilton et al.²³, therefore this amount was subtracted from the carbon content. Additionally, black carbon (BC) is known to be a significant product of incomplete combustion for some polymers, with worryingly a much higher global warming potential (GWP) than CO₂ alone. Here black carbon was calculated according to the emission factors given by Reyna-Bensusan et al.²⁴ leading to an estimated 271 kg/year of black carbon emissions. Taking the reported average GWP of BC as 2,200, and summing alongside the CO₂ emissions, the overall CO₂-equivalent emissions from open burning in Da Nang are 619 CO₂-eq tonnes/year.

²³ HAMILTON, L.A., S. FEIT, C. MUFFETT, M. KELSO, S.M. RUBRIGHT, C. BERNHARDT, E. SCHAEFFER, D. MOON, J. MORRIS and R.J.C.F.I.E.L. LABBÉ-BELLAS. *Plastic & Climate: The Hidden Costs of a Plastic Planet*. 2019

²⁴ REYNA-BENSUSAN, N., D.C. WILSON, P.M. DAVY, G.W. FULLER, G.D. FOWLER and S.R.J.A.E. SMITH. *Experimental measurements of black carbon emission factors to estimate the global impact of uncontrolled burning of waste*. 2019, 213, pp.629-639.

3.5.4 Retained on Land and in Drains

In addition to the plastic waste retained at the landfill, an estimated 6.8% of plastic waste is predicted to be retained dispersedly across land and in drains. For example, this plastic waste may have become trapped in vegetation and urban infrastructure. Whilst it is assumed that this plastic waste does not become marine litter within the modelling timeframe of a year, it is likely that some of this plastic may enter waterways in subsequent years. This is particularly the case if the plastic begins to degrade and fragment in the environment into microplastics (less than 5mm) making transportation by surface runoff more likely or contaminating soils. Likewise, plastic retained in the storm drain network poses risks of local flooding by obstructing the channels leading to potential flooding.



3.5.5 River and Marine Plastic Pollution

Whilst 1.3% of plastic waste generation becoming aquatic debris may sound small in comparison to other flows, in fact this represents 1087 tonnes of plastic waste a year. The lightweight nature of plastic means that this actually represents many millions of items. For example, the composition of this aquatic debris is 53.7% plastic bags by weight as shown in **Figure 25**. Assuming a plastic bag weighs approximately 5g, this would represent 116 million plastic bags entering aquatic environments each year! Likewise, although only 6.8% of the aquatic debris is plastic bottles, assuming an approximate average mass of 20 grams per bottle, this would represent 3.7 million bottles entering aquatic environments per year.

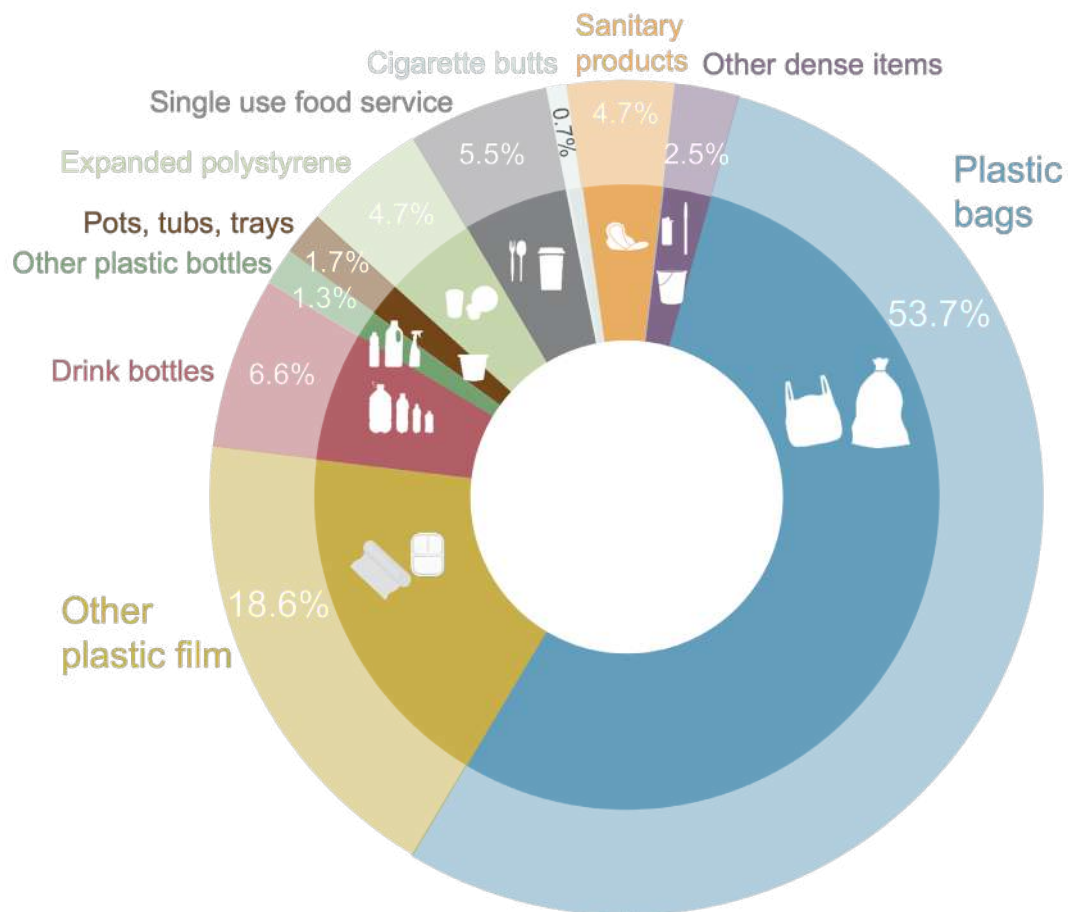


Figure 25
Composition of plastic waste entering waterways

As shown in **Figure 26**, the district that contributes the most amount of aquatic plastic debris is that of Liên Chiểu, with an estimated 246 tonnes of plastic waste entering aquatic environments each year. This district ranks top for aquatic plastic debris partially due to it also having one of the largest amounts of plastic waste emissions into the environment. However, whilst it may be thought that plastic waste emissions into the environment would correlate with plastic waste emissions entering waterways across all districts, this is not always the case. This is evidenced by Hải Châu instead having some of the lowest amounts of aquatic plastic debris emissions. The difference seen between these two districts contribution toward aquatic debris is predominantly explained by two reasons. Firstly, Liên Chiểu was calculated as having a higher percentage of its population living in very close proximity to waterways (less than 500m), therefore giving any emissions a higher probability of entering waterways.

Secondly, Liên Chiểu reportedly has 95% collection coverage whereas Hải Châu has 100%. This means that some of the uncollected waste in Liên Chiểu is being dumped into the environment, with this predicted to occur in non-built up areas such as on riverbanks thereby leading to higher aquatic plastic debris amounts.

Cẩm Lệ, Ngũ Hành Sơn and Hòa Vang are also relatively high contributors towards aquatic plastic debris after Liên Chiểu. Again, this is due to a combination of these districts having high population densities living in close proximity to waterways, whilst also having collection coverage lower than 100%. As a result of this, unserved populations have a higher probability of dumping waste directly into waterways, thereby leading to higher aquatic plastic debris than areas where transport across land is the dominant pathway (for example, Hải Châu and Thanh Khê).

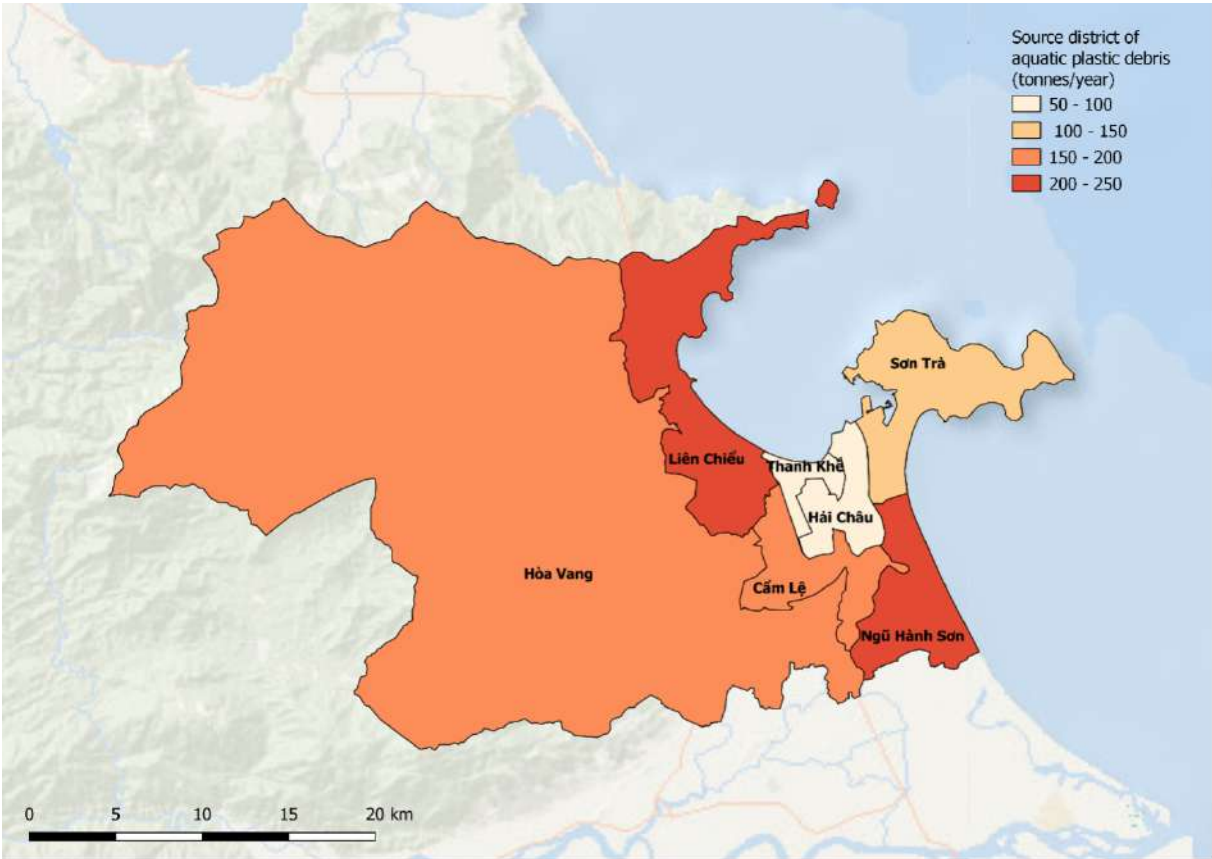


Figure 26

Map of districts contribution towards aquatic plastic debris

Although the Plastic Pollution Calculator does not model the flows of plastic waste once in waterways, here likely hotspot locations are presented showcasing where the aquatic plastic debris would enter the ocean. This is achieved by overlaying the river basins with district aquatic plastic debris and noting the outlet of where that river basin drains to, as seen in **Figure 27**. The Hàn River basin was found to have the largest flux of aquatic plastic debris with up to 1,060 tonnes of plastic potentially draining to this river. However, the much smaller river of kênh Phú Lộc may also receive some of this plastic debris. Lastly, Song Cu De River has much more negligible plastic discharge at 37 tonnes/year.

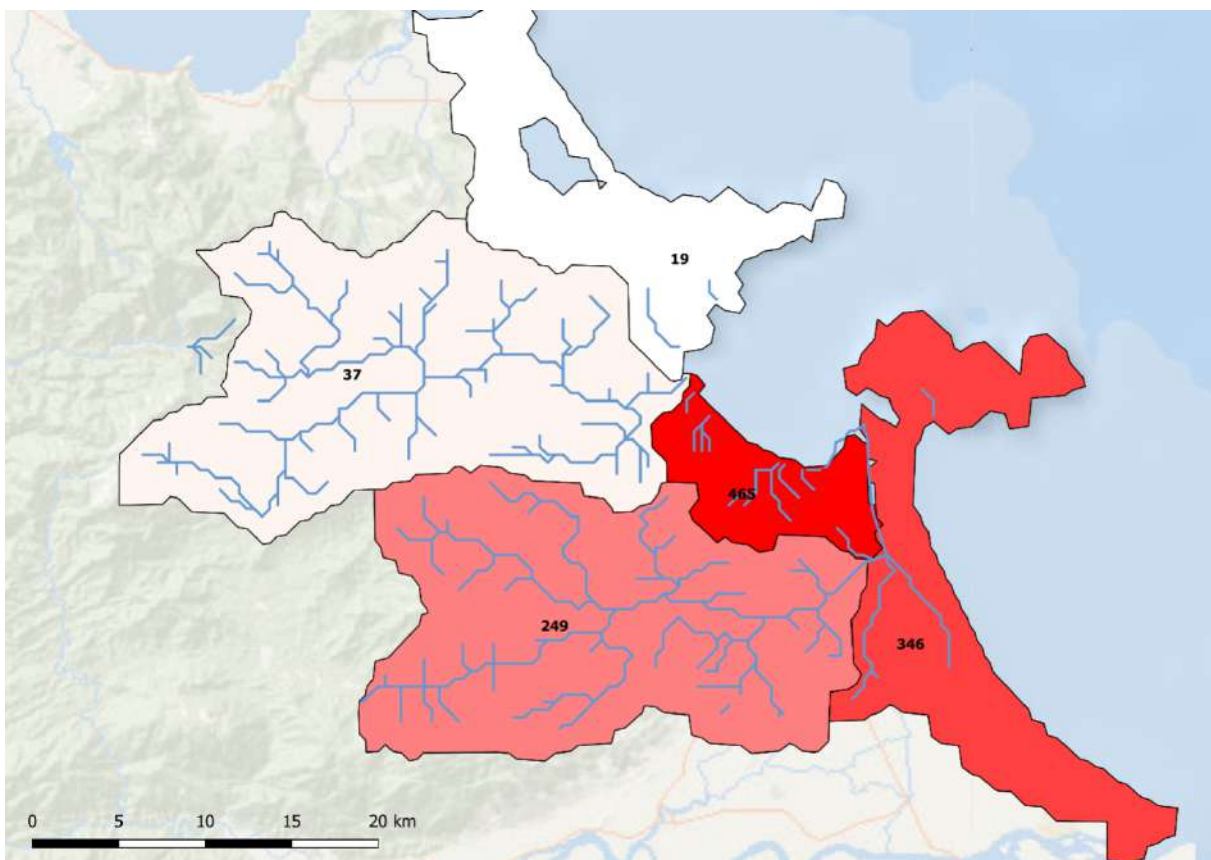


Figure 27

Aquatic plastic debris by river mouth



Figure 28

Maximum potential annual accumulation of plastic emissions on land assuming no retention

The exact locations at which plastic waste may enter waterways was further estimated by performing flow routing methods assuming plastic waste movement follows the natural drainage patterns of the land, as detailed in the methodology section. The results of this can be seen in **Figure 28** for the city centre of Da Nang, whereby each cell represents the flow of plastic waste that would pass through that location over one year assuming no retention (zero stock). However, as there will inevitably be some retention and clean-up, we expect the actual flows to be lower than those reported in this worst case annual scenario, instead summing up to those presented in **Figure 27**. As such, the results shown in **Figure 28** should be used as a qualitative description of possible entry points into rivers of plastic waste only.



CHAPTER 4

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

A Review of Governance Aspects

P84 **Institutional Setup**

National/ Provincial Institutions Responsible for
Implementing Plastic Waste/ Marine Litter
Local (City) Institutions Responsible for Implementing
Waste Management and Marine Litter

P94 **Key Policies and Regulations**

National Policies and Legislations
City Policies and Legislation

P99 **Financial Capacity**

P102 **Digital Readiness in Da Nang City**

CHAPTER 4

Results of Governance Assessment

4.1 Institutional Setup

4.1.1 National/ Provincial Institutions Responsible for Implementing Plastic Waste/ Marine Litter

The Ministry of Natural Resources and Environment (MONRE) is responsible for waste management at the national level, according to Decree 09/NQ-CP dated 2019 on unifying state administration. In addition, many other line ministries are involved in waste management as describes in **Table 4**.

| Name of the Ministry | Key Roles and Responsibilities |
|--|---|
| Ministry of Natural Resources and the Environment (MONRE) | A key agency on environmental management and protection. MONRE is also in charge of coordinating other line ministries and agencies in issuing guidance, regulations and standards on waste management, the development of long-term and short-term plans and strategies, and the delivery of national budgets for R&D for waste treatment projects. The Vietnam Environmental Agency (VEA) operates under MONRE, and it is responsible for developing, guiding and implementing programmes on waste segregation at source, as well as waste reduction, reuse and recycling. MONRE also responsible for hazardous waste management. |
| Ministry of Construction (MOC) | A central ministry with the highest authority in planning, construction of sitting landfills, investment in solid waste management (SWM) infrastructure, |
| Ministry of Industry and Trade (MOIT) | Plastics industry, trade development, production of green products with respect to waste management. In addition, this ministry deals mostly with industrial waste, such as inspect, supervise, and take measures to force businesses and establishments to strictly comply with regulations on industrial waste managements; and coordinate with waste disposal units in disposal of industrial waste (Directive No.199/TTg-1997). |
| Ministry of Agriculture and Rural Development (MARD) | Rural SWM, waste from agriculture and aquaculture is in charge of steering, guiding and verifying the implementation of agriculture waste management policies and guidelines, developing programmes to improve the effectiveness of solid waste management in rural areas, etc |
| Ministry of Health (MOH) | MOH involves in only hospital waste. Its responsibilities in terms of waste management are basically assessing the impacts of solid waste on human health, inspecting and supervising hospital waste treatment activities (Directive No.199/TTg-1997). |
| Ministry of Culture, Sport and Tourism (MOST) | Direct the dissemination and popularization of legal documents on waste management in order to raise awareness and responsibility of the public to environment protection (Directive No.199-1997) |
| Ministry of Planning and Investment (MPI) | The most influential policy maker at the ministerial level because its main task is to propose to the Government for approval of the overall national allocation of state budget. Regarding waste management, MPI together with the Ministry of Finance consider and provide funding and financial sources for other ministries, government agencies, and localities to implement waste management plans based on their annual and long-term waste management plans (Directive No.199/TTg-1997). Furthermore, MPI in coordination with MOF also issue economic incentives to facilitate waste management activities |
| Ministry of Finance (MOF) | Together with MPI, allocate budgets for waste management activities. However, it focuses more specifically on financial and pricing issues (Directive No.199-1997). |

Source: Compiled by authors

Table 4

Key national ministries involved in waste management

At the regional level, before the Decree 09/NQ-CP, the Department of Construction (DOC) is the focal point for SWM in 35 provinces/ cities. DONRE is the focal point for SWM in 20 provinces/cities. Eight provinces/cities assign the mandate to both DOC and DONRE. In compliance with Decree 09/NQ-CP, several provinces have begun to designate DONRE as a focal point for SWM. However, the transition is continuing, as time is needed to update the legislative structure on the competence of all relevant Ministries and to reorganize the respective human resources.

Under MONRE, the Viet Nam Environmental Administration (VEA) is responsible for state management in the environment sector. Under VEA, the Waste Management and Environment Promotion Agency (WEPA) has been assigned with responsibilities on waste management. The Viet Nam Administration of Seas and Islands (VASI) is an agency under the MONRE, with the function of advising and assisting the Minister in the field of integrated management of marine and island resources and environmental protection.

4.1.2 Local (City) Institutions Responsible for Implementing Waste Management and Marine Litter



Figure 29

Structure of Da Nang People's Committee

A Provincial People's Council is the local parliament of the province/city, elected by local people and has a law-making function at the local level. While Da Nang City is a Class 1 city, equal to the provincial level, People's Committee of Da Nang City is the executive agency responsible for state administration at the local level with overall responsibility for waste management (**Figure 30**). Main responsibilities include: (i) execute state management regulations on environment protection; (ii) approve projects of waste treatment in the locality; (iii) mobilize funds from various sources to invest in the landfills; (iv) instruct DONRE to design, develop, supervise, and implement the EIA report for waste treatment projects; (v) instruct URENCO to organize the activities of waste collection, transportation, and treatment; and (vi) approve waste treatment tariff based on the recommendations of provincial/city Department of Finance.

Table 5 shows the key departments in Da Nang City that are involved in waste management. The Department of Natural Resources and Environment (DONRE) is the focal point for MSW including plastic waste management. DONRE collaborates with relevant departments according to their functions and tasks, such as the Department of Planning and Investment, Department of Construction, Department of Agriculture and Rural Development Department of Culture, Sports and Tourism.

The Urban Environment Company (URENCO) (this may have a different name in different cities/provinces based on its role and functions) is the main state-owned company in charge of waste collection, transport, treatment, and the landfill site management in the City. URENCO is also responsible for maintaining hygiene in public places, public lighting, planting and maintenance of roadside trees.

| Name of the Agency | Key Roles and Responsibilities |
|--|---|
| Department of Natural Resources and Environment (DONRE) | Key agency of managing solid waste, including plastic waste |
| Department of Planning and Investment (DPI) | Review and allocate budget for investment project/ program on waste management |
| Department of Construction (DoC) | In-charged of construction solid waste management as well as the planning of solid waste treatment plants and transfer stations in the city |
| Department of Agriculture and Rural Development (DARD) | In-charged of managing waste generated from agriculture production, aquaculture and rural domestic waste |
| Department of Culture, Sports and Tourism | Managing tourism businesses which is a major sources of plastic waste generation |
| Urban Environment Company (URENCO) | Waste operator being responsible for waste collection, transport, treatment, and the landfill site management in the City |

Table 5

Key Departments involved in waste management functions

²⁵ <file:///C:/Users/premakumara/Documents/FY2020/ESCAP-data/Da%20Nang/Gifts%20for%20garbage%20Da%20Nang%20implements%20plastic%20waste%20reduction%20model.html>

In addition to URENCO, Community-based organization such as Youth Union and Women Union of the City actively participate in the communications and raising awareness activities on MSW management. For example, the Youth Union in Chinh Gian Ward (Thanh Khe District) has setup a model project to increase public awareness of plastic waste reduction and environmental protection by encouraging residents to exchange used plastic in return for gifts. Under the model, old bottles and used batteries are exchanged for supermarket gift vouchers every Saturday afternoon. The members can buy either soy sauce, dishwashing liquid, fish sauce, chili sauce or a soft drink using one voucher. If they use two vouchers, residents can buy either sugar, glutinous rice, jelly, cooking oil or chicken eggs²⁵.



In addition to the state agencies, the informal and private sector including waste pickers, junk shops and scrap collection facilities as well as local and international organisations all play key roles in plastic waste management in the City, which are summarized in **Table 6**.

According to a report in VietnamPlus, the URENCO, in co-operation with EverGreen Labs Consultant and EverGreen Social ventures, are aimed to start a pilot project on plastic waste recycling, such as recycling nylon bags, single-use plastic straws and cups, and Styrofoam, with the highly efficient and low cost reform process. The processed plastic waste could be used to make public or hotel trash bins, planks, gym poles or climbing boards, panels for furniture, as well as floor tiles. According to the URENCO, the pilot project cost about an investment of US\$100,000. However, due to the limitations and shortcomings at local levels, the private sector does not find it attractive to invest in solid waste management services due to the uncertainty of the legal framework, inconsistent implementation of regulations, low fees, and lack of reliable data, etc. In addition, ministries and relevant departments are unable to implement the policies on "privatization" due to unclear processes, a wide scope, and complicated procedures. Also, due to lack of legislation, resources, infrastructure, and technology, some of waste management and recycling businesses causing environmental pollution and adversely affecting the health of workers.

| Stakeholder | Responsibilities |
|--|--|
| Private sector | |
| Coca Cola (Ekocenter in Da Nang City) | The British Council and Coca-Cola Vietnam has cooperated with local authorities and businesses to aim to equip teachers with coordination skills, knowledge of waste management, and a positive citizenship spirit of creating positive changes in the environment through an innovative training method |
| DANAPLAST – Danang Plastic Joint Stock Company | One of the main suppliers of plastic bags and packaging |
| Coin for Change | One of social enterprises involved in recycling materials to produce souvenir |
| Packaging Recycling Organization (PRO) | One of the social enterprises of large beverage companies working to promote recycling activities in Vietnam |
| Civil Societies, Non-Governmental Organisations (NGOs), Academies | |
| Viet Nam Plastics Association (VPA) | A professional organization on producing, using, researching and managing plastic directly and indirectly |
| Centre for Environment and Community Research (CECR) | Works on raising awareness and encouraging recycling plastic at source based on community, protecting the ocean from plastic pollution. |
| Center for Consultancy on Sustainable Development (C4SD) | Works to preserve local environment and empower community action against climate change, biodiversity losses and reducing plastic waste |
| Pacific Environment – Vietnam Zero Waste Alliance | Conducts waste and brand audits to design tailored zero waste solutions for individual cities and communities. |
| GreenViet | Works with other partners to bring collaborative change for environmental goods, such as a fashion show where models displayed clothes made from recycled plastic bags and bottles. |
| GreenHub | Works with IUCN and other development partners like World Bank to introduce innovative ways to reduce plastic waste and provide new livelihoods for local women by repurposing this plastic waste. |
| The local higher education institutions (i.e. The University of Danang) | Higher education institutions have been conducting researches related to solid waste management in Danang. The research themes are diverse such as renovation of incineration treatment and composting treatment, optimization of solid waste collection system of Lien Chieu street and leachate wastewater treatment at Khanh Son landfill |

| Stakeholder | Responsibilities |
|--|---|
| Youth clubs (i.e. Green Hero, Green Points, Tram Eco) | Youth clubs play crucial roles in environmental voluntary activities in Da Nang city. Regarding to solid waste, the youth clubs have engaged the young generations and local communities in campaigns such as beach clean-up, Son Tra clean-up, free garbage exchange, recycle station, etc. |
| International Non-Governmental and Governmental Organisations (INGOs, IGOs) | |
| IUCN – Marine Plastics and Coastal Communities Project (Marplasticcs) | IUCN have been working in Da Nang and Quang Nam to promote integrated watershed and coastal management in Vu Gia – Thu Bon River Basin and application of Source to Sea Approach in addressing plastic waste pollution in the river basin, assists governments to strengthen, develop and implement legislation and other measures to reduce plastic pollution, and work with PRO and LAD (MONRE) in supporting the development of the policy on extended producer responsibility |
| WWF – Plastic Smart Cities Initiative | WWF is implementing “Plastic Smart Cities” Initiative, Thanh Khe District is developing an Action plan on Plastic Waste Management with the goal “to reduce by 30% plastic waste emitted to the environment by 2022 compared to 2020 and no more plastic waste emitted to the environment by 2030” |
| The Research Institute for Development (IRD) | The COMPOSE project aims at Creating an Observatory for Measuring Plastic Occurrences in Society and Environment in Vietnam, which is led by the French Embassy in Vietnam and IRD, in partnership with IUCN. The project site includes Da Nang and the research results aims to provide inputs to support policy actions. |
| USAID | Assists selected cities to develop an integrated Waste Management Plan; Clean Cities, Blue Ocean programmes |
| JICA | JICA is a long-term international partner for solid waste management in Da Nang. The current work involved promoting source segregation and recycling in Da Nang City |
| UNDP | Scaling Up a Socialised Model of Domestic Waste and Plastic Management that aims to develop integrated, green and fair models to improve domestic waste and plastic management, in five Vietnamese cities, including Da Nang City |

Table 6

Key Stakeholders involved in Plastic Waste Management in Da Nang City

4.2 Key Policies and Regulation

4.2.1 National Policies and Legislations

With the rising amount of plastic waste and its pollution in the country, the government has started to concentrate more on the problem and began to implement new policies and laws to control plastic pollution. The National Action Plan for Management of Marine Litter by 2030 was approved by the Prime Minister (Decision 1746/QD-TTg) in 2019 to implement counties initiatives effectively and meet international commitments to address plastic waste (**Table 7**). The Plan specifies priority projects, tasks and actions under five categories: (i) Knowledge dissemination, awareness raising and changing behaviour towards plastic products and marine plastic waste, (ii) Collection, separation, treatment and control of plastic waste from source, (iii) International cooperation, scientific research, application, development and transfer of ocean plastic waste treatment technology, (iv) Review, research and building a mechanism to manage marine plastic waste and (v) Monitoring, inspection, supervision and evaluation of the implementation of Decision 1746/QD-TTg.

| Targets | By 2025 | By 2030 |
|---|---|--|
| Reduce marine plastic litter | 50% | 75% |
| Collect abandoned, lost or discarded fishing gear | 50% | 100% |
| Prevent the use of single-use plastics and non-biodegradable plastic bags in costal tourism areas, tourist attractions, accommodations and other seaside tourism services | 80% | 100% |
| Strive marine protected areas to be free of plastic litter | 80% | 100% |
| Monitor marine plastic litter annually and assess marine plastic litter every 5 years at a number of estuaries in the major drainage basins | 5 major drainage basins in 12 insular districts | 11 major drainage basins and in the 12 insular districts |

Table 7

Key targets in the National Action Plan for Management of Marine Litter by 2030

In addition, the Prime Minister promulgated the Directive No. 33/CT-TTg dated August 2020 on strengthening the management, reuse, recycling, treatment and reduction of plastic waste aims to reduce the consumption of single-use plastics and promote eco-friendly alternatives.

The National Strategy on Integrated Solid Waste Management to 2025, vision to 2050 has defined clear directions for waste management, set the objectives and tasks and solutions to achieve the targets. The Strategy has made clear the integrated approach of solid waste management with 3Rs as shown in **Table 8**.

| Target | By 2025 | By 2050 |
|--|---------|---------|
| Rate of municipal waste collection | 90% | 100% |
| Recycling rate of municipal waste | 85% | 90% |
| Collection rate of C&D waste in urban areas | 80% | 90% |
| Recycling rate of C&D waste in urban areas | 50% | 60% |
| Reduction rate of plastic bags in supermarkets compared with 2010 | 65% | 85% |
| Rate of municipalities implementing waste at source segregation and recycling facilities | 80% | 100% |
| Collection rate of non-hazardous industrial waste | 90% | 100% |
| Reuse and recycling rate of non-hazardous industrial waste | 75% | - |
| Collection rate of solid waste from households in rural areas | 70% | 90% |
| Collection of solid waste from craft villages | 80% | 100% |

Table 8

Key targets in the National Strategy on Integrated Solid Waste Management to 2025, vision to 2050

Waste management policies and legislations in Viet Nam has become more and more comprehensive and detail. Integrated solid waste management and 3Rs measures have been gradually introduced into regulations (**Table 9**).

| Policy, regulation and strategic plans | Any specific explanation/ target/ strategies addressing plastic waste and/or marine plastic in the plan, policy and regulation |
|---|--|
| The National Action Plan for Management of Marine Litter by 2030 | The National Action Plan approved by the Prime Minister at Decision No. 1746/QD-TTg in December 2019 aims to prevent and reduce ocean plastic waste from waste sources on land and activities at sea, to completely eliminate the use of single-use plastic products and plastic bags from resorts, tourist attractions, accommodations and other tourist service businesses along the coast to ensure no plastic wastes in marine protected areas. |
| National Strategy on Integrated Solid Waste Management by 2025, with a Vision towards 2050 | Approved by the Prime Minister via the Decision No. 491/QD-TTg dated 2018 aims at development and deployment of the scheme for improvement of solid waste management in Vietnam. This Strategy identified the specific targets for domestic waste in urban area (Table 5) |
| Viet Nam Socio-Economic Development Strategy for the Period of 2011-2020. | One of the priorities identified for achieving sustainable development is to improve solid waste management minimizing waste generation and waste disposal in landfills to save resources and developing integrated solid waste management system with waste separation, collection, reuse, recycle and fully treatment using proper advanced technology. |
| Law on Environmental Protection. 2014²⁶, 2020²⁷ | <p>The country's primary environmental law presenting statutory guidelines on environmental protection, measurement and resource use. It requests business owners, organizations, households and individual to separate waste at source, reuse, and recycle solid waste.</p> <p>The 2020 Law on Environmental Protection will replace the current Law when it is put into effective on 1 January 2022. It requires industries to use the best available technology to control pollution and limit environmental impact. It also acknowledges communities as an essential part of the environment conservation. Also, the revision reclassifies waste as resources if they could be used as raw materials, fuel, or some other key component of another industry's production process. It introduces polluter pay principles for industrial and household solid waste. The revisions also specify that the government will levy environmental protection taxes and enact preferential policies to encourage manufacturing, distribution and use of ecofriendly products and services.</p> |

²⁶ <http://ljjp.vn/web/images/stories/enviroment-documents/Law%20on%20Environmental%20Protection%20No%2055.2014.QH13.pdf>

²⁷ <https://www.rfa.org/english/news/vietnam/environment-11182020123525.html>

| Policy, regulation and strategic plans | Any specific explanation/ target/ strategies addressing plastic waste and/or marine plastic in the plan, policy and regulation |
|--|--|
| National Strategy for Environmental Protection until 2010, and Vision Toward 2020²⁸ | Defines national pollution prevention, environmental protection and biodiversity targets to 2020, with a vision to 2030. Some targets are related to waste management, such as 95% urban & 75% rural solid waste collection and 85% reuse/recover/recycle by 2020. |
| Law on Water Resources. 2012²⁹ | Addresses the management, protection, exploitation and use of water resources. Mandates the development of national and local master plans to prevent and mitigate water pollution, including prohibition of dumping waste into the water bodies, does not allow the construction of land fill or dumping sites with high risk of water pollution; waste properly treated before being discharged to the environment. |
| National Action Plan for the Implementation of the 2030 Sustainable Development Agenda. 2017³⁰ | The National Action Plan approved by the Prime Minister at Decision 622/QĐ-TTg assigning tasks to the relevant ministries to implement the Sustainable Development Agenda with corresponding SDGs. |
| Law on Marine and Island Resources and Environment | Defines the rights, obligations and responsibilities for stakeholders managing marine and island resources. Includes a master plan on coastal resource use, pollution control and outlines marine monitoring and surveillance. It requires inventory and assessment of sources of waste from the main land, waste generated from boats and drilling rigs must be strictly managed; floating waste must be collected, separated and treated in compliance with related environmental protection legislation. Also, stipulates that waste generated from mainland activities must be treated to meet technical environmental regulations before being discharged to the sea, which needs to be reported to the functional management agencies; pollution sources from river basin into the sea must be strictly assessed and controlled. |

Table 9

Relevant policies and plans

²⁸ <https://www.env.go.jp/air/tech/ine/asia/vietnam/files/law/QD1216-English.pdf>

²⁹ IUCN (2020): The legal and institutional framework governing marine plastics in Viet Nam

³⁰ <https://vietnam.un.org/index.php/en/4123-national-action-plan-implementation-2030-sustainable-development-agenda>

4.2.2 City Policies and Legislation

Da Nang City has not yet issued a separate policy or legislation focusing on plastic waste management but has several local waste management plans that set some general goals, including: Dan Nang City Plan on the Implementation of Waste Segregation at Source to 2025, Plan for Solid Waste Treatment until 2030, with a Vision Towards 2045, Building Da Nang City - Environmental City Plan for the Period of 2021-2030, and Da Nang City Socio-Economic Development Master Plan to 2020, with a Vision to 2030 (Table 10). Many of these are implemented at a district level. For example, in Thanh Khe district, the Plastic Smart Cities project collaborates with DONRE to plan, issue and implement the plan on plastic waste management by 2025.

| | By 2020 | By 2025 | By 2030 | By 2045 |
|---|---|--------------------------------|---|--|
| Da Nang City Plan on the Implementation of Waste Segregation at Source to 2025 | 12% of waste reuse and recycle | 15% of waste reuse and recycle | | |
| Plan for Solid Waste Treatment until 2030, with a Vision Towards 2045 | | | 100% domestic waste collection and treatment 90% of waste reuse, recycle and composting 100% waste separation at source | 95% of waste reuse, recycle and composting |
| Building Da Nang City - Environmental City Plan for the Period of 2021 - 2030 | 15% of waste recycling | | | |
| Da Nang City Socio-Economic Development Master Plan to 2020, with a Vision to 2030 | 95%-98% of waste collection 70% of waste recycle | 100% waste collection | | |

Table 10

Key targets set by the Da Nang City



4.3 Financial Capacity

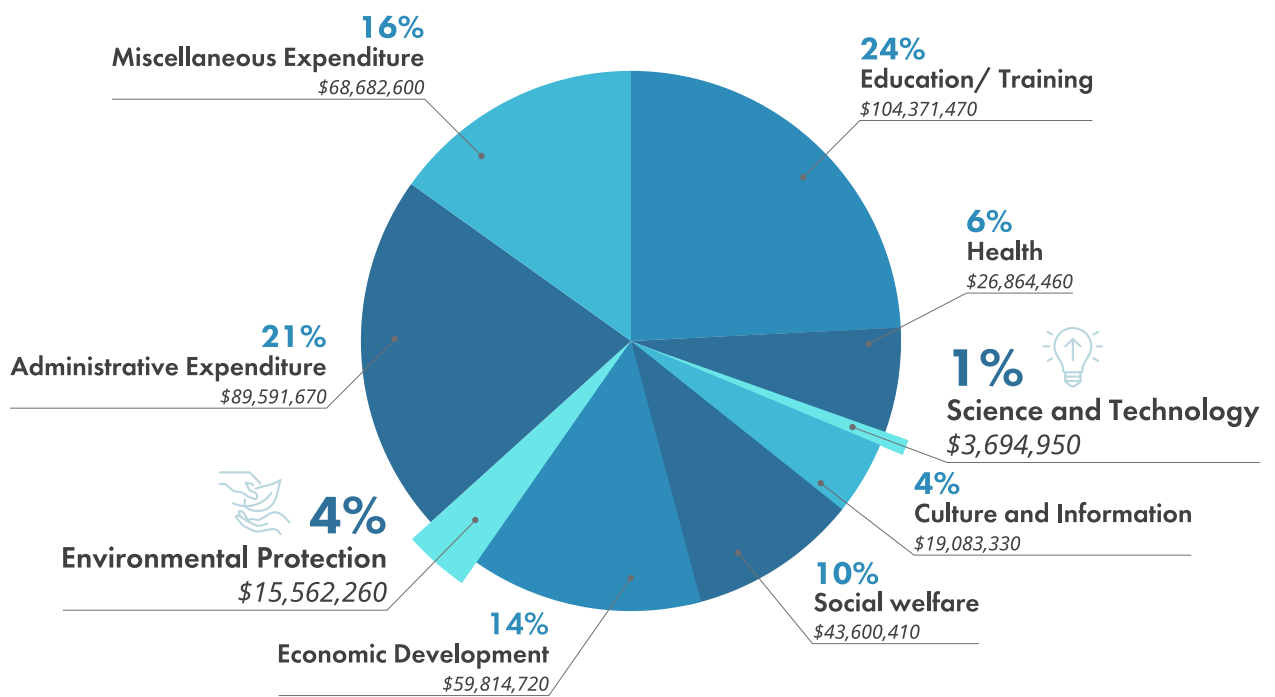
The local revenue of Da Nang City has been steadily increasing with the growth of the local economy and was estimated to reach 26.7 trillion VND in 2019 (\$ 1.16bn US) (**Table 11**). Of the total operating expenditure of 9.9 trillion VND (\$431m US), Da Nang spent 358 billion VND (\$15.6m US) on environment protection and 85 billion VND on Science and Technology in 2019 (\$3.69m US). The operating expenses of the waste service provider URENCO come from household and corporation environmental fees. The City People's Committee determines the unit price based on the total amount of waste collected.

| Item | 2010 | 2019 |
|---|-------------------|-------------------|
| 1. Total Local Budget Revenue | 16,580,800 | 26,782,000 |
| 1.1. Export and Import Duties | 971,300 | 1,195,000 |
| 1.2. Value Added Tax of Import | 1,134,100 | 2,118,000 |
| 1.3. Domestic Revenue | 9,527,900 | 23,469,000 |
| 1.3.1. Revenue from Central Enterprises | 108,900 | 12,548,000 |
| 1.3.2. Revenue from Local State Enterprises | 880,700 | |
| 1.3.3. revenue from Foreign Investment | 760,400 | |
| 1.3.4. revenue from Non-State Enterprises | 1,280,400 | |
| 1.3.5. Income Tax | 435,900 | 2,298,000 |
| 1.3.6. Registration Fees | 309,300 | 1,297,000 |
| 1.3.7. Other Fees | 583,500 | 3,699,000 |
| 1.3.8. Land and Housing Tax | 5,055,200 | 3,627,000 |
| 2. Total Local Budget Expenditure | 10,474,300 | 23,545,000 |
| 2.1. Local Government Expenditure | 9,304,200 | 20,537,000 |
| 2.1.1. Capital Expenditure | 6,226,300 | 8,220,000 |
| 2.1.2. Current Expenditure | 3,046,000 | 9,921,000 |
| 2.1.2.1. Education/ Training | 827,100 | 2,401,000 |
| 2.1.2.2. Health | 716,500 | 618,000 |
| 2.1.2.3. Science and Technology | 14,000 | 85,000 |
| 2.1.2.4. Culture and Information-gym, sport | 88,500 | 439,000 |
| 2.1.2.5. Social welfare | 208,000 | 1,003,000 |
| 2.1.2.6. Economic Development | 237,600 | 1,376,000 |
| 2.1.2.7. Environmental Protection | 78,700 | 358,000 |
| 2.1.2.8. Administrative Expenditure | 545,800 | 2,061,000 |
| 2.1.2.9. Miscellaneous Expenditure | 222,400 | 1,580,000 |
| 2.1.3. Transfer to Financial Reserve Fund | - | 200,000 |
| 2.1.4. Transfer to Next Year's Budget | 406,900 | 2,196,000 |
| 2.2. Additional Expenditure under Budget | 543,600 | 2,981,000 |
| 2.3. Others | 219,500 | 27,000 |

Source: Da Nang Statistical Yearbook, 2011 and 2020

Table 11

Da Nang State Revenue and Expenditure in 2010 / 2019 (Unit: VND millions)

**Figure 30**

Da Nang State Expenditure during 2019

4.4 Digital Readiness in Da Nang City

Technology is playing an increasingly important role in optimising waste management and detecting waste leakage into the environment. Da Nang City is one of the first cities in Viet Nam to begin smart city development in alignment with the National Sustainable Smart City Development Plan (2018-2025). The Da Nang City Socio-Economic Development Master Plan, 2030 also sets the goal for Da Nang City to become a smart city. The City has introduced new information technologies to reduce bureaucracy and to enhance effective public services and utilities. It was developed based on a software framework called Da Nang Open eGov-Platform with experience and technology shared by the Korea National Information Society Agency (NIA) and used for 21 online public services such as the bus management system with cruise monitoring equipment; the centre for managing and operating traffic signals; public transport monitoring system; early warning system for drinking water quality and supply; school management software; hospital management software and food safety and hygiene database³¹. In addition, the City has launched the first stage of the 341 ha Da Nang Information Technology Park (DITP) – central Viet Nam’s ‘Silicon Valley’ - with a total investment of US \$278 million.

³¹ VOV. 2019. <https://vov.vn/en/economy/danang-taking-the-lead-in-smart-city-building-396001.vov>



According to the Da Nang Department of Information and Communications, smart city project focuses on six pillars and 16 priority areas, the roadmap is divided into three phases with specific goals by 2030. In order to achieve the goal, the City has identified 53 key programmes and projects implemented by 12 state management agencies with the total investment capital of VND2.14 trillion (\$93 million), of which the City budget will account for 30%. The city has also been actively working with domestic and foreign organisations by investing into infrastructure and sharing their experiences on urban development models such as smart city, green-fresh city, eco-city, and low-carbon city.



CHAPTER 5

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

Conclusions and Recommendations

P107 Management-Level Recommendations

P110 Policy-Level Recommendations

CHAPTER 5

Conclusions and Recommendations

Based on the results and findings from the previous sections, policy recommendations have been developed. They are however, not definitive, but provide a wide basis on which to consult key stakeholders in the development of the final city action plan.

Eliminating plastic pollution is the overall goal of international frameworks, such as the Osaka Blue Ocean Vision, the ASEAN Framework of Action on Marine Debris, and broader policy frameworks, such as the Sustainable Development Goals. However, achieving this global goal will only be possible if each city takes tailored and targeted evidence-based action. It is hoped that this report will support stakeholders take action at the city level in Da Nang to support of these common goals.

5.1 Management-Level Recommendations

1) Reduce Use of Single-Use Plastics, including Plastic Bags and Plastic Bottles

Plastic bag is the primary cause of plastic pollution in Da Nang City due to its largest amount of generation (48% of plastic waste stream). Along with the National Action Plan for Management of Marine Litter by 2030 which shows quantitative target for reduction of single-use plastic in tourism areas and marine plastic litter by 2030, potential interventions shown below to address plastic bags could result in significant reduction of plastic pollution:

- Introduce bans on single-use and light-weight plastic bags
- Introduce a tax or levy for single -use plastic bags. The tax referred to customer charges for the targeted single-use plastic products or taxes paid by stores that sell them.
- Assess the availability of alternatives to consumers such as paper bags/container, reusable bags, biodegradable bags/containers, etc. and ensure that there are pre-conditions for their uptake in the market.
- Sign a voluntary agreement with the retail sector to encourage them to freely take measures allowing them to reduce their distribution of plastic bags.
- Introduction of an EPR scheme, even on voluntary basis.

2) Reduce Littering, Open Dumping and Increase Collection

Littering is the largest emission cause in Da Nang City followed by inadequate waste collection and fly-tipping, particularly in the tourist areas. Da Nang City Plan for Solid Waste Treatment aims at 100% waste collection by 2030. Interventions to address this issue include:

- Establish a sufficient network of public litter bins and provide frequent evacuation of bins. Litter bins shall be provided at regular intervals in streets where there are many pedestrians and where there are no community bins into which passers-by can drop unwanted items.
- Place signboard alerting polluters on fines for littering, open dumping and fly tipping. Introduce fixed penalty notices.
- Ensure cooperation among the local authority, land owners, and citizens to monitor and control the illegal dumping for prevention and clean-up of fly-tipped and littered waste.
- Establish comprehensive and targeted street sweeping to remove any littered items and promote clean living environment.
- Organise awareness and education campaigns around littering and fly-tipping
- Establish affordable but efficient collection mechanism for residents by involving both formal and informal sectors as well as community-based organisations.
- A waste collection service charge (WCSC) can be applied to finance the better collection operation.



3) Increase Source Separation

All collecting and sorting activities for recycling are currently carried out by the informal sector in Da Nang City and aggregated plastic waste is transported and processed by private companies outside the City. Under the current situation where only 6.1% of plastic is collected for recycling in Da Nang City, compared to the national average of 10-15%, the City aims at 100% of waste separation at source by 2030. Possible interventions to address this issue include:

- Establish neighbourhood collection stations and urge residents to bring recyclable materials to the stations where they are bought at fixed prices or can exchange them with lottery coupons that give discounts at department stores. In order to increase interest on residents participation run a campaign to raise awareness of the value of recycling among many of the worst affected and most vulnerable communities
- Encourage business investment to develop adequate sorting technology or effective collection mechanism, resulting in increase in recycling and recovery
- Bring financial support from international cooperation by showing commitment and progress of waste separation pilot initiatives

5.2 Policy-Level Recommendations

1) Implementation of Policy

While the enactment of the new National Action Plan for Management of Marine Litter by 2030 and National Strategy on Integrated Solid Waste Management to 2025, vision to 2050 at national level was a major step toward improving plastic waste management in Da Nang City. In addition, the City also setup a few local policies and plans which shows clear targets in addressing plastic waste.

Da Nang City is encouraged to develop and implement pilot projects to reduce plastic waste generation at all levels, including community groups, commercial sectors, schools, tourism facilities, agri- and aquaculture and healthcare facilities.

2) Move from waste management to circular economy solutions

An integrated approach is needed from segregated waste collection to resource recovery and final disposal. The large proportion of reusable and recyclable materials provides a great opportunity for increasing in reuse and recycling.

As mandated under the national and local policies and plans, the concept of circular economy with 3Rs (reduce, reuse and recycle) being the centre of solid waste management should be promoted to reduce the amount of waste going to disposal sites, resulting in saving costs of transportation and disposal site management as well as reducing the risk to public health and environment.

To handle or treat plastic waste, resource recovery, recycling and treatment facilities need to be installed in partnership with private sector. At the same time, research and communications to prevent plastic waste generation should be promoted through development and innovation of alternative material and change in lifestyle.

3) Strengthening Capacity of Local Bodies

Da Nang City is responsible for waste management including waste collection, transport, treatment, and final disposal management. However, it faces challenges to effectively manage MSW due to shortage of financial and human resources, technical and managerial skills, inter-agency and inter-stakeholder engagement and coordination. Building in-house capacity and enhancing coordination is thus essential.

By partnering with local academic institutions, training modules can be developed to provide training programmes targeting different levels of staff and covering specific subjects including but not limited to; data management, planning, waste collection and transport, appropriate technologies for treatment, and final disposal, budgeting. Also, a proper institutional setup, coordinating systems and information-sharing mechanisms to encourage the cross-units and cross-institution coordination should be considered as viable institutional capacity.

4) Public and Private Sector Participation

Da Nang City alone cannot address plastic pollution and keep the city clean and healthy. Community participation needs to be ensured with the support from NGOs and CBOs through continuous and intensive information, education, and communication on 3R and better SWM at the beginning. Awareness should start from the basic “no littering” in public places. Communities should be fully consulted and their views need to be addressed from the planning stage. Introducing appropriate methods for waste segregation and collection also require close consultation and collaboration with communities.

On the other hand, uncertainty of the legal framework, inconsistent implementation of regulations, low fees, and lack of reliable data and market analysis prevents business sector from investing large capital on infrastructure development and sustainable operation. Da Nang City needs to create a supportive environment to attract investors.

6) Resource Mobilisation

Currently, Da Nang City is collecting an SWM service charge through various ways including a surcharge on property and business tax, and direct fees from households and bulk waste generators. Initially, the focus will be on increasing the coverage of fee collection rather than increasing the amount, and the fee should be commensurate with the level of service provided. Later, a gradual increase in fee could be considered in association with improvements in the level of service so that operation and maintenance costs are fully recovered. Reduction in expenditures on SWM is equally important. The City should review its existing budget management practice to identify cost-saving measures. These may include the provision of performance-based incentives to their staff and contractors, and benefit-sharing arrangements with CBOs or private sector while rationalizing the services that the municipalities themselves provide.

It is also important to mobilise financial and technical support from national and international organisations. To do so, the City should be able to present not only the strong political commitment but also the strategy for sustainable operation without external support.

7) Use of Digital Tools, Data Management

The Plastic Pollution Calculator together with AI integrated digital tool technology gives very useful information on the state of plastic waste management in Da Nang City. The City needs to establish a proper institutional monitoring mechanism to regularly update the numerical and spatial data to track changes and progress against the targets set in the City action plan. The established digital systems in Da Nang City illustrate a high technological capacity and scope for on-boarding new digital solutions to address plastic pollution. Innovation in the waste management sector opens new ways to prevent, reduce and even eliminate plastic waste. These innovations can also advance resource recovery, achieve high treatment and disposal standards, and reduce pollution and environmental impacts. At the same time, it provides new tools to promote stakeholders' interaction, awareness, and citizens' participation; to apply the "polluter pays" and the "extended producer responsibility" principles; to make the policy development process more inclusive and participatory; and to reduce dangerous jobs and occupational health and safety risks. Dissemination of data through city newsletters and the City's website will help the public and other stakeholders better understand the status of plastic waste management and eventually attract business investment





ANNEX

CLOSING THE LOOP ON PLASTIC POLLUTION
IN DA NANG CITY, VIETNAM

Summary results for: Da Nang, Vietnam

PPC Version: V2.16

Implementation by: Dr. Josh Cottom and Dr. Costas Velis (University of Leeds)

Date: July 2021

As part of: UNESCAP Closing the Loop Project

| RESULT | UNIT | DA NANG | Hoa Vang | Hai Chau | Thanh Khe | Cam Le | Ngu Hanh Son | Lien Chieu | Son Tra |
|--|---------------|---------|----------|----------|-----------|--------|--------------|------------|---------|
| MSW generation | tonnes/year | 448,903 | 34,824 | 96,146 | 66,687 | 63,340 | 49,353 | 66,049 | 72,504 |
| MSW generation rate (exc. tourists) | kg/capita/day | 1.08 | 0.65 | 1.30 | 0.98 | 1.08 | 1.49 | 0.92 | 1.25 |
| MSW generation rate (inc. tourists) | kg/capita/day | 1.02 | 0.65 | 1.22 | 0.97 | 1.08 | 1.23 | 0.92 | 1.07 |
| MSW generation by: | | | | | | | | | |
| Residential | tonnes/year | 205,168 | 15,788 | 41,598 | 33,127 | 26,413 | 22,844 | 30,181 | 35,215 |
| Commercial | tonnes/year | 174,774 | 13,230 | 40,289 | 22,652 | 27,209 | 19,263 | 25,065 | 27,066 |
| Institutional | tonnes/year | 25,128 | 1,741 | 5,492 | 3,796 | 3,553 | 3,051 | 3,968 | 3,527 |
| Other | tonnes/year | 43,834 | 4,064 | 8,767 | 7,113 | 6,164 | 4,195 | 6,834 | 6,696 |

Annex 1

Summary of Results of PPC in Da Nang City

| RESULT | UNIT | DA NANG | Hoang Vang | Hai Chau | Thanh Khe | Cam Le | Ngu Hanh Son | Lien Chieu | Son Tra |
|---------------------------------------|-------------|---------|------------|----------|-----------|--------|--------------|------------|---------|
| MSW generation by: | | | | | | | | | |
| Multi-family dwellings | tonnes/year | 43,605 | 0 | 9,373 | 7,891 | 11,094 | 220 | 5,587 | 9,441 |
| Single-family dwellings | tonnes/year | 161,563 | 15,788 | 32,226 | 25,237 | 15,319 | 22,624 | 24,594 | 25,775 |
| Informal settlements | tonnes/year | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Rural settlements | tonnes/year | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Street Cleansing | tonnes/year | 4,189 | 327 | 895 | 620 | 591 | 461 | 618 | 676 |
| Direct to junk shops / bring sites | tonnes/year | 3,415 | 497 | 529 | 624 | 456 | 277 | 617 | 415 |
| Informally collected waste (D2D only) | tonnes/year | 16,705 | 1,207 | 3,673 | 2,545 | 2,303 | 1,796 | 2,407 | 2,774 |
| Uncollected litter | tonnes/year | 7,496 | 257 | 1,833 | 1,428 | 1,270 | 770 | 894 | 1,044 |
| Uncollected fly-tipped waste | tonnes/year | 2,259 | 532 | 151 | 183 | 257 | 124 | 622 | 391 |
| Flushed sanitary waste | tonnes/year | 9,770 | 1,245 | 1,687 | 1,712 | 1,287 | 768 | 1,676 | 1,396 |
| Events and festivals | tonnes/year | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Retail Area | tonnes/year | 31,859 | 4,726 | 6,534 | 3,754 | 4,767 | 3,299 | 4,392 | 4,387 |
| Transportation and storage | tonnes/year | 45,672 | 2,913 | 8,199 | 8,762 | 7,565 | 4,438 | 8,601 | 5,194 |
| Food, drink and accommodation | tonnes/year | 28,571 | 1,095 | 3,797 | 1,652 | 3,086 | 6,011 | 3,043 | 9,886 |
| Office and other services | tonnes/year | 66,623 | 4,376 | 21,300 | 8,147 | 11,533 | 5,296 | 8,609 | 7,364 |
| Public administration | tonnes/year | 7,031 | 532 | 1,589 | 909 | 1,064 | 893 | 994 | 1,050 |
| Education | tonnes/year | 9,221 | 661 | 2,277 | 1,287 | 1,371 | 978 | 1,283 | 1,364 |
| Health and social care | tonnes/year | 8,876 | 548 | 1,626 | 1,600 | 1,119 | 1,180 | 1,691 | 1,113 |
| Recreational | tonnes/year | 2,050 | 121 | 459 | 337 | 258 | 219 | 421 | 235 |

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